# Annual Review of CyberTherapy and Telemedicine

## A Healthy Mind in a Healthy Virtual Body: The Future of Virtual Reality in Health Care

Editors:

Brenda K. Wiederhold, Ph.D., MBA, BCB, BCN

Giuseppe Riva, Ph.D., M.S., M.A.

Chris Fullwood, Ph.D., BSc

Alison Attrill-Smith, Ph.D.

Grainne Kirwan, Ph.D., C.Psychol.

15

# ANNUAL REVIEW OF CYBERTHERAPY AND TELEMEDICINE 2017

# Annual Review of Cybertherapy And Telemedicine 2017

A Healthy Mind in a Healthy Virtual Body:
The Future of Virtual Reality in Health Care

Edited by

## Brenda K. Wiederhold

*Interactive Media Institute, San Diego, CA, USA*
*Virtual Reality Medical Institute, Brussels, Belgium*

## Giuseppe Riva

*Catholic University of Milano, Milan, Italy*
*Istituto Auxologico Italiano, Milan, Italy*

## Chris Fullwood

*University of Wolverhampton, United Kingdom*

## Alison Attrill-Smith

*University of Wolverhampton, United Kingdom*

## Gráinne Kirwan

*Institute of Art, Design and Technology (IADT),*
*Dun Laoghaire, Co Dublin, Rep. of Ireland*

LEGAL NOTICE
The publisher is not responsible for the use which might be made of the following information

Richard M. Satava MD,
FACS
University of Washington

Anna Spagnolli, Ph.D.

University of Padova

Stefan Stieger, Ph.D

University of Konstanz

Ioannis Tarnanas, Ph.D.

Kozani University CATLab

David Walshe, Ph.D.

University College Cork

Dave Thomas, Ph.D.

National Institute on Drug
Abuse

Mark D. Wiederhold, M.D.,
Ph.D., CPE, FACP, FACPE

Virtual Reality Medical
Center

Stefano Triberti, Ph.D.
Università Cattolica del Sacro
Cuore

Dennis Patrick Wood, Ph.D.,
ABPP, CAPT MSC USN -retired

Virtual Reality Medical Center

# General Information

**Annual Review of CyberTherapy and Telemedicine** (ARCTT – ISSN: 1554-8716) is published annually (once per year) by the Interactive Media Institute (IMI), a 501c3 non profit organization, dedicated to incorporating interdisciplinary researchers from around the world to create, test, and develop clinical protocols for the medical and psychological community. IMI realizes that the mind and body work in concert to affect quality of life in individuals and works to develop technology that can be effectively used to improve the standards and reduce the cost of healthcare delivery.

**About the Journal**
ARCTT is a peer-reviewed all-purpose journal covering a wide variety of topics of interest to the mental health, neuroscience, and rehabilitation communities. The mission of ARCTT is to provide systematic, periodic examinations of scholarly advances in the field of CyberTherapy and Telemedicine through original investigations in the Telemedicine and CyberTherapy areas, novel experimental clinical studies, and critical authoritative reviews. It is directed to healthcare providers and researchers who are interested in the applications of advanced media for improving the delivery and efficacy of mental healthcare and rehabilitative services.

**Manuscript Proposal and Submission**
Because Annual Review papers examine either novel therapeutic methods and trials or a specific clinical application in depth, they are written by experienced researchers upon invitation from our Editorial Board. The editors nevertheless welcome suggestions from our readers. Questions or comments about editorial content or policies should be directed to the editors only.

**Manuscript Preparation**
Manuscripts should be submitted in electronic format on CD-Rom or floppy disks as well as on 8 1⁄2 x 11-in. paper (three copies), double-spaced format. Authors should prepare manuscripts according to the Publication Manual of the American Psychological Association (5th Ed.). Original, camera-ready artwork for figures is required. Original color figures can be printed in color at the editors' discretion and provided the author agrees to pay in full the associated production costs; an estimate of these costs is available from the ARCTT production office on request. ARCTT policy prohibits an author from submitting the same manuscript for concurrent consideration by two or more publications. Authors have an obligation to consult journal editors concerning prior publication of any data upon which their article depends. As this journal is a primary journal that publishes original material only, ARCTT policy prohibits as well publication of any manuscript that has already been published in whole or substantial part elsewhere, unless authorized by the journal editors.

*Disclaimer*
All the published papers, editorial news and comments, opinions, findings, conclusions, or recommendations in ARCTT are those of the author(s), and do not necessarily reflects or constitute the opinions of the Journal, its Publisher, and its editorial staff.

# REVIEW BOARD

We would like to extend a warm and heartfelt thank you to all members of the review board whose help made this year's publication possible:

# PRINCIPLES of the ANNUAL REVIEW

**Ethical Standards.**
Authors published in the Annual Review must uphold and respect ethical standards in the preparation and realization of their research, as well as in the writing style of the papers (avoid prejudice, protect confidentiality of the patients, etc.). Research involving human subjects must have been conducted with respect to current ethical practices and after participants expressed their free and informed consent (e.g., with a signed consent form or other appropriate method). Ethical standards also apply to research that is not conducted with humans (e.g., animal protection protocol), and to publishing issues (e.g., plagiarism, research fraud, authorship misappropriation, duplication of publications).

**Conflicts of Interest.**
It is the position of the Annual Review that potential conflicts of interest must be made available to the readers since an author's economic and commercial interests may, even involuntarily, bias objectivity. Economic and commercial interests do not necessarily constitute a conflict of interest, and conflicts of interest do not necessarily imply biased research. But the best practice is to disclose activities and relationships that, if known to others, might be viewed as a conflict of interest.

Potential conflicts of interest include, but are not limited to: (a) funding or remuneration, including salaries and equipment, from organizations that may gain or lose financially through the publication of the paper; (b) personal financial interests, including receiving royalties or holding stocks and shares in companies that may gain or lose financially from publication; (c) holding patent and patent applications whose financial value may be affected; (d) employment by an organization that may gain or lose from publication of the paper. All contributing authors are expected to provide the Editor with a signed presenter disclosure form, and all contributing authors and reviewers are encouraged to contact the Editor at any stage in the manuscript review process if they believe that a potential conflict of interest needs to be examined.

**Upholding the Annual Review's Standards.**
Our publication pays careful attention to the protection of a patient's anonymity in case reports and elsewhere.

Identifying information such as names, initials and hospital numbers must be avoided. Also, authors should disguise identifying information when discussing patients' characteristics and personal history.

# Preface

ARCTT is a peer-reviewed all-purpose journal covering a wide variety of topics of interest to the mental health, neuroscience, and rehabilitation communities. This mission of ARCTT is to provide systematic, periodic examinations of scholarly advances in the field of Cybertherapy and Telemedicine through original investigations in the telemedicine and cybertherapy areas, novel experimental clinical studies, and critical authoritative reviews.

Healthcare delivery systems have been evolving to rely more heavily on technology. There has been a shift in care diagnosis and treatment which has decreased the importance of traditional methods of care delivery. Technology has not only helped to extend our lifespan, but it has improved the quality of life for all citizens.

We have put a great deal of effort into the definition of the structure of the volume and in the sequence of the contributions, so that those in search of a specific reading path will be rewarded. To this end, we have divided the different chapters into six main sections:

1. Editorial: This introductory text expresses the position of the Editors – Brenda K. Wiederhold  Giuseppe Riva  Chris Fullwood  Alison Attrill-Smith  Gráinne Kirwan - about the focus of this year's issue;
2. Critical Reviews: These chapters summarize and evaluate emerging cybertherapy topics, including technology-enhanced rehabilitation, Interreality, and Intersubjectivity;
3. Evaluation Studies: These chapters are generally undertaken to solve some specific practical problems and yield decisions about the value of cybertherapy interventions;
4. Original Research: These chapters research studies addressing new cybertherapy methods or approaches;
5. Clinical Observations: These chapters include case studies or research protocols with long-term potential.
6. Work in Progress: These chapters include papers describing a future research work.
7. Brief Communications: These chapters include brief papers reporting preliminary data on-going research work and/or new developments.

For both health professionals and patients, the selected contents will play an important role in ensuring that the necessary skills and familiarity with the tools are available, as well as a fair understanding of the context of interaction in which they operate.

In conclusion, this volume underlines how cybertherapy has started to make progress in treating a variety of disorders. However, there is more work to be done in a number of areas, including the development of easy-to-use and more affordable hardware and software, the development of objective measurement tools, the need to address potential side effects, and the implementation of more controlled studies to evaluate the strength of cybertherapy in comparison to traditional therapies.

We are grateful to Silvia Serino and Stefano Triberti from Università Cattolica di Milano and Ian Miller from VRMC for their work in collecting and coordinating chapters for this volume.

We sincerely hope that you will find this year's volume to be a fascinating and intellectually stimulating read. We continue to believe that together we can change the face of healthcare.

<div align="right">
Brenda K. Wiederhold<br>
Giuseppe Riva<br>
Chris Fullwood<br>
Alison Attrill-Smith<br>
Gráinne Kirwan
</div>

# Contents

## Section VI. Work In Progress

## Section VII. Brief Communication

x

# ANNUAL REVIEW OF CYBERTHERAPY
# AND TELEMEDICINE 2017

# Annual Review of Cybertherapy
# And Telemedicine 2017

A Healthy Mind in a Healthy Virtual Body:
The Future of Virtual Reality in Health Care

Edited by

## Brenda K. Wiederhold

*Interactive Media Institute, San Diego, CA, USA*
*Virtual Reality Medical Institute, Brussels, Belgium*

## Giuseppe Riva

*Catholic University of Milano, Milan, Italy*
*Istituto Auxologico Italiano, Milan, Italy*

## Chris Fullwood

*University of Wolverhampton, United Kingdom*

## Alison Attrill-Smith

*University of Wolverhampton, United Kingdom*

## Gráinne Kirwan

*Institute of Art, Design and Technology (IADT),*
*Dun Laoghaire, Co Dublin, Rep. of Ireland*

Richard M. Satava MD, FACS
University of Washington

Anna Spagnolli, Ph.D.
University of Padova

Stefan Stieger, Ph.D
University of Konstanz

Ioannis Tarnanas, Ph.D.
Kozani University CATLab

David Walshe, Ph.D.
University College Cork

Dave Thomas, Ph.D.
National Institute on Drug Abuse

Mark D. Wiederhold, M.D., Ph.D., CPE, FACP, FACPE
Virtual Reality Medical Center

Stefano Triberti, Ph.D.
Università Cattolica del Sacro Cuore

Dennis Patrick Wood, Ph.D., ABPP, CAPT MSC USN -retired
Virtual Reality Medical Center

# General Information

**Annual Review of CyberTherapy and Telemedicine** (ARCTT – ISSN: 1554-8716) is published annually (once per year) by the Interactive Media Institute (IMI), a 501c3 non profit organization, dedicated to incorporating interdisciplinary researchers from around the world to create, test, and develop clinical protocols for the medical and psychological community. IMI realizes that the mind and body work in concert to affect quality of life in individuals and works to develop technology that can be effectively used to improve the standards and reduce the cost of healthcare delivery.

**About the Journal**
ARCTT is a peer-reviewed all-purpose journal covering a wide variety of topics of interest to the mental health, neuroscience, and rehabilitation communities. The mission of ARCTT is to provide systematic, periodic examinations of scholarly advances in the field of CyberTherapy and Telemedicine through original investigations in the Telemedicine and CyberTherapy areas, novel experimental clinical studies, and critical authoritative reviews. It is directed to healthcare providers and researchers who are interested in the applications of advanced media for improving the delivery and efficacy of mental healthcare and rehabilitative services.

**Manuscript Proposal and Submission**
Because Annual Review papers examine either novel therapeutic methods and trials or a specific clinical application in depth, they are written by experienced researchers upon invitation from our Editorial Board. The editors nevertheless welcome suggestions from our readers. Questions or comments about editorial content or policies should be directed to the editors only.

**Manuscript Preparation**
Manuscripts should be submitted in electronic format on CD-Rom or floppy disks as well as on 8 1⁄2 x 11-in. paper (three copies), double-spaced format. Authors should prepare manuscripts according to the Publication Manual of the American Psychological Association (5th Ed.). Original, camera-ready artwork for figures is required. Original color figures can be printed in color at the editors' discretion and provided the author agrees to pay in full the associated production costs; an estimate of these costs is available from the ARCTT production office on request. ARCTT policy prohibits an author from submitting the same manuscript for concurrent consideration by two or more publications. Authors have an obligation to consult journal editors concerning prior publication of any data upon which their article depends. As this journal is a primary journal that publishes original material only, ARCTT policy prohibits as well publication of any manuscript that has already been published in whole or substantial part elsewhere, unless authorized by the journal editors.

*Disclaimer*
All the published papers, editorial news and comments, opinions, findings, conclusions, or recommendations in ARCTT are those of the author(s), and do not necessarily reflects or constitute the opinions of the Journal, its Publisher, and its editorial staff.

# REVIEW BOARD

We would like to extend a warm and heartfelt thank you to all members of the review board whose help made this year's publication possible:

# PRINCIPLES of the ANNUAL REVIEW

**Ethical Standards.**
Authors published in the Annual Review must uphold and respect ethical standards in the preparation and realization of their research, as well as in the writing style of the papers (avoid prejudice, protect confidentiality of the patients, etc.). Research involving human subjects must have been conducted with respect to current ethical practices and after participants expressed their free and informed consent (e.g., with a signed consent form or other appropriate method). Ethical standards also apply to research that is not conducted with humans (e.g., animal protection protocol), and to publishing issues (e.g., plagiarism, research fraud, authorship misappropriation, duplication of publications).

**Conflicts of Interest.**
It is the position of the Annual Review that potential conflicts of interest must be made available to the readers since an author's economic and commercial interests may, even involuntarily, bias objectivity. Economic and commercial interests do not necessarily constitute a conflict of interest, and conflicts of interest do not necessarily imply biased research. But the best practice is to disclose activities and relationships that, if known to others, might be viewed as a conflict of interest.

Potential conflicts of interest include, but are not limited to: (a) funding or remuneration, including salaries and equipment, from organizations that may gain or lose financially through the publication of the paper; (b) personal financial interests, including receiving royalties or holding stocks and shares in companies that may gain or lose financially from publication; (c) holding patent and patent applications whose financial value may be affected; (d) employment by an organization that may gain or lose from publication of the paper. All contributing authors are expected to provide the Editor with a signed presenter disclosure form, and all contributing authors and reviewers are encouraged to contact the Editor at any stage in the manuscript review process if they believe that a potential conflict of interest needs to be examined.

**Upholding the Annual Review's Standards.**
Our publication pays careful attention to the protection of a patient's anonymity in case reports and elsewhere.

Identifying information such as names, initials and hospital numbers must be avoided. Also, authors should disguise identifying information when discussing patients' characteristics and personal history.

# Preface

ARCTT is a peer-reviewed all-purpose journal covering a wide variety of topics of interest to the mental health, neuroscience, and rehabilitation communities. This mission of ARCTT is to provide systematic, periodic examinations of scholarly advances in the field of Cybertherapy and Telemedicine through original investigations in the telemedicine and cybertherapy areas, novel experimental clinical studies, and critical authoritative reviews.

Healthcare delivery systems have been evolving to rely more heavily on technology. There has been a shift in care diagnosis and treatment which has decreased the importance of traditional methods of care delivery. Technology has not only helped to extend our lifespan, but it has improved the quality of life for all citizens.

We have put a great deal of effort into the definition of the structure of the volume and in the sequence of the contributions, so that those in search of a specific reading path will be rewarded. To this end, we have divided the different chapters into six main sections:

1. Editorial: This introductory text expresses the position of the Editors – Brenda K. Wiederhold  Giuseppe Riva  Chris Fullwood  Alison Attrill-Smith  Gráinne Kirwan - about the focus of this year's issue;
2. Critical Reviews: These chapters summarize and evaluate emerging cybertherapy topics, including technology-enhanced rehabilitation, Interreality, and Intersubjectivity;
3. Evaluation Studies: These chapters are generally undertaken to solve some specific practical problems and yield decisions about the value of cybertherapy interventions;
4. Original Research: These chapters research studies addressing new cybertherapy methods or approaches;
5. Clinical Observations: These chapters include case studies or research protocols with long-term potential.
6. Work in Progress: These chapters include papers describing a future research work.
7. Brief Communications: These chapters include brief papers reporting preliminary data on-going research work and/or new developments.

For both health professionals and patients, the selected contents will play an important role in ensuring that the necessary skills and familiarity with the tools are available, as well as a fair understanding of the context of interaction in which they operate.

In conclusion, this volume underlines how cybertherapy has started to make progress in treating a variety of disorders. However, there is more work to be done in a number of areas, including the development of easy-to-use and more affordable hardware and software, the development of objective measurement tools, the need to address potential side effects, and the implementation of more controlled studies to evaluate the strength of cybertherapy in comparison to traditional therapies.

We are grateful to Silvia Serino and Stefano Triberti from Università Cattolica di Milano and Ian Miller from VRMC for their work in collecting and coordinating chapters for this volume.

We sincerely hope that you will find this year's volume to be a fascinating and intellectually stimulating read. We continue to believe that together we can change the face of healthcare.

<div style="text-align: right">

Brenda K. Wiederhold
Giuseppe Riva
Chris Fullwood
Alison Attrill-Smith
Gráinne Kirwan

</div>

# Contents

## Section VI. Work In Progress

## Section VII. Brief Communication

x

# SECTION I

---

# EDITORIAL

# A Healthy Mind in a Healthy Virtual Body: The Future of Virtual Reality in Health Care

Giuseppe RIVA [*, a,b], Brenda K. WIEDERHOLD [c], Andrea GAGGIOLI [a,b]

[a] *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*
[b] *Applied Technology for Neuro-Psychology Lab. Istituto Auxologico Italiano, Milan, Italy*
[c] *Interactive Media Institute, San Diego, CA, USA*

**Abstract.** The increasing interest of neuroscience, cognitive science and social psychology towards the study of the body experience is providing a more comprehensive framework for the *Bodily Self Consciousness (BSC),* namely the experience of being in a body. In particular, it suggests that BSC is the outcome of the "body matrix" - a supramodal multi-sensory representation of the body and the space around it - which provides predictions about the expected sensory input and tries to minimize the amount of free energy (or 'surprise'). The contents of the body matrix are modified by bottom-up prediction errors that signal mismatches between predicted and actual content of the different body representations. In this view, damage, malfunctioning, or altered feedback from and toward the body matrix might be involved in the aetiology of different clinical disturbances: from neurological disorders, such as chronic pain and neglect to psychiatric disorders, such as depression, schizophrenia, eating and weight disorders, and depersonalization/derealization disorder. In this paper we suggest that this framework provides the rationale for a new research field: "Embodied Medicine". In Embodied Medicine advanced tools - Virtual Reality, neuro/biofeedback and different simulation/stimulation technologies – are integrated to modify the experience of being in a body with the goal of improving health and well-being.

**Keywords.** Virtual Reality, health care, embodied health, body matrix, multisensory integration, bodily self consciousness, experiential interface

## 1. The Neuroscience of the Experience of the Body

The increasing interest of neuroscience, cognitive science and social psychology towards the study of the body experience is providing a more comprehensive framework for the *Bodily Self Consciousness (BSC),* namely the experience of being in a body [1-4]. As noted by Olaf Blanke [1]: *"This aspect of self-consciousness, namely the feeling that conscious experiences are bound to the self and are experiences of a unitary entity ('I'), is often considered to be one of the most astonishing features of the human mind."* (p. 556).In fact, the above studies support also the idea that body representations play a central role in structuring cognition and the self [1-4]. For this reason, the experience of the body is strictly connected to processes like cognitive development and autobiographical memory. More, even though BSC is apparently experienced by the subject as a unitary experience, neuroimaging and neurological data clearly suggest that BSC includes different experiential layers that are integrated in a coherent experience [1; 5-8]. Thus, our body is not simply an object like any other but it has a special status [9]: In general, we become aware of our bodies *from outside* (Exteroception, the body perceived through the senses) as well as *from within* (Inner Body, including Interoception, the sense of the physiological condition of the body, Proprioception, the sense of the position of the body/body segments, and Vestibular Input, the sense of motion of the body) [10; 11].

---

[*] Corresponding Author: giuseppe.riva@unicatt.it

Further, the characteristics of BSC evolve over time following the ontogenetic development of the subject. As Riva discussed recently in Cortex [12], our bodily experience is constructed from early development through the continuous integration of sensory and cultural data from different representations of the body.

So, how are these different body representations integrated in a coherent and single experience of the body? Different authors have suggested that the multisensory brain mechanism has a critical role in the ability to integrate bodily signals [13-16]. According to Moseley and colleagues, body representations are integrated in a coarse supramodal multi-sensory representation of the body and the space around it, that defined "*body matrix*." Its evolutive goal is to allow the individual to protect and extend her/his boundaries at both the homeostatic and psychological levels [17-19].

The body matrix emerges from the flow of information across large-scale networks that link various regions of the brain [17; 18; 20]. Specifically, through the connections between the posterior parietal cortex and the insular cortex, the body matrix integrates somatotopic and peripersonal sensory data with body-centred spatial sensory data and an object-centred body image from vision and memory.

Computational models have shown that different bodily inputs can be combined using maximum-likelihood estimation models that minimize errors and allow multisensory integration with a perceptual precision greater than that of the individual inputs [16; 21]. This is achieved through the predictive, multi-sensory integration (multisensory binding) that is activated by central top–down attentional processes [22-27]. In agreement with the predictive coding framework [28-30], the body matrix actively maintains a mental model of the body and the space around it (peripersonal space), which provides predictions about the expected sensory input and tries to minimize the amount of free energy (or 'surprise').

According to the predictive coding model the contents of the body matrix are adjusted on the basis of the (dis)agreement [22] between the perceived sensory activity, and the activity predicted through the integration of the contents of the different representations that define the satisfaction conditions of the intentions of the self.

## 2. Embodied Mental Health: The role of an impaired BSC in the aetiology of different clinical disorders

We have just seen how the contents of the body matrix are modified by bottom-up prediction errors that signal mismatches between predicted and actual content of the different body representations. In this view, damage, malfunctioning, or altered feedback from and toward the body matrix might be involved in the aetiology of different clinical disturbances [31], from neurological disorders, such as chronic pain [32; 33] and neglect [34; 35], to psychiatric disorders, such as depression [36; 37], schizophrenia [38-40], eating and weight disorders [41-47], and depersonalization/derealization disorder [48; 49]. How does this occur? In his recent Cortex paper [12] Riva suggested the following two possibilities:

    a.  *through an impairment in the ability of correctly linking bodily signals to their potential pleasant (or aversive) consequences*: According to Paulus & Stein [50], a brain circuit that involves the medial prefrontal cortex, the dorsolateral prefrontal cortex, and the anterior cingulate evaluates anticipatory interoceptive signals using self-relevant and belief-based processes to identify those that are relevant. If this process is impaired, the individual no longer can correctly identify the relevant interoceptive signals that predict potential pleasant (or aversive) consequences. In this view, the different diseases are related to the degree to which these wrong interoceptive prediction schemas evolve [50].

    b.  *through an impairment in the ability of updating the body matrix with new contents from real-time perception-driven inputs*: As we have seen previously, a critical goal of the body matrix is the integration of multisensory bodily signals. In particular, lower level sensory signals within an egocentric frame of reference must be integrated with higher level abstract bodily information within an allocentric frame of reference. According to a prominent neural model of spatial memory and imagery [51; 52], the translation between

egocentric and allocentric representations involves the retrosplenial cortex, with the support of place and grid cells. However, different factors [41; 53; 54] – from stress, to functional connectivity alterations, to an altered monoamine neural modulation – may impair this process, locking the individual to an old memory of the body that cannot be updated.

## 3. Embodied Medicine: Altering the body matrix to improve health and well-being

In the last twenty years VR has been used extensively in mental health. A recent paper assessed the 27 available reviews and meta-analyses exploring the efficacy of VR in behavioral health [55]. The authors' findings supported the use of this technology for the treatment of anxiety disorders, stress-related disorders, pain management, and eating and weight disorders.

In most pathologies VR is used as simulative tool for controlled exposure to critical/fearful situations. The possibility of presenting realistic controlled stimuli and, simultaneously, of monitoring the responses generated by the user offers a considerable advantage over real experiences. More, the possibility of designing targeted VR experiences with different difficulty levels - from easy performances to very difficult ones – offers an important source of personal efficacy [55].

Nevertheless, VR can also be used as an embodied technology able to alter our experience of the body and space. If most VR applications to date have been used to simulate external reality, it is also possible to use VR for the simulation/transformation of our BSC, including the way we perceive our body, control it and affectively react to what happens to it [55].

Following the discussion above, two possible ways of to correct a dysfunctional body matrix are:
1. *the use of virtual technologies to facilitate the integration of external and inner body signals and,*
2. *the use of virtual technologies to induce a controlled mismatch between the predicted/dysfunctional content and the actual sensory input thereby improving the body representations.*

The emerging fields of interoceptive feedback [56], sonoception, i.e, the use of sound and vibration to modify inner body signals [57; 58], and body illusion techniques [59],  provide interesting suggestions for implementing the above strategies.

First, Suzuki and colleagues [56] created a "cardiac rubber hand illusion" in which a computer-generated, augmented-reality providing a real-time feedback of interoceptive (cardiac) information, thereby facilitating the online integration of exteroceptive and interoceptive signals. Second, in a recent study Azevedo and colleagues [58] used a wearable device to deliver discrete, on-demand, heartbeat-like vibrations on the wrist to modulate levels of arousal and calmness. Finally, another recent paper by Serino and colleagues [60] provided evidence that an illusion of body ownership over a body different from the current one can change body percept and affect (i.e., reduce body size distortions and body dissatisfaction) and motivate initiation and maintenance of healthy eating behaviours.

These studies provided the basis for a new trans-disciplinary research field that we propose to call "Embodied Medicine" [31; 57], the main goal of which is the use of advanced technology for altering the body matrix with the goal of improving people's health and well-being. However, to exploit the full potential of this evolving situation the development of future embodied media will require multi-disciplinary teams of engineers, computer programmers, and therapists working in concert to treat specific clinical problems. Hopefully, by bringing this community of experts together, further interest from granting agencies and companies will be stimulated.

## 4. Acknowledgments

## References

[1] O. Blanke Multisensory brain mechanisms of bodily self-consciousness. *Nature reviews,* **13** (2012), 556-571.

[2] T. Tsakiris, M. R. Longo, P. Haggard. Having a body versus moving your body: neural signatures of agency and body-ownership, *Neuropsychologia* **48** (2010), 2740-2749.

[3] V. Slaughter, C. Brownell. *Early development of body representations*, Cambridge University Press, Cambridge, UK, 2012.

[4] S. Gallagher. *How the Body Shapes the Mind*, Oxford, 2005.

[5] C. Pfeiffer, C. Lopez, V. Schmutz, J. A. Duenas, R. Martuzzi, O. Blanke . Multisensory origin of the subjective first-person perspective: visual, tactile, and vestibular mechanisms, *PLoS One,* **8** (2013), e61751.

[6] K. Vogeley, G. R. Fink. Neural correlates of the first-person-perspective, *Trends Cogn Sci,* **7** (2003), 38-42.

[7] C. Shilling. *The Body & Social Theory*, SAGE, London, 2012.

[8] N. Crossley. *The Social Body: Habit, Identity and Desire*, SAGE, London, 2001.

[9] J. E. Aspell, B. Lenggenhager, O. Blanke. Multisensory Perception and Bodily Self-Consciousness. From Out-of-Body to Inside-Body Experience, in: *The Neural Bases of Multisensory Processes,* MM. Murray and MT. Wallace, eds., CRC Press, Boca Raton, FL, 2012, p. Available from: http://www.ncbi.nlm.nih.gov/books/NBK92870/.

[10] C. Durlik, F. Cardini, M. Tsakiris. Being watched: The effect of social self-focus on interoceptive and exteroceptive somatosensory perception. *Consciousness and cognition,* **25** (2014), 42-50.

[11] S.N. Garfinkel, H.D. Critchley. Interoception, emotion and brain: new insights link internal physiology to social behaviour. Commentary on: "Anterior insular cortex mediates bodily sensibility and social anxiety" by Terasawa et al. (2012), *Social cognitive and affective neuroscience,* **8** (2013), 231-234.

[12] G. Riva. The neuroscience of body memory: From the self through the space to the others, *Cortex* (2017).

[13] V.I Petkova, M. Bjornsdotter, G. Gentile, T. Jonsson, T.Q. Li, and H.H. Ehrsson. From part- to whole-body ownership in the multisensory brain, *Curr Biol,* **21** (2011), 1118-1122.

[14] H.E. Ehrsson, C. Spence, R.E. Passingham. That's my hand! Activity in premotor cortex reflects feeling of ownership of a limb. *Science,* **305** (2004), 875-877.

[15] A. Maselli, K. Kilteni, J. Lopez-Moliner, M. Slater. The sense of body ownership relaxes temporal constraints for multisensory integration. *Sci Rep,* **6** (2016), 30628.

[16] O. Blanke, M. Slater, A. Serino. Behavioral, Neural, and Computational Principles of Bodily Self-Consciousness. *Neuron,* **88** (2015), 145-166.

[17] G. L. Moseley, A. Gallace, A. Spence. Bodily illusions in health and disease: physiological and clinical perspectives and the concept of a cortical 'body matrix'. *Neuroscience & Biobehavioral Reviews,* **36** (2012), 34-46.

[18] A. Gallace, A. Spence. *In touch with the future: The sense of touch from cognitive neuroscience to virtual reality*, Oxford University Press, Oxford; 2014.

[19] A. Sedda, D. Tonin, G. Salvato, M. Gandola, G. Bottini. Left caloric vestibular stimulation as a tool to reveal implicit and explicit parameters of body representation. *Consciousness and cognition*, **41** (2016), 1-9.

[20] N. Bolognini, S. Convento, A. Rossetti, L.B. Merabet. Multisensory processing after a brain damage: Clues on post-injury crossmodal plasticity from neuropsychology. *Neuroscience and Biobehavioral Reviews,* **37** (2013), 269-278.

[21] M. Prsa, D. Jimenez-Rezende, O. Blanke. Inference of perceptual priors from path dynamics of passive self-motion. *J Neurophysiol*, **113** (2015), 1400-1413.

[22] D. Talsma. Predictive coding and multisensory integration: an attentional account of the multisensory mind. *Front Integr Neurosci,* **9** (2015), 19.

[23] A. Clark. Attention alters predictive processing. *Behavioral and Brain Sciences* **39,** (2016), e234.

[24] H. Feldman, K. Friston Attention, uncertainty, and free-energy. *Front Hum Neurosci,* **4** (2010), 215.

[25] D. Talsma, D. Senkowski, S. Soto-Faraco, M.G. Woldorff. The multifaceted interplay between attention and multisensory integration. *Trends in Cognitive Sciences,* **14** (2010), 400-410.

[26] M. Samad, A. J. Chung, L. Shams. Perception of Body Ownership Is Driven by Bayesian Sensory Inference. *PLoS One,* **10** (2015).

[27] F. de Vignemont. A Multimodal Conception of Bodily Awareness. *Mind,* **123** (2014), 989-1020.

[28] K. Friston. The free-energy principle: a unified brain theory?. *Nat Rev Neurosci,* **11** (2010), 127-138.

[29] K. Friston Embodied inference and spatial cognition. *Cognitive Processing,* **13 Suppl 1** (2012), S171-177.

[30] A. Clark. Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behav Brain Sci*, **36** (2013), 181-204.

[31] G. Riva. Embodied Medicine: What Human-Computer Confluence Can Offer to Health Care, in: *Human Computer Confluence: Transforming Human Experience Through Symbiotic Technologies*, A Gaggioli, A Ferscha, G Riva, S Dunne, I Viaud-Delmon, eds., De Gruyter Open, Warsaw, 2016, pp. 55-79.

[32] D. Di Lernia, S. Serino, G. Riva. Pain in the body. Altered interoception in chronic pain conditions: A systematic review. *Neurosci Biobehav Rev,* **71** (2016), 328-341.

[33] A. Tsay, T.J. Allen, U. Proske, M.J. Giummarra. Sensing the body in chronic pain: A review of psychophysical studies implicating altered body representation. *Neuroscience & Biobehavioral Reviews,* **52** (2015), 221-232.

[34] N. Bolognini, S. Convento, C. Casati, F. Mancini, F. Brighina, G. Vallar. Multisensory integration in hemianopia and unilateral spatial neglect: Evidence from the sound induced flash illusion. *Neuropsychologia,* **87** (2016), 134-143.

[35] B.Lenggenhager, T. Loetscher, N. Kavan, G. Pallich, A. Brodtmann, M.E. Nicholls, P. Brugger. Paradoxical extension into the contralesional hemispace in spatial neglect. *Cortex,* **48** (2012), 1320-1328.

[36] L.F. Barrett, K.S. Quigley, P. Hamilton. An active inference theory of allostasis and interoception in depression. *Philosophical Transactions of the Royal Society B-Biological Sciences*, **371** (2016).

[37] J. Wheatley, C.R. Brewin, T. Patel, A, Hackmann, A. Wells, P. Fisher, S. Myers. I'll believe it when I can see it: imagery rescripting of intrusive sensory memories in depression. *J Behav Ther Exp Psychiatry,* **38** (2007), 371-385.

[38] L.Postmes, H.N. Sno, S. Goedhart, J. van der Stel, H.D. Heering, L. de Haand. Schizophrenia as a self-disorder due to perceptual incoherence. *Schizophrenia research,* **152** (2014), 41-50.

[39] F. Ferri, M. Costantini, A. Salone, G. Di Iorio, G. Martinotti, A. Chiarelli, A. Merla,A. Di Giannantonio, V. Gallese. Upcoming tactile events and body ownership in schizophrenia. *Schizophrenia research,* **152** (2014), 51-57.

[40] M. Klaver, H.C. Dijkerman. Bodily Experience in Schizophrenia: Factors Underlying a Disturbed Sense of Body Ownership. *Front Hum Neurosci,* **10** (2016), 305.

[41] G. Riva. Out of my real body: cognitive neuroscience meets eating disorders. *Front Hum Neurosci,* **8** (2014), 236

[42] S Serino, A. Dakanalis, S. Santino, G. Carrà, P. Cipresso, M. Clerici, G.Riva. Out of body, out of space: impaired reference frame processing in eating disorders. *Psychiatric Research,* **230** (2016), 732-734.

[43] K. Keizer, M.A. Smeets, H.C. Dijkerman, A. van Elburg, A. Postm. Aberrant somatosensory perception in Anorexia Nervosa. *Psychiatry Res,* **200** (2012), 530-537.

[44] K. Keizer, M.A. Smeets, H.C. Dijkerman, S.A.Uzunbajakau, A.van Elburg, A. Postma. Too fat to fit through the door: first evidence for disturbed body-scaled action in anorexia nervosa during locomotion. *PLoS One,* **8** (2013), e64602.

[45] F. Scarpina, D. Migliorati, P. Marzullo, A. Mauro, M. Scacchi, M. Costantini. Altered multisensory temporal integration in obesity. *Sci Rep,* **6** (2016), 28382.

[46] G. Riva, S. Gaudio. Locked to a wrong body: Eating disorders as the outcome of a primary disturbance in multisensory body integration. *Consciousness and cognition,* (2017).

[47] G. Riva. Letter to the Editor: Virtual reality in the treatment of eating and weight disorders, *Psychol Med* (2017), 1-2.

[48] R. K. Jauregui. Vestibular Function and Depersonalization/Derealization Symptoms. *Multisens Res,* **28** (2015), 637-651.

[49] D. Simeon, O. Guralnik, E.A. Hazlett, J. Spiegel-Cohen, E. Hollander, M.S. Buchsbaum. Feeling unreal: a PET study of depersonalization disorder. *Am J Psychiatry,* **157** (2000), 1782-1788.

[50] M. P. Paulus, M. B. Stein. Interoception in anxiety and depression. *Brain Struct Funct,* **214** (2010), 451-463.

[51] P. Byrne, S. Becker, N. Burgess. Remembering the Past and Imagining the Future: A Neural Model of Spatial Memory and Imagery. *Psychological Review.* **114** (2007), 340-375.

[52] P. Byrne, S. Becker. A principle for learning egocentric-allocentric transformation. *Neural Comput,* **20** (2008), 709-737.

[53] G. Riva. Neurobiology of Anorexia Nervosa: Serotonin Dysfunctions Link Self-Starvation with Body Image Disturbances through an Impaired Body Memory. *Front Hum Neurosci,* **10** (2016), 600.

[54] S. Gaudio, G. Riva. Body Image Disturbances in Anorexia: The link between functional connectivity alterations and reference frames. *Biological Psychiatry,* **73** (2013), e25-e26.

[55] G. Riva, R.M. Baños, C. Botella, F. Mantovani, A. Gaggioli Transforming Experience: The Potential of Augmented Reality and Virtual Reality for Enhancing Personal and Clinical Change. *Frontiers in Psychiatry.* **7** (2016).

[56] K. Suzuki, S.N. Garfinkel, H.D. Critchley, A.K. Seth. Multisensory integration across exteroceptive and interoceptive domains modulates self-experience in the rubber-hand illusion, *Neuropsychologia* **51** (2013), 2909-2917.

[57] G.Riva, S. Serino, D. Di Lernia, E.F. Pavone, A. Dakanalis. Embodied Medicine: Mens Sana in Corpore Virtuale Sano. *Frontiers in Human Neuroscience,* **11** (2017).

[58] R. T. Azevedo, N. Bennett, A. Bilicki, J. Hooper, F. Markopoulou, M. Tsakiris. The calming effect of a new wearable device during the anticipation of public speech. *Sci Rep,* **7** (2017), 2285.

[59] M. Costantini. Body perception, awareness, and illusions. *Wiley Interdisciplinary Reviews: Cognitive Science*, **5** (2014), 551-560.

[60] S. Serino, F. Scarpina, A. Keizer, E. Pedroli, A. Dakanalis, G. Castelnuovo, A. Chirico, M. Novelli, S. Gaudio, G. Riva. A Novel Technique for Improving Bodily Experience in a Non-operable Super-Super Obesity Case. *Frontiers in psychology,S* **7** (2016), 837.

# SECTION II

---

# CRITICAL REVIEWS

In general, there are two reasons why cybertherapy is used: either because there is no alternative, or because it is in some sense better than traditional medicine.

In this sense telehealth has been used very successfully for optimizing health services delivery to people who are isolated due to social and physical boundaries and limitations.

Nevertheless, the benefits of cybertherapy, due to the variety of its applications and their uneven development, are not self-evident.

However, the emergence of cybertherapy is supporting the cost-effectiveness of certain applications, such as assessment, rehabilitation and therapy in clinical psychology and neuroscience.

*Wiederhold & Riva, 2004*

# The small-world of cybertherapy

Brice GOUVERNET[*,a] and Lise HADDOUK[a]

[a]*Normandy University Rouen, Department of Psychology, CRFDP laboratory*

**Abstract.** Is cybertherapy a scientific paradigm? Is it made up of heterogeneous individuals or an organized scientific community? How has it evolved since 2006? To answer these questions, we took an interest in the keywords used in the scientific literature dealing with cybertherapy. A network approach has been put forward in order to (1) highlight the most central concepts, (2) to make some themes emerge, (3) to determine whether this structure could testify to a small-world organization, revealing paradigmatic aspects of a scientific discipline. 1510 articles have been extracted from the Pubmed and Elsevier databases from the query: « cybertherapy » OR "computer based therapy" OR "online therapy" OR "tele-psychology" OR "telepsychotherapy" OR « tele-mental health ". Over the period considered, (i) the conceptual network appears coherent and organized (S = 3.28), (ii) 18 themes emerge, (iii) the anxious disorders seem particularly central. The analysis of the temporal evolution shows an increase in the number of keywords which, combined with a reduction in the number of themes, makes possible to circumscribe the cybertherapy more than to promote its scattering. Although still above 3, the S-smallworld index decreases from year to year. All the results support an exemplary cybertherapeutic paradigm. However, the decline in the small world index over time invites us to ensure that this scientific coherence remains at the risk of a scattering of cybertherapy that could lead to an impoverishment of its identity. Ethical, methodological and educational implications are considered.

**Keywords.** Cybertherapy, scientific paradigm, network approach, text-mining small world

## 1. Introduction

This article questions the scientific coherence of cybertherapy, starting from the following questions: do cyber therapists constitute a heterogeneous group of individuals using digital technologies randomly according to their research works, or a scientific community organized around an object? What are their main interests? How have these interests evolved over the last 10 years? In order to answer these questions, we are interested in the methods of construction of the body of knowledge via the lexicometric study of the scientific productions. The position adopted consists in considering scientific knowledge as an intersubjective construct [1]. Thus, we question, in reference to Kuhn's work, the paradigmatic value of cybertherapies [2]. To this end, we are interested in the keywords used in the scientific literature dealing with cybertherapies. They represent a

---

[*] Corresponding Author: bruce.gouvernet@univ-rouen.fr

fundamental core of scientific knowledge [3]. A network approach was favored. Modeled in particular by Wasserman & Faust [4], this approach focuses on interactions, connections, relationships between units rather than studying units isolated from one another.

Therefore, from an operative point of view, we started with the analysis of articles indexed in two scientific search engines (a) to think about the interactions between concepts or keywords, (b) to study the structure of these interactions, i.e. to highlight the most central concepts, (c) to study the modalities to cluster together different concepts in order to make themes emerge, (d) to determine whether this structure could show a particular organization, called small world, in reference to Milgram's work on the six degrees of separation [5]. A network smallworld structure designates a coherent and organized network. It differs from networks in which inter-relationships are random as well as networks in which elements are strictly sectorized. Small-world networks are therefore highly structured but flexible [6]. The transmission of information from one point to another in the network is optimized. Following Yi and Choi's work [7], we will consider that the small-world dimension is revealing the paradigmatic aspects of a scientific discipline.

## 2. Method

The request was made on two databases [ScienceDirect (Elsevier) and PUBMED (MEDLINE)] in January 2017. It concerned the period from 2006 to 2016. Terms were searched in the titles, keywords and summaries as follows: (cybertherapy OR "computer based therapy" OR "online therapy" OR "tele-psychotherapy" OR "tele-psychotherapy" OR "tele-mental health ").

In addition to smallworld analyzes, network analyzes were also focused on the betweenness coefficients [4] in order to extract the main signifiers in the communication [8]. Themes were constructed by community analyzes, using the Walktrap algorithm [9]. Data processing was made using the free software R (http://cran.r-project.org/) and it was done in 2 steps. At first, it covered the full considered period (2006 : 2016). Secondly, the analyzes were conduct by years of publication. Network analyzes were mainly performed using the qgraph package [10]. The small-world organization has been evaluated using the Smallworldness index (S: [11], originally implemented in the qgraph package. Note that to qualify a small world network, the value of the S index must be higher than 1.

## 3. Results

1759 articles were extracted from the two databases studied over the 11 years period considered (2006-2016). After cleaning the corpus, 1510 articles were submitted to analysis (85% of the initial articles). These 1510 articles were published on 571 different scientific medias (Figure 1).
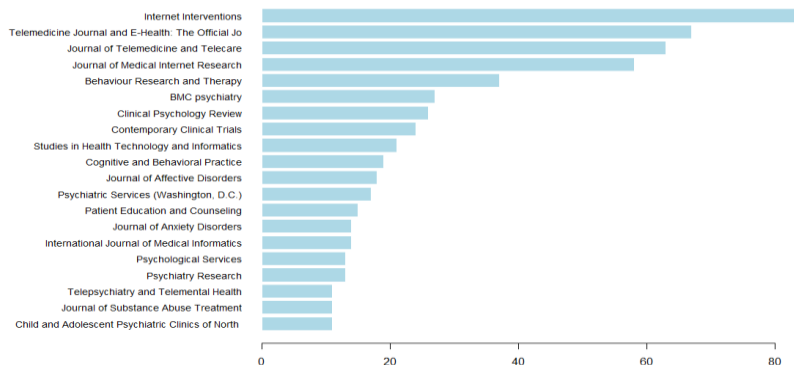
**Figure 1.**Main medias

Subsequent analyzes were carried out on the concepts present in at least 1 % of articles. 220 concepts were selected. Network analyzes, based on chi squared distance matrices, permit to classify these concepts into 18 conceptual communities (Figure 2). Finally, the network of concepts used between 2006 and 2016 has the characteristics of a small world (S = 3.28).
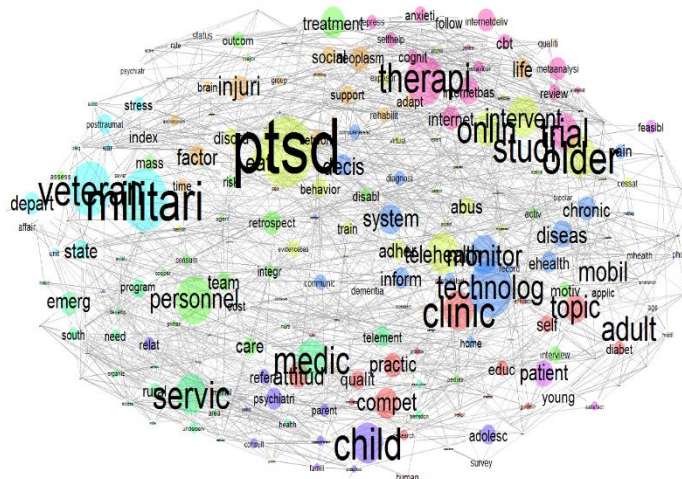


*The size of the nodes is proportional to their importance in the network (betweenness centrality). The concepts belonging to the same theme are grouped by color and position*

**Figure 2.** Keywords network

These first analyzes were completed by the study of the temporal evolution of the works related to cybertherapies. An increase in publications since 2006, reflecting a

growing interest among scientists in this area, can be noted. Is this growing interest associated with the dissemination of knowledge about cybertherapies or with a structuration of knowledge? In order to answer this question, we have compared the evolution of the number of published articles with the number of publication media (Figure 3). It appears that the increase of the number of publications is associated with an increase in the number of different supports dealing with cybertherapy, arguing in favor of an increasing diffusion of cybertherapies on the international scientific scene. The increase of the number of articles and the increase of the number of supports are however not strictly parallel. Knowledge about cybertherapies seems to be increasingly sectorized and, little by little, clustered in specialized publication media. This result argues in favor of an identity pattern of cybertherapy.
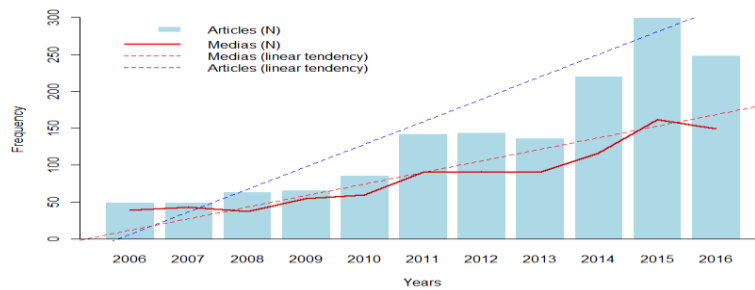


**Figure 3.** Temporal evolution of articles and supports of publications

Central concepts evolve between 2006 and 2016 (Table 1). General concerns about the effectiveness of a device, implementing rules of the device or large psychopathological entities, are gradually replaced by concerns related to more specific issues that question the cultural situation (ex: 2010), the modalities of specific psychotherapeutic interventions (ex: 2014) or the specific characteristics of the subjects. At the same time, the need to assess the interest of cybertherapy seems less major. The evolution of questioning is related to technological evolutions: digital technologies become central as well as web interventions.

**Table 1.** Centrality concepts by years: Top 10

| 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| use | factor | metaanalysi | primari | chronic | technolog | ptsd | technolog | activ | young | rural |
| record | evalu | analysi | Disable | pain | telepsychiatri | telehealth | Review | diabet | ptsd | pain |
| inform | comput | design | prevent | public | telehealth | dementia | systemat | systemat | webbas | older |
| communic | Use | electron | treatment | intervent | diseas | cognit | Older | mellitus | internetbas | nurs |
| telepsychiatri | model | injuri | metaanalysi | cultur | behaviour | exposur | Comput | ambulatori | underserv | parent |
| medic | technolog | practic | Use | comput | electron | activ | internetdeliv | cbt | veteran | diabet |
| compet | hospit | time | consum | metaanalysi | risk | virtual | intervent | caregiv | adult | practic |
| anxieti | telemedicin | clinic | militari | medic | exposur | intervent | telement | network | metaanalysi | relat |
| intervent | australia | educ | Clinic | psychiatri | ehealth | medic | Train | pain | suicid | veteran |
| psychotherapi | pain | pain | selfhelp | guidelin | webbas | suicid | network | older | clinic | chronic |

Between 2006 and 2016, the number of keywords used increased (Figure 4). Logically, the number of relationships between the different concepts also increases. However, it doesn't lead to an explosion of the number of the themes adressed in cybertherapy. On the contrary, the number of themes declines. In other words, the increase in the number of concepts seems more likely to circumscribe cybertherapy than to favor its scattering. Despite a decrease in the smallworld index over 10 years, it still remains above 3, reflecting the consistency of cybertherapy over the 10-year period considered.
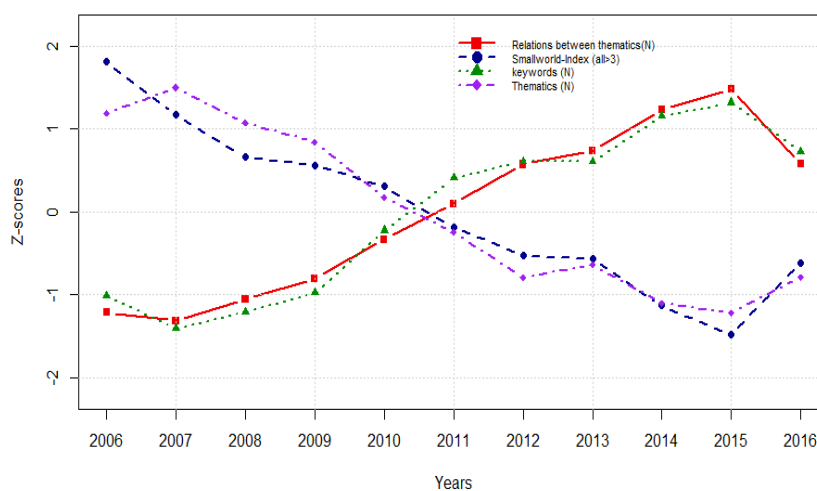


**Figure 4.** Evolution of cohesion from 2006 to 2016

## 4. Conclusion

Cybertherapies question a plurality of disciplinary fields, techniques and modalities of care. They interest human sciences and all sub-disciplines of psychology. The emergence of specific media supports shows that these questions are likely to contribute to the emergence of a specific identity to this disciplinary field. The constant increase in scientific interest in issues related to cybertherapies has been highlighted, as well as the structuration of a disciplinary field in the context of some increasingly precise questions concerning the use and scope of cybertherapies, for more and more specified populations. Social and cultural influence, as for any paradigm [2], is undoubtedly not to be neglected, as evidenced by the themes centered on the military, veterans of recent wars, important themes, especially in the United States as well as the thougts about culture, since 2010. However, the cybertherapeutic field is not limited to specific populations. Actually, cybertherapy is gradually emerging as a global approach to individuals of all ages, social and demographic categories. It concerns the patient as well as the practitioner and health institutions.

Cybertherapies are anchored in the evolution of technologies, which constitute one of the key points in the structuring of knowledge. It is obvious that a good understanding of cybertherapies implies a minimal up-to-date knowledge of ICT in order to fully understand the stakes and the possibilities they offer.

These elements could lead to blur the specificity of cybertherapies. However, analyzes of keyword networks lead us to a completely different view. The construction of the scientific knowledge about cybertherapy seems far from chaotic. Its coherence appears strong and the various themes are highly structured, as evidenced by the various analyzes in small world conducted here. This result is all the more important since the keyword analyzes of the scientific literature often struggle to reveal such a phenomenon [6]. Would the constitution of this disciplinary field be exemplary then? The decrease of the small world index over time invites us however to be careful that this scientific coherence is maintained, at the risk of a scattering of cybertherapy.

Cybertherapy has the value of a paradigm, but what means do we give ourselves to ensure the training of future cybertherapists? If specialized media emerge for the dissemination of a specific scientific knowledge - integrating knowledge of technological advances and human-digital interactions - the training of cyberpsychologists requires a specific pedagogy. This is a vast project which, to our knowledge, still needs to be developed in France, as in Europe.

## 5. References

[1]   W. F. McComas, M. P. Clough, Almazroa H. The role and character of the nature of science in science education. In: WF McComas, editor, *The nature of science in science education*. Springer; 1998.

[2]   T. Kuhn. *The Structure of Scientific Revolutions*. University of Chicago Press. Chicago; 1962.

[3]   P. C. Lee, H. N. Su, T.Y. Chan. Assessment of ontology-based knowledge network formation by Vector-Space Model. *Scientometrics*. **85** (2010), 689‑703.

[4]   S. Wasserman, K. Faust. *Social network analysis: Methods and applications.* Cambridge university press; 1994.

[5]   S. Milgram. The small world problem. *Psychology Today,* **2** (1967), 60‑67.

[6]   D. J. Watts, S. H. Strogatz. Collective dynamics of 'small-world'networks. *Nature,* **393** (1998), 440‑442.

[7]   S. Yi S, J. Choi. The organization of scientific knowledge: the structural characteristics of keyword networks. *Scientometrics,* **90** (2011):1015‑1026.

[8]   D. Paranyushkin. Identifying the pathways for meaning circulation using text network analysis. *Berlin: Nodus Labs. Retrived at: http://noduslabs. com/research/pathways-meaning-circulation-text-network-analysis*, 2011.

[9]   P. Pons, M. Latapy. Computing communities in large networks using random walks. In: *International Symposium on Computer and Information Sciences*. Springer; 2005.

[10]  S. Epskamp, A. O. Cramer, L.J. Waldorp, V. D. Schmittmann, D. Borsboom. Qgraph: Network visualizations of relationships in psychometric data. *Journal of Statistical Software,* **48** (2012), 1‑18.

[11]  M. D. Humphries, K. Gurney. Network 'small-world-ness': a quantitative method for determining canonical network equivalence. *PloS One,* **3** 2008, e0002051.

# Neural Basis of Virtual ExposureTreatment

Aleksandra LANDOWSKA [a,*] David ROBERTS[a] and Peter EACHUS[a]

[a] *University of Salford*

**Abstract.** Virtual reality exposure therapy (VRET) is an increasingly common treatment for a range of anxiety disorder, specific phobias, PTSD and addictions, however neural mechanisms supporting VRET are yet to be understood. This review summarises existing studies which investigated the neural basis of VRET. Searches of electronic databases were performed using keywords related to VRET, mental disorders and neuroimaging. The search yielded 32 studies, and of these, 5 studies met inclusion criteria. Results indicated the role of prefrontal cortex in VRET, although more research is needed.

**Keywords.** VRET, neuroimaging, review, prefrontal cortex, anxiety disorders

## 1. Introduction

Virtual Reality Exposure Therapy (VRET) has shown promise in the treatment of a range of anxiety disorders [1], however, neural mechanisms underlying its efficacy are still not well understood [2]. Combining VRET with neuroimaging would help to understand its neural mechanisms, aid tailoring of more efficient VRET interventions, and evaluate treatment effects and directions in research and clinical application.

A meta-analysis assessing neuroimaging studies of anxiety, phobia, PTSD and emotional processing, identified a "fear network" consisting of the prefrontal cortex (PFC) and amygdala. Healthy controls showed greater activity in the medial prefrontal cortex (MPFC) and dorsolateral prefrontal cortex (DLPFC) when exposed to aversive stimuli. Activity in these areas has an inverse relationship with the activity in the amygdala. Conversely, patients with anxiety showed decreased activity in DLPFC and MPFC inversely correlated with activity in the amygdala when exposed to anxiogenic stimuli [3]. Previous studies demonstrated that exposure therapy (EP) restores a balance within a fear circuit [4]. Although neural mechanisms underlying traditional (EP) are well documented, the neural basis of VRET and its effect on brain activity are still poorly understood [2]. The aim of this paper is to review and summarise an existing literature on the neural basis of VRET.

## 2. Methods

The aim of this review was to investigate what existing literature tells us of the impact of virtual exposure treatment on brain function. The objective was to identify brain areas and patterns of neural activity triggered by VRET.

---

* Corresponding Author, A.Landowska@edu.salford.ac.uk

## 2.1. Search and analysis strategy

We performed a systematic online database search on PubMed, MEDLINE, ISI Web of Science, and Google Scholar by entering various combinations of search items: VRET, virtual reality exposure, fMRI, PET, EEG, neuroimaging. Studies were included if they used (1) any combination of VRET and neuroimaging, (2) were performed on either healthy or patients with anxiety, phobia, PTSD or addiction, (3) activity in the neural fear circuit was reported. All studies that met inclusion criteria were critically reviewed in terms of study aims and objectives, methodology, population, sample size and technology.

## 2.2. Results

The search yielded thirty - two studies, and of these, five studies met inclusion criteria. We identified four studies employing fMRI and one using EEG. In each of those studies, VRET was delivered through HMD. All five studies are summarised below.

## 2.3. Studies

Three studies investigated neuronal mechanisms of VRET for addiction treatment. Lee et al. used fMRI to compare the efficacy of using 2D images and 3D VR as a tool for delivering VRET for smoking cessation. Participants in the 2D condition showed increased brain activity when viewing smoking-related cues in the right superior frontal gyrus, right middle frontal gyrus, and left orbital gyrus, left anterior cingulate gyrus, left supplementary motor area, right inferior temporal gyrus, right lingual gyrus, and right precuneus. Participants in VR exposed to smoking-related cues in VR, additionally showed increased activity in the left superior temporal gyrus, right superior frontal gyrus, and left inferior occipital gyrus, indicating more attention, visual balance and spatial orientation. The findings indicated that 3D VR may be superior to 2D images regarding ecological validity [5]. Another fMRI study conducted by Moon et al. studied eight participants on a six session VRET smoking cessation program, during which they were exposed to cues in the virtual bar which could trigger cigarette cravings. The fMRI scan was performed before and after the treatment. The results revealed increased activity in the left inferior frontal gyrus and left superior frontal gyrus in response to smoking-related cues [6]. Lee  et al. compared the effect of ten sessions of VRET for alcohol dependence (ADP) patients with healthy controls using EEG. The results revealed increased alpha waves in PFC after treatment in ADP patients [7].

Only two studies investigated the neural basis of VRET for anxiety disorders. Clemente et al used fMRI to assess brain activity during VRET for assessment of specific phobia. Eleven participants with a mild phobia of small animals were exposed to simulations of these animals in VR. Results revealed increased activity in the right DLPFC (superior frontal gyrus). Activity was also found in the occipital lobe related to increased visual attention. Although authors concluded that activity in PFC is related to the self-awareness, they suggested it could be related to suppression of fear when exposed to the threatening stimuli [8]. Roy et al. was the only randomized controlled trial (RTC) employing brain imaging techniques to investigate VRET for PTSD.

Functional Magnetic Resonance (fMRI) was used before and after the treatment to assess improvement in brain function after VRET and found decreased activity in the amygdala, anterior cingulate cortex and increased activity in lateral prefrontal cortex [2].

## 3. Discussion

This review evaluated existing studies investigating neural mechanisms underlying VRET. In line with previous neuroimaging studies, this review indicated an essential role of PFC in VRET, in particular DLPFC and MPFC. The role is that of regulation of emotion and fear inhibition to reduce fear responses. In turn this reduces anxiety, phobias and PTSD symptoms, as well as craving in addictions through inhibitory function. Successful VRET treatment should restore balance within the prefrontal - amygdalar fear circuit. Unfortunately, due to the small number of studies, there is limitted evidence of how VRET affects brain function. Moreover, all existing studies evaluated the effect of VRET delivered through HMD.

There is a need for better designed randomized controlled trials, with larger samples, employing different VR systems, to verify the efficacy of VRET and its impact on brain function. So far there are no studies the effect of VRET in CAVE-like VR on brain activity.

## References

[1]    D. Opriș, S. Pintea, A, García-Palacios, C. Botella, S. Szamosközi, D. David. Virtual reality exposure therapy in anxiety disorders: a quantitative meta-analysis, *Depress Anxiety* **29,** (2012), 85–93.

[2]    M. J. Roy, J. Francis, J. Friedlander, L. Banks-Williams, R.G. Lande, P. Taylor, J. Blair, J. McLellan, W. Law, V. Tarpley, I. Patt, H. Yu, A. Mallinger, J. Difede, A. Rizzo, B.. Rothbaum Improvement in cerebral function with treatment of posttraumatic stress disorder. *Psychiatr. Neurol. Asp. War,* **1208** (2010), 142–149.

[3]    A. Etkin, T. D, Wager. Functional neuroimaging of anxiety: a meta-analysis of emotional processing in PTSD, social anxiety disorder, and specific phobia. *Am. J. Psychiatry,* **164,** (2007) 1476–88.

[4]    K. K. K. Hauner, S. Mineka, J. L. Voss, K.A. Paller. Exposure therapy triggers lasting reorganization of neural fear processing. *Proceedings of the National Academy of Sciences*, **109** (2012) , 9203-9208.

[5]    J. Lee, Y. Lim, B. Wiederhold, S. Graham. A functional magnetic resonance imaging (FMRI) study of cue-induced smoking craving in virtual environments. *Applied psychophysiology and biofeedback,* **30,** (2005), 195-204.

[6]    J. Moon, J. H. Lee. Cue exposure treatment in a virtual environment to reduce nicotine craving: a functional MRI study. *Cyberpsychology and. Behaviour,* **12,** (2009), 43–45.

[7]    S. H. Lee, D. H. Han, S. Oh, I. K. Lyoo, Y.S. Lee, P.F. Renshaw, S.E. Lukas. Quantitative electroencephalographic (qEEG) correlates of craving during virtual reality therapy in alcohol-dependent patients. *Pharmacol. Biochem. Behav,* **91** (2009), 393–397.

[8]    M. Clemente, B. Rey, A. Rodriguez-Pujadas, J. Breton-Lopez, A. Barros-Loscertales, R. M. Baños, C. Botella, M. Alcañiz, C. Avila. A functional magnetic resonance imaging assessment of small animals' phobia using virtual reality as a stimulus. *JMIR serious games,* **2** (2014), 1-19.

# The Internet as a possibility of empowerment for the lower classes in Brazil

Paula MELGAÇO[a,*], Bruna MADUREIRA[a], Junia DE VILHENA[a]

[a]*Department of Psychology, Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro, Brazil*

**Abstract.** This study reflects on the Internet and its resources, especially social media websites, as a scenario of empowerment for the Brazilian lower classes, which find in that space an opportunity to express their opinions, to socialize with their friends and family and to discover new horizons and conjunctures. Based on a literature review and on reports from social networks, we found evidence that the Internet is a place removed from the oppressive and stigmatizing gaze of various social and state authorities, beyond their daily lives marked by violence, inequality and segregation. The findings show that the Internet seems to offer them a safe environment where they may expose their reality and to reflect about it, to have fun, and to strengthen interpersonal relationships, even if the Brazilian elite seems to be somewhat reluctant to share the same virtual spaces.

**Keywords.** Internet; Empowerment; Brazilian lower classes.

## 1. Introduction: The use of the internet by the urban lower classes in Brazil

If we know that in developed countries, such as the United States, birthplace of the internet, the scope of users in several layers of the population has broadened, how has this process occurred in the Brazilian reality? Is the internet just another expression of the social inequality of the country?

According to the survey "Communications and Information Technology in Households- TIC Brazil Households" [1], among the individuals included in the D/E and C classes, respectively, 16% and 56% have access to the virtual world. As well as the lack of resources provided by the government for the sector, the main reasons alleged by individuals that do not have internet access are: lack of a computer in the household, lack of need, or interest on the part of the household members, high cost to maintain a broadband internet connection at the home and a lack of knowledge on how to use the technological resources [1].

---

* Corresponding Author, paulamelgaco.psi@gmail.com .

With respect to those who have internet access, 81% of users from the D/E classes and 84% of the C class sent messages via *what´s app*, *Facebook* chat or *Skype;* 68% of the D/E classes and 76% of the C class made use of social media such as *Facebook*, *Instagram* and *Snapchat* [1]. These statistics reveal a prevalence of social media in the preferences of individuals from lower classes that have the possibility of being connected to the virtual world. Next, we will demonstrate that the numbers are not far from the social context, since it is no coincidence that these resources are used more by those who have access to this infrastructure.

When analyzing the data above, the initial impression may be that the use of the internet by the B, C and D classes in Brazil is limited to an interpretation, the focus of which would be social inequality and problems related to digital inclusion. Although these are issues of undeniable importance, the focus of this study is to portray conjunctures that fight against social exclusion, invisibility and violence by means of the instruments available on the internet.

What one observes is that social strata appropriate technology in a very peculiar manner, intrinsically related to the context in which they are inserted. In the scenario of lower classes, for example, the use of the internet, and in particular social media, makes possible a new way of forming relationships within a context that is particularly governed by violence, hostility and brutality. Consequently, we raise the hypothesis that the use of social media for these subjects constitutes a means of empowerment.

This supposition becomes apparent, for example, in the use of virtual tools, such as *YouTube* or blogs, that inaugurate a new knowledge base. It is interesting to note the impact of some websites (that offer courses in needlework, cookery, decoration, among others) in the learning process of some individuals, which engineer changes in their lives, especially in the educational and professional fields. In this manner, the internet gains new characteristics as it is appropriated in diverse ways by low income subjects, and the positive impact that these tools have on their lives is undeniable.

Social media equally provokes a change in these people's lives. One of the basic issues in their lives is the lack of basic sanitation, as well as access to health and education. With respect to this, it is imperative to highlight the high rates of functional illiteracy in the less privileged strata of the population, due to the poor quality of teaching in Brazil and the difficulties of the insertion of this group in schools. As described above, some websites are used as a source for the acquisition of knowledge on different themes. However, it is social media that provokes interesting changes in the case of some functional illiterates. Once they desire to be a part of this world, they not only seek an online insertion, but also the construction of strategies to use its resources on a day to day basis, by means of the sending and receiving of messages and/or sharing pictures, video and text. This task, which is supposedly simple, becomes an arduous activity for those who do not understand what they read, or write [2].

This obstacle, however, does not prevent people from making use of the tool. Again, it is interesting to note the appropriation that this collective makes of the social network. Despite not formally comprehending all the resources available, they appropriate them in order to make their first steps, to learn to read and write. In other cases, even if they do not become literate, some individuals, with the aid of the community, manage to use the internet instinctively with other means, especially images.

Thus, social media becomes a possibility for empowerment, in that it permits the subject to gain knowledge and, consequently, leave the category of illiterate. Access to information, even if informal and virtual, stimulates the production of knowledge and critical thinking.

In a similar manner to the examples presented previously, there are numerous episodes of empowerment - the appropriation of tools found in the virtual world that culminate into positive transformations - from the conquering of the internet by the subject that begins to navigate in the virtual world seeking freedom and autonomy. This becomes evident at the moment in which a youngster sends selfies to a mother who is away at work, not only as an expression of feelings, but especially as a means of communication. Further, the internet makes possible contact between friends and family members who live in districts dominated by different factions, or that are areas at risk or with difficult access for lack of public transportation and/or sanitation. In a scenario dominated by lack of safety and violence, the internet becomes the only safe place for meeting and maintaining contact between dear family members [2].

In a more general sense, violence and danger prowls the districts of lower classes, be it by the presence of police or drug traffickers, which implies a lack of freedom not only to move in physical space, but also to express opinions and beliefs about what is going on around them. In this context of threat and risk, the subject sees in social networks a possibility for safety, albeit limited, to express his/her feelings with respect to his/her life and indignation and the lack of safety or access to health and education. This is why it is understood that the internet gains new characteristics when it is appropriated by the lower classes, which use the instruments available in the virtual sphere to show the world the context of their lives and, in particular, their daily fight to stay alive despite the precariousness and uncertainty. Wouldn't this, after all, be a form of empowerment?

## 2.The internet as an empowerment tool

Despite the inequality present in Brazilian society with respect to internet access, there are many users who make use of its tools in their day-to-day lives, for example, *Facebook, Youtube* and online games. Nemer and Freeman [2] investigated the use that dwellers of Brazilian shanty towns make of *selfies* and found quite interesting results about this type of self-portrait, which assume aspects that go far beyond pure photographic registry, becoming forms of *"...nonverbal, visual communication that implies one's thoughts, intentions, emotions, desires..."* [2]. In this sense, the authors consider that selfies taken by the surveyed population represent an exercise in freedom, self-awareness and strengthening of interpersonal connections.

In addition to selfies, one of the forms of expression used by this part of the population to expose their thoughts and feelings, Nemer and Freeman [3] reveal that the dwellers of shanty towns in Brazil who were the target of investigation in his research find in social media a safe and important place where, as well as expressing their opinions on community life and other matters they experience, they can feel part of a society dominated by consumption. This is comparable to saying that, in that they show they are present in the virtual world, using its apparatus and resources, they perceive that they are included and belong to the consumer society. As Barros points out well: *"The appropriations from lower class segments in the fields of new technologies seek, for the most part the dissolution of hierarchical schemes such as speech, through the establishment of more egalitarian relations with others, that are founded on the idea of "having access" to the "new world" of contemporary connections."* [4]

Further, Nemer [3] reveals in his research that many cell phones, called "xing ling" by locals from communities in *Espírito Santo*, were shared between groups of friends that got together at Telecenters and/or LAN houses to make use of the devices together. All of this creates a sense of community, as well as stimulating sociability. Castells also highlights the qualification role of the internet that *"reinforces feelings of safety, personal freedom and influence – all with positive effects on personal well-being"* [5]

Upon analyzing the examples described, it becomes apparent that the internet may be related to empowerment, especially at the individual level, which can be described as the construction of an environment that makes possible that "*people feel they are competent in a certain situation, that their presence is relevant, they have more opportunities and resources to act than constraints and limitations.*" [6]

It is worth noting that empowerment can be understood as a *"process by which individuals, organizations and communities gather resources that permit that they have a voice, visibility, influence and capacity for action and decision."* [6]. That is, it is the possibility that the individuals can participate and have decision power in that which affects their lives. In this sense, empowerment can be understood as the construction of a space of freedom, action, voice and visibility. Still, according to Horochovski and Meirelles [6], there are many kinds of empowerment, that can occur individually or in groups, which range from actions inserted in public policies to movements promoted by the citizens themselves, that use everyday resources to create strategies to make themselves heard. It seems to us that the internet and its resources can enter exactly in this place of a search for autonomy and an exit from a lack of viability, since they are often ignored by the other layers of society and by the State.

Beyond individual interventions, there are also those that are idealized by groups. The "rolezinhos" are the most recent example of this. In general, these kinds of events are organized by youth who belong to the lower classes, with a certain recognition and a large number of followers on social media, who invite their friends for a big meeting at a place that was originally inaccessible to them such as shopping centers and public squares that are outside the periphery. It is a movement that, in a certain manner, empowers youths to occupy public spaces that were previously considered "exclusive" to the Brazilian elite. Such actions made possible by the Internet also produce impacts on the feeling of belonging of these individuals, since socially the shopping center is considered an icon of consumer society.

Even if these movements have been criminalized by the police and a large part of Brazilian society, they were extremely important, since they made possible the beginning of the discovery of new spaces and means of socialization, up to then quite limited for the lower classes that, in turn, should be confined to the periphery and cultural forma appropriate for the "poor".

It is worth highlighting that, according to Castells [5], social movements enabled by social media are set into motion by "a process of communicative action" that stimulates action and social change that, in turn, reinforces the enthusiasm of the individuals that manage to conquer their fear and *"transform into a conscious collective actor."* [5]. Thus, the social function of the internet is as essential in contemporaneity with respect to the expansion of the scenarios in which transformations can be built and there is the possibility of the passage from a feeling of indignation to one of hope. In the author's words: *"People can only challenge domination by connecting amongst themselves, sharing their indignation, feeling companionship and building alternative projects for themselves and for society as a whole. Their connectivity depends on*

*interactive communication networks. In our society, the fundamental form of large scale horizontal communications is based on the internet and wireless networks."* [5]

### 3.Final considerations

Even though there is resistance from the elite in accepting that the less economically fortunate classes share the same virtual space, such as *Facebook, Instagram* and *Snapchat*, and in fact sometimes migrate to other networks when they consider that their territory has been invaded, the low-income population continues to fight for the construction of a place where they can express themselves and interact freely, far from the prejudice and repression coming from several social actors.

Barros [4] references several examples of discriminatory and excluding comments in *Orkut,* on the part of the elite, that created definitions of standards of consumption and behavior that they began to associate with poverty. Thus, everything that was defined as "poor" should be banned from their space, making it exclusive to those who fit their parameters. We would like to call attention to the resistance of some members of the popular classes that refused to exit this social network and made an effort to maintain their space, through posts that reinforced their culture and nature. Information corroborated by Nemer [3] who highlights the comments from the middle and upper classes on the poor use of Portuguese, the photos considered to be bad taste and the lack of education of the "poor" who --in the opinion of this part of the population-- were deteriorating *Orkut*.

Feeling that they were being discriminated and excluded from some groups on *Orkut*, a large part of the individuals from the lower classes migrated to *Facebook,* a social network where they in fact began to feel at ease to post their opinions, even if there were signs that something similar to what happened in Orkut would happen in the new network, since the elite had also migrated to it.

Thus, feeling a part of the virtual community in a more egalitarian manner, even if they had a certain fear of being judged, they start to build particular means of using the resources on *Facebook,* to talk to distant family members, to express their individuality, to keep in touch with their parents - who often work several jobs – keeping updated on their location, and also to manifest their indignation with the situation in which they live and emit opinions on issues of their lives and communities [3].

As well as *Facebook*, *Youtube* has also been used quite frequently as a means of entertainment and leisure, as well as the perspective of finding new horizons, new hopes, such as learning some new activity that might generate revenue or discover new interests that up to then were restricted to a certain part of the population.

Beyond entertainment, Facebook has been a potent strategy in combatting against prejudice and a facilitating instrument for the expression of different aspirations. Two good examples of pages can be quoted: the "Nuvem Negra" collective, which emerged at PUC-Rio and the "Bastardos da PUC" (PUC Bastards). On the webpage of the first one reads: "*We are black students of PUC-Rio. We share the resistance, affection, the affirmation of black identity and, above all, the fight against racism*" [7]. The "Bastardos da PUC", whose page bears reports of discriminations, also uses its webpage to spread awareness and demand rights: "*We have awoken this morning with one right missing. Today, we scholarship/quota/low income students received the news that we will no longer have the right to a free university pass during recess (...) Today it is the loss of the free pass during the holidays, tomorrow it will be during weekends and holidays?*

*And then we will lose our rights for good? Faced with this, we summon all PUC-Rio students, especially those who receive the right to a university free pass, to gather at the Act against the blocking of our rights. #NotOneRightLess*" [8]

As Carvalho and Vasconcelos [9] point out well, based on a survey with followers, dwellers of the peripheries of several regions of Brazil, of the "Viva Favela" *website* (which was idealized based on a collaborative concept) and the *blog* "Mamíferas", *"from horizontal communications, members of the so-called minority groups have the opportunity to express their ideas, as well as finding their peers and sharing such ideas with them."* [9].

Posting a *selfie,* a video, lyrics, a word, is, therefore, an attempt to leave invisibility and have one's culture recognized. It is not rare that we see youngsters post their *rap* lyrics, their dances, music and poetry. More than a narcissistic appearance, the desire that their culture be recognized and valued, and that doors to new places be opened is noteworthy such as in the examples of the two pages created by the two collectives on *Facebook.*

In this sense, even if further investigation is necessary with respect to this theme, one can conclude that the internet opens new possibilities for the subjects of the lower classes to feel more qualified to change their own reality, that is, become empowered and feel capable of making more autonomous decisions, through which they can have their voices heard, be it through text, video, image or photograph.

## References

[1]    Centro regional de estudos para o desenvolvimento da sociedade da informação - CETIC. *Tecnologia de Informação e Comunicação Domicílios- TIC Domicílios Brasil* (2015).

[2]    D. Nemer, G. Freeman. Empowering the Marginalized: Rethinking Selfies in the Slums of Brazil. *International Journal of Communication,* **9** (2015), 1832-1847.

[3]    D.Nemer. Online favela: the use of social media by the marginalized in Brasil. Information Technology for Development (2015),1-26.

[4]    C. Barros. "Pobreza" e tecnologia no olhar do outro: representações sobre diferenças culturais. *Anais do XX Encontro da Compós* (2011), 1-17.

[5]    M. Casttells. *Redes de indignação e esperança,* Zahar, Rio de Janeiro, 2013.

[6]    Horochovski R, Meirelles G. Problematizando o conceito de empoderamento. *Anais do II Seminário Nacional: Movimentos sociais, participação e democracia* (2007), 485- 506.

[7]    Coletivo    nuvem    negra.    Facebook.    10    de    janeiro    de    2017.    Available    at: https://www.facebook.com/coletivonuvemnegra (accessed Jan 11, 2017).

[8]    Bastardos da PUC. Ato contra o bloqueio dos nossos direitos. Facebook. 19 de janeiro de 2017. Available at: https://www.facebook.com/events/184247859269041 (accessed Jan 18, 2017).

[9]    C. Carvalho, E. Vasconcelos. O Empoderamento das "minorias" por meio das mídias sociais: a conexão dos pares no site Viva Favela e no blog Mamíferas. *Anais do XXXV Congresso Brasileiro de Ciências da Comunicação* (2012), 1-15.

# SECTION III

## EVALUATION STUDIES

To date, some cybertherapy applications have improved the quality of health care, and later they will probably lead to substantial cost savings.

However, cybertherapy is not simply a technology but a complex technological and relational process.

In this sense, clinicians and health care providers that want to successfully exploit cybertherapy need a significant attention to clinical issues, technology, ergonomics, human factors and organizational changes in the structure of the relevant health service.

*Wiederhold & Riva, 2004*

# An e-health protocol to help elderly breast cancer patients to cope with chemotherapy: preliminary results

Daniela VILLANI[a,*], Chiara COGNETTA[a], Davide TONIOLO[b], Francesco SCANZI [c], and Giuseppe RIVA[a,d]

[a] *Department of Psychology,Università Cattolica del Sacro Cuore, Milan*
[b] *Department of Medical Oncology, "G.Salvini" ASST Rhodense, Milan, Italy,*
[c] *U.O. Oncologia Medica, Ospedale S.Giuseppe-Multimedica, Milan, Italy,*
[d] *Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan, Italy*

**Abstract.** Breast cancer is the most frequently diagnosed cancer in women. The aging population increases the number of new diagnoses and several studies showed that women of all ages experience psychological stress for possible side effects. To prepare women over 60 years diagnosed with breast cancer to face the imminent chemotherapy we developed an e-SIT (Stress Inoculation Training) protocol lasting two weeks. The online protocol includes 10 sessions to see once a day and each session integrates two parts: a live-video interview with women who have gone through breast cancer experience and a guided relaxation and meditation experience. The aim of this study is to test the efficacy of the training, in addition to traditional treatment provided by the hospital, through a controlled trial with a control group without treatment. The effectiveness is assessed through self-report validated questionnaires aimed to evaluate women's emotion regulation strategies and their adjustment to disease. Questionnaires are administered at the beginning and at the end of the training in two face-to-face meetings with the psychologist. At the moment 20 elderly women (M=64.5 years old) have been enrolled in the study. They are mostly married and not workers. Data show that both anxious preoccupation and fighting spirit increase more in women of the experimental group than in women of the control group. Thus, preliminary results suggest the activation of anticipatory

---

[*] Corresponding Author: daniela.villani@unicatt.it

coping and encourage to design and to develop future e-health interventions aimed to support elderly breast cancer patients in coping with chemotherapy and related side effects.

## 1. Introduction

Breast cancer is the most common cancer in women in the world and its incidence still increases even if at a slower rate in women aged over 50 years until age of 80 years [1]. Actually the incidence of breast cancer represents a critical health concern in the growing ageing population [2, 3] and some studies found that - due to several age-related factors - older breast cancer patients have more difficulty in adjusting to breast cancer and related treatments than younger women [4].

Among several treatment options, chemotherapy treatment is experienced as distressing and traumatizing for women of all ages [5]. Some studies suggest that side effects are experienced as less distressing as patients can anticipate them [6]. Thus, age-appropriate patient education interventions might need to be designed and implemented to prepare older women for the social, physical, function and treatment-related effects of breast cancer and thus reducing their anxiety and increasing their control over the situation [7].

As investigated by Fogel and colleagues [8], an increasing number of patients of any age are accessing health information on the Internet [9] and offering Web support as part of regular care can be a powerful tool to help breast cancer patients manage their illness [10,11]. However, Internet educational programs available for breast cancer patients are still rare and mostly focused on increasing patients' knowledge, focusing more on "basic details" related to the disease and information about procedures rather than on diagnosis, treatment, recovery and quality of life [12].

Thanks to the opportunity of e-health interventions to promote the enhancement of affective strategies [13,14], we developed a 2 weeks e-health protocol based on Meichenbaum's Stress Inoculation Training (SIT) [15] for helping elderly women undergoing chemotherapy to cope with treatment side effects [16]. The protocol includes three phases that are coherent with the general SIT objectives [17] 1) increasing knowledge about the stress process, 2) developing emotion-regulation skills and 3) helping individuals to use the acquired coping skills in real contexts. The aim of the study is to test the efficacy of the e-health intervention on emotion regulation and adjustment to cancer compared with a control group without intervention.

## 2. Methods

### 2.1. Participants

Two oncologists of two hospitals of Milan (ASST Rodhense and Hospital S. Giuseppe Multimedica) proposed the research to all breast cancer patients whom were offered chemotherapy. They fulfilled the following inclusion criteria: diagnosis of breast cancer radically operated; negative staging for distant metastases; and suitability for adjuvant chemotherapy with anthracyclines and taxanes. At the present (the research is ongoing) 20 elderly patients have been enrolled (M age=64.5 years old, SD=5.8). They are mostly married (16 women) and not workers (16 women are housewife or retired). The level of education is mostly low (8 women have primary school certificate and 8 women have high school diploma).

### 2.2. Procedure and Measure

During the first face-to-face consultation with the psychologist, patients filled in the informed consent and the questionnaires (baseline) and they experienced a live-video simulation of a chemotherapy session that they will have received within a few weeks (*conceptualization phase*).

Then participants followed the intervention remotely by accessing the e-Health protocol through a dedicated website (www.conilsenodipoi.it) for a period of 14 days (10 sessions). During that time the psychologist's personal contact was provided in order to support patients in case of technical and psychological difficulties. During the 2 weeks the two phases of the eSIT protocol were proposed. The aim of the *Skills acquisition and rehearsal phase* (sessions 1-7) was to provide the opportunity to learn psychophysical coping strategies. Each session lasted about 25 minutes and included two parts. First, patients watched live-video interviews with women who have gone through breast cancer experience, with particular attention to their expectations and emotions, chemotherapy side effects and strategies to cope with changes. Second, a relaxation and meditation experience - integrating natural relaxing video and narrative audio - was proposed. The aim of the *Application and follow - through phase* (sessions 8-10) was to expose women to the effects of the imminent chemotherapy and to verify their acquisition of coping skills to effectively manage the stressful upcoming event. Each of these sessions included two parts. First, live video of breast cancer patients' interviews currently undergoing chemotherapy - both with and without wigs - were presented. In addition, suggestions proposed by other patients offered the chance to anticipate possible adaptive behaviors to typical side effects. Second, supported by a natural relaxing video integrated with narrative audio, women were encouraged to apply relaxation and meditation strategies acquired in the previous sessions. In the last face-to-face consultation with the psychologist, patients gave their feedback about the protocol and filled in the questionnaires (post-treatment).

To test the effectiveness of the protocol, an experimental group following the e-Health intervention as an adjunct to treatment as usual has been compared with a control group that received the usual care for two weeks. Figure 1 shows the protocol flow.
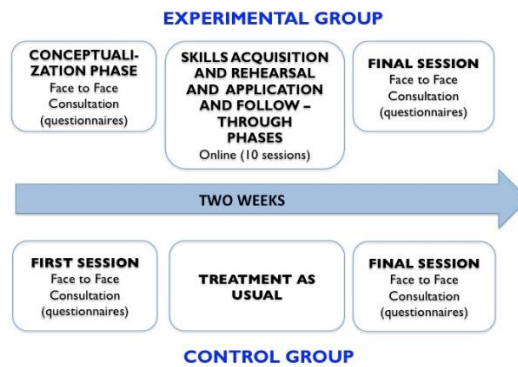
**Figure 1.** Protocol flow

Italian self-report validated questionnaires have been used to evaluate the women's emotion regulation strategies and their adjustment to disease.

The Emotion Regulation Questionnaire (ERQ [18], Italian version  [19]) is a 10-item questionnaire measuring 2 ER strategies. *Cognitive reappraisal* is a cognitive strategy that attempts to change the emotional impact of a situation by reinterpreting its meaning. By contrast, *emotional suppression* directly targets expressive behaviour, as it involves the attempt to inhibit the overt expression of emotions. The10 items are rated on a likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The Mini-Mental Adjustment to Cancer (Mini-MAC [20], Italian version [21]) is a 29-item self-report questionnaire evaluating patients' adjustment to cancer. Subscales describe five strategies: *fighting spirit* (the tendency to confront and actively face the illness), *anxious preoccupation* (the tendency to experience the illness as responsible for increased anxiety and tension), *fatalism* (the tendency to have a resigned and fatalistic attitude towards the illness), *helplessness/hopelessness* (the tendency to adopt a pessimistic attitude), *and avoidance* (the tendency to avoid direct confrontation with illness-related issues). Higher scores (ranging 0-4) indicate greater prominence of a specific style of adjustment.

## 3. Results

First, all variables were compared among the two groups at the baseline, and no significant differences were found, as measured by the ERQ (*cognitive reappraisal*: $F(1,18)= 2.237$, p=.152; *emotional suppression*: $F(1,18)=.501$, p=.488) and Mini-MAC (*fighting spirit*: $F(1, 18) =.162$, $p =.692$; *anxious preoccupation*: $F(1, 18) =.664$, $p =.426$; *fatalism*: $F(1, 18) = 2.396$, $p =.139$; *helplessness/hopelessness*: $F(1, 18) = 2.720$, $p =.116$; *avoidance*: $F(1, 18) = 3.528$, $p =.077$) questionnaires.

Due to the low number of patients included in each group and to overcome the low statistical observed power, gain score variables were created with the difference between values of the original variables (ER strategies and coping styles) at the two times (pre and post intervention). These variables were used to conduct the analyses.

Results show no differences between groups concerning both ER strategies: *cognitive reappraisal* ($F(1, 18) = .084$, $p =.776$) and *emotional suppression* ($F(1, 18)$

*D. Villani et al. / An e-health protocol to help elderly breast cancer patients to cope with  chemotherapy:preliminary results*

31

= .012, $p$ =.914). Concerning patients' adjustment to cancer, we found that both *fighting spirit* ($F(1, 18) = 3.380$, $p$ =.083) and *anxious preoccupation* approached significance ($F(1, 18) = 3.576$, $p$ =.075), while we did not find differences related to the other coping styles (*fatalism*: $F(1, 18) = 1.688$, $p$ =.210; *helplessness/hopelessness*: $F(1, 18) = 1.804$, $p$ =.196; *avoidance*: $F(1, 18) = .012$, $p$ =.912).

**Table 1.** Descriptive statistics: Means and Standard Deviations

|  | E-Health Protocol | | Control | |
| --- | --- | --- | --- | --- |
|  | Baseline | Post-intervention | Baseline | Post-intervention |
| Cognitive Reappraisal | 5.26 (1.19) | 5.35 (1.01) | 4.32 (1.58) | 4.27 (1.90) |
| Emotional Suppression | 2.94 (1.79) | 3.50 (1.71) | 3.43 (1.28) | 3.81 (1.44) |
| Fighting Spirit | 3.15 (.58) | 3.51 (.49) | 3.03 (.71) | 2.93 (.60) |
| Anxious Preoccupation | 2.75 (.87) | 2.89 (.71) | 3.03 (.66) | 2.64 (.84) |
| Fatalism | 2.72 (.75) | 3.05 (.54) | 3.23 (.70) | 3.04 (.71) |
| Helplessness/ hopelessness | 1.69 (.63) | 1.71 (.48) | 2.29 (.93) | 1.99 (.75) |
| Avoidance | 3.33 (.50) | 3.44 (.45) | 2.89 (.55) | 3.03 (.32) |

## 4. Discussion and Conclusion

Preliminary results show that the e-health protocol, offering the opportunity to breast cancer patients to anticipate the experience of chemotherapy, to compare their feelings with those of other patients and to develop affective control strategies, has an effect on patients' coping experience. On the one hand, anxious preoccupation is activated by the anticipated experience and starts to increase; on the other hand, the acquisition of affective management strategies leads to an increase of fighting spirit, which represents a functional proactive coping style. As highlighted by previous studies, adjustment responses such as fighting spirit, described as a highly optimistic attitude, accompanied by a search for greater information about cancer, have been reported to be beneficial [22, 23]. More, even if the connection between mental adjustment and survival is still a controversial field and several studies have failed to find any effect of coping or mental adjustment on survival, fighting spirit has shown to be associated with greater adherence to a chemotherapy treatment and thus beneficial for relapse-free survival [24].

Results did not show a significant change on patients' emotion regulation strategies. According to Gross and John [18] emotion regulation strategies are thought to reflect stable patterns of self-regulation, and even if individuals may increase or reduce their use of these strategies depending on the pressures of the context they are facing, probably patients need more time to acquire these skills. The research is ongoing and follow up assessment represents a critical aspect to understand the role of the e-health protocol on the acquisition of emotion regulation strategies and patients' adjustment to chemotherapy treatment.

The activation of anticipatory coping encourages design and development of future e-health interventions aimed to support elderly breast cancer patients in coping with chemotherapy and related side effects.

## Acknowledgments

## References

[1]    C. DeSantis, R.  Siegel, P. Bandi, A. Jemal. Breast cancer statistics, 2011, CA. *A Cancer Journal for Clinicians*, **61** (2011) 408–418.

[2]    H. Frith, D. Harcourt, A. Fussell. Anticipating an altered appearance: Women undergoing chemotherapy treatment for breast cancer. *European Journal of Oncology Nursing*, **11** (2007) 385–391.

[3]    L. Biganzoli, H. Wildiers, C. Oakman, L. Marotti, S. Loibl, I. Kunkler, M. Reed, S. Ciatto, A.C. Voog, E. Brain, B. Cutuli, C. Terret, M. Gosney, M. Aapro, R. Audisio. Management of elderly patients with breast cancer: Updated recommendations of the International Society of Geriatric Oncology (SIOG) and European Society of Breast Cancer Specialists (EUSOMA). *The Lancet Oncology*, **13** (2012).

[4]    B.W.L. S. Park, A.R. Lee, K.H. Lee, S. Y. Wang. Quality of life differences between younger and older breast cancer patients. *Journal of Breast Cancer*, **14** (2011) 112–118.

[5]    M. Browall, F. Gaston-Johansson, F. Danielson. Postmenopausal women with breast cancer: their experiences of the chemotherapy treatment period. *Cancer Nursing*, **29** (2006) 34–42 9p.

[6]    H. Frith, D. Harcourt, A.  Fussell. Anticipating an altered appearance: Women undergoing chemotherapy treatment for breast cancer. *European Journal of Oncology Nursing*, **11** (2007) 385–391.

[7]    J.T.Treacy, D. K. Mayer. *Perspectives on cancer patient education*.  Seminars in Oncology Nursing, **16** (2000) 47–56.

[8]    J. Fogel, S. Albert, F. Schnabel, B. A. Ditkoff, A. I. Neugut. Use of the Internet by women with breast cancer. *Journal of Medical Internet Research*, **4** (2002).

[9]    G. Seçkin. I am proud and hopeful: age-based comparisons in positive coping affect among women who use online peer-support. *J Psychosoc Oncol*, **29** (2011) 573–591.

[10]   E. Børøsund, M. Cvancarova, S.M. Moore, M. Ekstedt, C.M.  Ruland. Comparing effects in regular practice of e-communication and web-based self-management support among breast cancer patients: Preliminary results from a randomized controlled trial. *Journal of Medical Internet Research*, **16** (2014).

[11]   F. Ventura, J. Ohlen, I. and Koinberg, An integrative review of supportive e- health programs. *European Journal of Oncology Nursing*, **17** (2013) 498–507.

[12]   E. Warren, K. Footman, M. Tinelli, M. McKee, C.Knai. Do cancer-specific websites meet patient's information needs?. *Patient Education and Counseling*, **95** (2014) 126–136.

[13]   D. Villani, G. Riva. Does interactive media enhance the management of stress? Suggestions from a controlled study. *Cyberpsychology, Behavior, and Social Networking*, **15** (2012) 24–30.

[14]   C. Carissoli, D. Villani, G. Riva. Does a meditation protocol supported by a mobile application help people reduce stress? Suggestions from a controlled pragmatic trial. *Cyberpsychology, Behavior, and Social Networking*, **18** (2015) 46–53.

[15]   D. H. Meichenbaum, J.L.  Deffenbacher. Stress Inoculation Training. *The Counseling Psychologist*, **16** (1988) 69–90.

[16]   V. Villani, C. Cognetta, D. Toniolo, F. Scanzi, G. Riva. Engaging Elderly Breast Cancer Patients: The Potential of eHealth Interventions. *Frontiers in Psychology*, **7** (2016) 1825.

[17]   S. Serino, S. Triberti, D. Villani, P. Cipresso, A. Gaggioli, G. Riva. Toward a validation of cyber-interventions for stress disorders based on stress inoculation training: A systematic review. *Virtual Reality,* **18** (2014) 73–87.

[18]   J. J. Gross, O. P. John. Individual differences in two emotion regulation processes: implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, **85** (2003) 348–362.

[19]   S. Balzarotti, O. P. John, J. J. Gross. An Italian adaptation of the emotion regulation questionnaire. *European Journal of Psychological Assessment*, **26** (2010) 61–67.

[20]   M. Watson, M. Law, M. dos Santos, S. Greer, J. Baruch, J.  Bliss. The Mini-MAC: Further development of the Mental Adjustment to Cancer Scale. *Journal of Psychosocial Oncology*, **12** (1994) 33–46.

[21]   L.Grassi, P. Buda, L. Cavana, M. A. Annunziata, R. Torta, A. Varetto. Styles of coping with cancer: The Italian version of the mini-mental adjustment to cancer (Mini-MAC) scale. *Psycho-Oncology*, **14** (2005) 115–124.

[22]   A. Ayres, P.W. Hoon, J.W. Franzoni, K.B. Matheny, Cotanch, S. Takayanagi. Influence of mood and adjustment to cancer on compliance with chemotherapy among breast cancer patients. *Journal of Psychosomatic Research*, **38** (1994) 393–402.

[23]   M. Watson, J. Homewood, J. Haviland, M. Bliss, Influence of psychological response on breast cancer survival: 10-Year follow-up of a population-based cohort, *European Journal of Cancer*. **41** (2005) 1710–1714.

[24]   M. Johansson, A. Rydén, and C. Finizia, Mental adjustment to cancer and its relation to anxiety, depression, HRQL and survival in patients with laryngeal cancer - a longitudinal study., *BMC Cancer*. **11** (2011) 283.

# Robots and Socio-cognitive Conflict Enhance Wayfinding in Children

Martina BENVENUTI[a,*], Gioele PIOBBICO[a] , Elvis MAZZONI[a]

[a]*ALMA MATER STUDIORUM-University of Bologna Department of Psychology*

**Abstract.** This research aims to verify the effectiveness of robots (MecWilly, a humanoid robot and Blue-Bot, a non-humanoid robot) as learning-partners in children that act within their Zone of Proximal Development through the Socio-cognitive Conflict, compared to children acting with human learning-partners. The study aims to evaluate how a specific activity (define a route from beginning to the end) enhances the wayfinding skill in a group of 156 five years old children.

**Keywords.** Socio-cognitive Conflict, Robot, Children, Wayfinding.

## 1. Introduction

Studies about robotics use have significantly increased. The main theories regarding learning through the use of robotic artifacts are related to constructivism [13] and social constructivism [11], including assumptions from the theory of the zone of proximal development [19] and assumptions from the social learning theory [1].

Constructivism states that the human being is not a passive learner but builds his own knowledge through active experience with reality [13]. Particularly relevant is the theory of social constructivism, which states that individuals create meanings through interactions with other people and with the environment, which is why learning is considered a social process [11]. In situations in which robots assume the role of learning partners (or tutors), the concept of zone of proximal development is particularly relevant [19]. The theory states that the child can reach his or her full potential interacting with a more experienced partner. Although, the social learning theory [1] emphasizes the relevance of social relations in the learning process, highlighting the children's capability of acquiring new knowledge and assimilating new behaviours by observing the actions of others. Finally, as claimed by Piaget [14, 20], learning may be initiated by cognitive conflict. According to the theories of social constructivism, this conflict originates in social interaction. Doise and Mugny [4] showed that inexperienced children benefit from the partner's point of view (such as in the theories of Vigotsky) but they also claim that expert children get benefits from pairs, allowing them to increase their performance capabilities.

---

* Corresponding Author: martina.benvenuti2@unibo.it

For these reasons, in the present study it is assumed that a robot-partner may engage the child in a real situation of socio-cognitive conflict, in order to enhance the child's ability.

## 2. The Use of Robots in Child Education

The employment of robots involves many human domains. It was found that robots are not only used in disability support, in ability development or to learn about robotics itself, but also in other fields such as the learning of a second language [12] or enhancing spatial skills [10;16].

Mubin and colleagues [13] refer to the specific use of robotics in education and identify two main categories concerning learning contents: robotics and computer education and non-technical education. The first domain category deals with learning about robotics itself or the functioning of technology (i.e. how to assemble or to program a specific robot). Meanwhile, in the second category learning regards non-technical information, because the robot acts as an intermediate tool to enhance specific abilities [9].

Some aspects, such as the type of robot used, or its purpose, depend on the setting and on the person who will interact with it. If the goal is merely a request to show a behavior or a sequence of movements, it is recommended to use basic and low-cost robots. Robots like Asimo [15] and MecWilly [12] result very useful to enhance abilities or acquiring non-technical knowledge such as music, spatial orientation and language [13]. The educational context also defines the robot role, since it can be a passive tool to be manipulated and programmed, a co-learner or a partner.

## 3. The Role of Wayfinding and Spatial Orientation in Children

In the present study it will be analyzed the enhancement of a specific spatial orientation ability: the wayfinding competence, that is defined as the process of defining and following the path or route between an origin and a destination [6].

Some researchers [7; 18] questioned the idea that these knowledge systems are created from scratch. According to these authors such schemas do not appear in specific stages of development but they would always be available in the child. Indeed, investigation showed that in verbal interference task the advantage of adults compared to kids disappears in simple tasks of wayfinding [8]. This claims that children have no advantages because of their new mental schemas, but thanks to the use of language they can benefit from a different processing system and spatial information [22].

Other studies show that 2 year old children are able to use landmark and geometric information in order to locate objects previously seen and then hidden [22]. The same authors also claim that children under 3 years can link the spatial information to the left-right concept, clearly in a non-verbal manner, underling in this way the precociousness of an early spatial behaviour. Moreover, Cheng and Newcombe [2] verify that 2 to 3 years old children that are spatially disorientated by researcher can orientate themselves using exclusively the structure of the environment. On the other side, 3-4 year old children use other types of information to get orientation, such as colors of objects [3]. Furthermore, 5 to 6 year old children use physical maps to move in experimental locations [17].

## 3.1. Research Hypothesis

This research aims to verify the effectiveness of robots as learning-partners in pre-school children that act within their Zone of Proximal Development, compared to children acting with human learning-partners. The robots used are two: the humanoid robot MecWilly (fig.1) and the non-humanoid robot Blue-Bot (fig. 2).



**Figure 1:** MecWilly the Humanoid Robot



**Figure 2:** Blue-Bot the non-Humanoid Robot

Moreover, the study aims to analyze whether two different experimental conditions enhance the wayfinding skills in a group of 156 five years old children. The first condition is called Child Socio-Cognitive Conflict (Child SCC), in which two children interact to reach a joint solution to give the correct instruction to the robot to perform the task. The second condition is called Robot Socio-Cognitive Conflict (Robot SCC), in which a child alone interacts with the robot to perform the same task. Children of all groups were individually evaluated in a pre-test detection and in a post-test detection. Further, a control group performed the same task of the previous conditions only after the post-test.Considering the presence of two robots (Mecwilly and Blue-Bot) it was hypothesized that there would be significant improvement from the pre-test to the post-test phase in the time and in the number of moves it took to perform the task in both experimental conditions (MecWilly Child SCC, MecWilly Robot SCC, Blue-Bot Child SCC, Blue-Bot Robot SCC), except the control group.According to Doise and colleagues [5], socio-cognitive conflict supports learning when children are actually comparing the resolution of the task. If a child performs the task without taking into account the information and the opinion of his partner, there will be no negotiations and result in real socio-cognitive conflict, thus the enhancement will be less effective.Starting from this premise, the differences in improvements in children will be compared in two different groups (considering also the control group): a Negotiation group (MecWilly Child SCC, SCC MecWilly Robot, Blue-Bot Child SCC) where there is an actual negotiation and a Non-Negotiation group (Blue-Bot Robot SCC), where interaction and negotiation are not present.

## 3.2. Method

The study involves 156 five year old children (80 females and 76 males) attending preschool. All activities were held in the preschool attended by the children. The conditions with the humanoid robot MecWilly used a 6X6 chessboard drawn on the floor (3x3 meters), while the condition using the Blue-Bot robot called for a smaller version of the same chessboard (90x90 centimeters) placed on the table. Some squares of the chessboard contained recycling bins. The children (either alone or in pairs) guide MecWilly and Blue-Bot via voice commands (forward, backward, right, left). The goal is to throw the plastic into the specific recycling bin.

## 3.3. Results

Following the first purpose of the research a repeated measures T-test was run. The results revealed that the groups MecWilly Child SCC (T=3.73), MecWilly Robot SCC (T=2.99) and Blue-Bot Child SCC (T=3.27) are characterized by similar and highly significant improvements in moves. Also, MecWilly Child SCC (T=10.95), MecWilly Robot SCC (T=8.14) and Blue-Bot Child SCC (T=6.09) improve in the time it took to perform the task. Opposingly, the Blue-Bot Robot SCC group exhibited a non-significant improvement in moves (0.07 moves less compared to the post-test), as well as the control group (0.54) moves less compared to the post-test). However, both groups showed a similar and highly significant improvement in the time to perform the task. Finally, to test the differences in improvements in the Negotiation group (MecWilly Child SCC, SCC MecWilly Robot, Blue-Bot Child SCC) and in the Non-Negotiation group (Blue-Bot Robot SCC) pre-test and the post-tests performances were compared. The ANOVA test showed non-significant differences between the Negotiation group and the Non-Negotiation groups in the pre-test, both in terms of moves (F = 0.00) and in the time to perform the task (F = 2.33). Conversely, the post-test shows significant differences. Indeed, the participants of the Negotiation group have used an average of 2.21 moves less to complete the task (F = 14.71) in the post-test. Similar results were found in the time to perform the task, at post-test, the Negotiation group takes less than 24.8 seconds compared to the Non-Negotiation group to complete the task (F= 6.97). The Negotiation group improved 40.14 seconds more than the Non-Negotiation Group (F = 23.10).

## 4. Discussion

In the present research it was verified that all experimental groups achieved significant improvements in the amount of time and the number of moves it took to perform the task, with the exception of Blue-Bot Robot SCC group and the Control Group. The results of the Blue-Bot robot SCC group and the control group lead to two important implications. First, taking the measurement test twice after a specific period of time (the control group situation) leads to solve the task in less time but do not solve it with less moves. In addition, the child activities alone with Blue-Bot (Blue-Bot robots SCC) showed no improvement since the activity. The improvement of the task execution time is a result of the repetition of the measurement test. Blue-Bot by itself is not a good partner for learning. Also, the experimental task done by two children together (Child SCC group), with MecWilly or Blue-Bot, brings benefits in terms of learning. The benefits are due to the socio-cognitive conflict condition that is generated between the two children. Children who do the experimental task with MecWilly (MecWilly Robot SCC group) achieved comparable improvements to children pursuing the task in pairs. Considering these results, it is possible to infer that MecWilly is an effective learning partner as a human partner [12]. Contrarily, considering the non-humanoid robot Blue-Bot, the results reveal that the experimental condition of the robot with the Non-Negotiation group (Blue-Bot Robot SCC) does not provide a real socio-cognitive conflict. Indeed, the activity of the individual child does not make improvements over the simple repetition of the task. In this regard it is important to point out that Doise and colleagues [5] showed that the socio-cognitive conflict should benefit learning when there is a negotiation of points of view. For these reason, MecWilly, while dispensing only dubitative questions (not having therefore a real point of view), succeeds in recreating the child's own cognitive stimulation given by negotiation between children. This conclusion is supported by the same results obtained by the MecWilly Robot SCC group (which is part of the Negotiation group) and Child SCC group.

## 5. Conclusions

This study has verified how a humanoid robot can be an effective learning partner enhancing wayfinding abilities in pre-school children, generating a socio-cognitive conflict situation as if there were two human partners. In particular, it has been found that the socio-cognitive conflict plays a key role in learning, making MecWilly a better learning partner than Blue-Bot.

Future research should investigate the bases launched by this study using other types of interactive robots and proposing the task to children of different ages, as well as investigating what other skills (e.g. solve logical and mathematical tasks) could be enhanced by using a robot as a learning partner.

## References

[1] A. Bandura, *Social learning theory*. Morristown, 1971.
[2] K. Cheng, N. S. Newcombe, Is there a geometric module for spatial orientation? Squaring theory and evidence, *Psychonomic bulletin & review* **12** (2005),1-23.
[3] J. S. DeLoache, Rapid change in the symbolic functioning of very young children, *Science*, **238** (1987), 1556-1557.

[4]  W. Doise, G. Mugny, *The social development of the intellect*, Oxford, Pergamon Press, 1984.

[5]  W. Doise, G. Mugny, A. S. James, N. Emler, D. Mackie, *The social development of the intellect (Vol. 10)*, Elsevier, 2013.

[6]  R. G. Golledge, Human wayfinding and cognitive maps. *Wayfinding behaviour: Cognitive mapping and other spatial processes*, (1999) 5-45.

[7]  H. Heft, J. F. Wohlwill, Environmental cognition in children, *Handbook of environmental psychology* **1** (1987), 175-203.

[8]  L. Hermer-Vazquez, E. S. Spelke, A. S. Katsnelson, Sources of flexibility in human cognition: Dual-task studies of space and language, *Cognitive psychology* **39** (1999), 3-36.

[9]  K. Highfield, J. Mulligan, J. Hedberg, Early mathematics learning through exploration with programmable toys. *In Proceedings of the Joint Meeting of PME 32 and PME-NA*, 2008, 169-176.

[10] P. Jansen-Osmann, Use of virtual environments to investigate development of spatial behavior and spatial knowledge of school-age children. *Psychological reports* **100** (2007), 675-690.

[11] B. Kim, Social constructivism, *Emerging perspectives on learning, teaching, and technology* **1** (2001), 16.

[12] E. Mazzoni, M. Benvenuti, A Robot-Partner for Preschool Children Learning English Using Socio-Cognitive Conflict, *Educational Technology & Society* **18** (2015), 474-485.

[13] O. Mubin, C. J. Stevens, S. Shahid, A. Al Mahmud, J. J. Dong, A review of the applicability of robots in education, *Journal of Technology in Education and Learning* **1** (2013), 209-0015.

[14] J. Piaget, B. Inhelder, *The Psychology of the Child (Vol. 5001)*, Basic Books, New York, 1969.

[15] S.Y. Okita, V. Ng-Thow-Hing, R. Sarvadevabhatla, Learning together: ASIMO developing an interactive learning partnership with children, *In RO-MAN 2009-The 18th IEEE International Symposium on Robot and Human Interactive Communication* 2009, 1125-1130.

[16] A. Schelter, P. Jensen, M. Heil, Empirical evaluation of virtual enviroment technology as an experimental tool in developmental spatial cognition research, *European Journal of Cognitive Psuchology* **21** (2009), 724-739.

[17] E. H. Sandberg, J. Huttenlocher, Advanced spatial skills and advance planning: Components of 6-year-olds' navigational map use, *Journal of cognition and development* **2** (2001), 51-70.

[18] C. Spencer, Z. Darvizeh, The case for developing a cognitive environmental psychology that does not underestimate the abilities of young children, *Journal of Environmental Psychology* **1** (1981), 21-31.

[19] L.S. Vygotskij, Interaction between learning and development, *Readings on the development of children* **23** (1978), 34-41.

[20] L. S. Vygotskij, *Mind in society: The development of higher psychological processes*, Harvard university press, 1980.

[21] R. F. Wang, L. Hermer, E. S. Spelke, Mechanisms of reorientation and object localization by children: a comparison with rats, *Behavioural neuroscience* **113** (1999), 475.

[22] R. F. Wang, E. S. Spelke, Human spatial representation: Insights from animals, *Trends in cognitive sciences*, **6** (2002), 376-382.

# To what extent does Internet use affect academic performance? Using Evidence from the large-scale PISA study

Dmitri ROZGONJUK[a,*] and Karin TÄHT[a]

[a] *Department of Psychology, University of Tartu, Estonia*

**Abstract.** Education is an area where various information and communication technologies (ICT), including the Internet, can be applied. Students and teachers often make use of ICTs in order to seek out information online. Students make use of online platforms to complete their homework, and to communicate with one another. ICTs are also used by students and teachers to monitor and share school-related notifications; however, it is unclear how much ICT use is beneficial for academic performance. The aim of this paper is to determine how much Internet use both within and outside of school correlates with higher academic performance. We used the Estonian sample from the Programme for International Student Assessment (PISA). The sample was comprised of 5586 15-year-old students, 49.3% of whom were boys. Participating students were administered several tests to assess their cognitive abilities in math, functional reading, and natural sciences. Several other constructs, such as duration of ICT use within and outside of the school settings, were also surveyed. The results of the analyses showed that the optimal time for Internet use at school was up to 60 minutes per day. Using the Internet at school for a longer period showed a linear decreasing pattern for all of the cognitive ability tests. The use of the Internet for more than six hours per day started to show a negative impact on academic performance. Our results also suggest that the negative effects of excessive Internet use (at school for more than 60 minutes per day) on academic outcomes is apparent even when controlling for students' socioeconomic status and gender. Possible explanations for these results are discussed below..

**Keywords.** Excesive Internet use, academic achievement, PISA, technology and education

## 1. Introduction

The use of the Internet has become widespread throughout the world, and Estonia is no exception. Several current technological devices (such as smartphones) allow people to have a constant connection to the Internet. At the same time the Internet has also become an essential learning environment and information resource for students' both during and outside of school. Adults, or those who were not born into the digital world ("digital immigrants") sometimes have concerns regarding young people's massive use of the Internet. As the internet has been in existence throughout their entire lives 15-year old adolescents are accustomed to the possibilities of the Internet, and are therefore digital natives, or "native speakers", of the digital language of computers and the Internet. The concepts of "digital immigrants" and "digital natives" were introduced by Prensky in

---

* Corresponding Author: dmroz@ut.ee

2001 [1]. He also introduced the idea that the learning process must change as the learners change.

The question then arises: what is the relationship between frequent use of the Internet and a students' academic performance? A study of home internet use and academic achievement showed that children from low-income families who used the Internet more at home achieved higher scores on standardized tests for reading comprehension and also had higher grade point averages [2]. In another longitudinal study [3] researchers concluded that the relationship between ICT use and GPA is complicated and various socio-demographic characteristics such as age, gender, race and household income can influence the relationship between ICT use and academic performance.

In another study of college students and internet use, it was shown that moderate Internet users had better grades and greater learning satisfaction than heavy (excessive) users [4]. Excessive use of the Internet, the habit of switching tasks and the reading of multiple texts simultaneously may all be connected with lower academic achievement. It has been shown that multitasking is not a good learning practice. High frequency ICT users are more likely to use multitasking and the switching of tasks as learning strategies when they are in class or studying. These behaviors are, however, known to lower academic performance [5].

The aim of this paper to clarify how much Internet use (both at and outside the school) is related to good academic achievement. We used regression analysis models in order to predict the students' academic performance via time spent on the Internet, gender and socioeconomic status.

## 2. Methods

### 2.1. Participants, Procedure, and Measures

The data from the large-scale *Programme for International Student Assessment* (PISA) survey conducted by *the Organisation for Economic Co-operation and Development* (OECD) was used. The PISA is a triennial international survey which attempts to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students [6,7]. In the current study, we focused on the PISA 2015 Estonian sample. Data for all of the participating countries' is available on the OECD website [8]. In the Estonian sample there were 5586 15-year-old students participating, 49.3% of whom were boys. Students were assessed in science, mathematics, and reading comprehension. Among the various measured constructs, there were many items regarding ICT use within and outside of school.

In this paper, we focused on the PISA science, mathematics and reading test results in relation to Internet use at school (item ID: IC005Q01TA; *During a typical weekday, for how long do you use the Internet at school?*; 1 = No time, 2 = 1-30 minutes per day, 3 = 31-60 minutes per day, 4 = Between 1 hour and 2 hours per day, 5 = Between 2 hours and 4 hours per day, 6 = Between 4 hours and 6 hours per day, 7 = More than 6 hours per day) and outside of school (item ID: IC006Q01TA; *During a typical weekday, for how long do you use the Internet outside of school?*; 1 = No time, 2 = 1-30 minutes per day, 3 = 31-60 minutes per day, 4 = Between 1 hour and 2 hours per day, 5 = Between 2 hours and 4 hours per day, 6 = Between 4 hours and 6 hours per day, 7 = More than 6 hours per day). Additionally, in order to predict the test scores we incorporated

regression analyses, gender (item ID: ST004D01T; 1 = *female*, 2 = *male*), and an index of economic, social and cultural status (item: ESCS) into our study.

## 3. Results and Conclusions

The relationship between science, reading and mathematics test scores and Internet use at school and outside school are shown in Figure 1 and Figure 2, respectively.
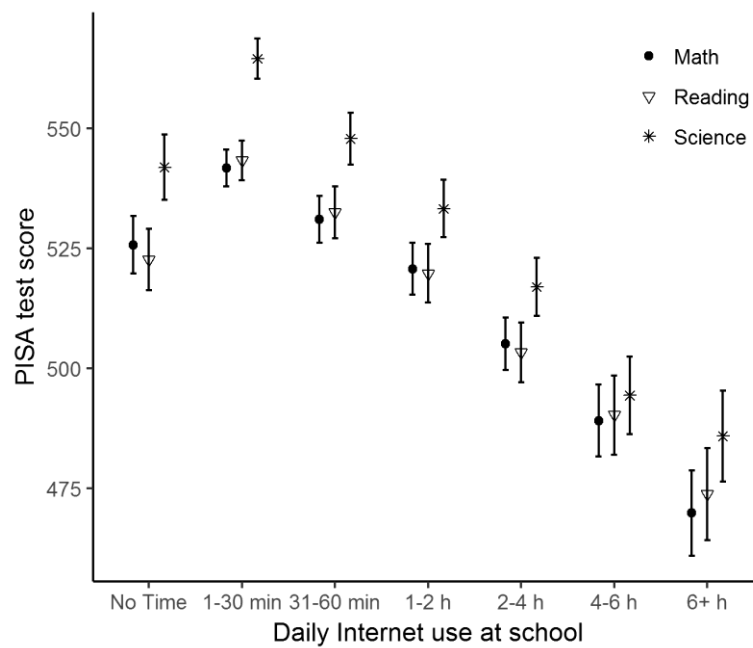


**Figure 1.** The relationship between daily Internet use at school and PISA test scores.
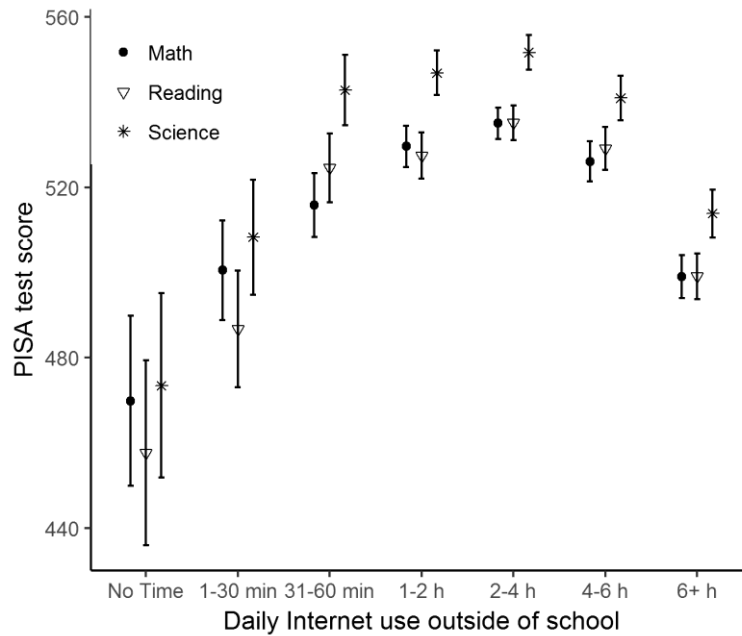
**Figure 2.** The relationship between daily Internet use outside of school and PISA test scores.

Furthermore, we conducted multiple regression analyses to predict reading, mathematics and science test scores in relation to Internet use within and outside of school (Model 1). Two more variables were also added to the models (gender and socio-economic status) in order to gain a better overview of the effect of Internet use (Model 2). The results are shown in Table 1.

**Table 1.** Regression analyses predicting PISA test scores in relation to Internet use at and out of school, combined with gender, and socio-economic status

|  | Reading | | Mathematics | | Science | |
|---|---|---|---|---|---|---|
|  | Model1 | Model2 | Model1 | Model2 | Model1 | Model2 |
| *Intercept* | 461.38*** | 478.96*** | 474.86*** | 471.57*** | 479.25*** | 477.81*** |
|  | (10.50) | (10.11) | (9.58) | (9.23) | (10.52) | (10.25) |
| Internet use at school Base: *None* |  |  |  |  |  |  |
| *1-30 min* | 17.56*** | 12.23*** | 14.25*** | 10.22*** | 19.81*** | 15.77*** |
|  | (3.83) | (3.66) | (3.49) | (3.34) | (3.84) | (3.71) |
| *31-60 min* | 4.15 | 3.53 | .95 | 1.30 | .82 | 1.08 |
|  | (4.17) | (3.98) | (3.81) | (3.63) | (4.18) | (4.04) |
| *1-2h* | -9.04** | -14.12*** | -9.88** | -11.97*** | -14.14*** | -16.43*** |
|  | (4.39) | (4.20) | (4.00) | (3.83) | (4.40) | (4.25) |
| *2-4h* | -27.21*** | -32.03*** | -26.76*** | -28.17*** | 31.78*** | -33.44*** |
|  | (4.58) | (4.38) | (4.18) | (3.99) | (4.59) | (4.44) |
| *4-6h* | -37.51*** | -42.13*** | -39.90*** | -38.29*** | -51.51*** | -50.47*** |
|  | (5.59) | (5.34) | (5.09) | (4.88) | (5.60) | (5.42) |

| | | | | | | |
|---|---|---|---|---|---|---|
| *6+h* | -48.51*** | -1.79*** | -54.95*** | -54.38*** | -56.45*** | -56.22*** |
| | (6.16) | (5.88) | (5.62) | (5.37) | (6.17) | (5.96) |
| Internet use outside of school Base: *None* | | | | | | |
| *1-30 min* | 20.10 | 21.25 | 22.46** | 25.55** | 24.21** | 27.06** |
| | (12.09) | (11.54) | (11.03) | (10.53) | (12.11) | (11.70) |
| *31-60 min* | 56.64*** | 51.77*** | 36.68*** | 35.23*** | 57.31*** | 55.61*** |
| | (11.13) | (10.62) | (10.15) | (9.70) | (11.15) | (10.77) |
| *1-2h* | 62.76*** | 57.52*** | 53.74*** | 51.57*** | 65.69*** | 63.31*** |
| | (10.72) | (10.23) | (9.78) | (9.34) | (10.74) | (10.37) |
| *2-4h* | 74.36*** | 69.63*** | 62.69*** | 60.69*** | 75.01*** | 72.83*** |
| | (10.59) | (10.11) | (9.66) | (9.23) | (10.61) | (10.25) |
| *4-6h* | 76.28*** | 75.16*** | 61.46*** | 61.21*** | 74.10*** | 73.78*** |
| | (10.71) | (10.22) | (9.77) | (9.33) | (10.73) | (10.36) |
| *6+h* | 59.14*** | 62.02*** | 48.29*** | 50.53*** | 61.57*** | 63.81*** |
| | (10.82) | (10.32) | (9.87) | (9.43) | (10.84) | (10.47) |
| Gender Base: *female* | | | | | | |
| *Male* | | -28.20*** | | 5.81*** | | 2.79 |
| | | (2.20) | | (2.01) | | (2.23) |
| ESCS | | 28.48*** | | 29.65*** | | 28.81*** |
| | | (1.46) | | (1.33) | | (1.48) |
| N | 5298 | 5298 | 5298 | 5298 | 5298 | 5298 |
| $R^2$ | .08 | .16 | .08 | .17 | .10 | .16 |
| Adj. $R^2$ | .08 | .16 | .08 | .16 | .09 | .15 |
| Res. SE | 83.22 | 79.41 | 75.91 | 72.49 | 83.36 | 80.49 |
| (df) | (5285) | (5283) | (5285) | (5283) | (5285) | (5283) |
| F(df) | 37.25*** | 72.37*** | 40.87*** | 75.07*** | 46.54*** | 70.33*** |
| | (12; 5285) | (14; 5283) | (12; 5285) | (14; 5283) | (12; 5285) | (14; 5283) |

*Notes.* ** $p < .05$ *** $p < .01$. *ESCS* = index of economic, social and cultural status.

The results clearly indicate that Internet use both at and out of school are quite notably related to PISA ability test results. Furthermore, the relationships remain even after controlling for gender and socio-economic status. In general, excessive use (more than six hours) of Internet both at and out of school are related to poorer ability test results. However, relationships of Internet use at and out of school and ability test results in non-excessive users are not clear-cut. Our analyses showed that excessive use of the Internet while at school had negative relationships with students' academic outcomes. Using the Internet while at school for less than 60 minutes is related to higher academic outcomes, but more frequent use of Internet while at school was related to lower academic achievement. The use of the Internet outside of school had no direct negative effect on students' academic outcomes, but usage times longer than 6 hours did correlate with lower academic outcomes.

## 4. References

[1] M. Prensky. Digital natives, digital immigrants part 1. *On the horizon*, **9**, (2001) 1-6.
[2] L. A. Jackson, A. Von Eye, F. A. Biocca, G. Barbatsis, Y. Zhao, H. E. Fitzgerald. Does

home internet use influence the academic performance of low-income children? *Developmental psychology*, **42**(2006) 429.

[3]L. A. Jackson,  A. Von Eye, E. A.Witt,  Y. Zhao, H. E. Fitzgerald, A longitudinal study of the effects of Internet use and videogame playing on academic performance and the roles of gender, race anD income in these relationships. *Computers in Human Behavior*, **27**(2011), 228-239.

[4] R. W. Kubey, M. J. Lavin, J. R. Barrows, J. R.  Internet use and collegiate academic performance decrements: Early findings. *Journal of communication*, **51**(2001), 366-382.

[5] W. C. Jacobsen,  R. Forste. The wired generation: Academic and social outcomes of electronic media use among university students. Cy*berpsychology, Behavior, and Social Networki*ng, **14**(2011), 275-280.

[6] OECD. PISA 2015 Results (Volume I): Excellence and Equity in Education. OECD Publishing, Paris, 2016

[7] OECD. PISA data. Retrieved from: http://www.oecd.org/pisa/data/2015database 02.05.2017, 2017

# Enhancing psychological wellbeing of women approaching the childbirth: a controlled study with a mobile application

Claudia Carissoli [a*], Daniela Villani[a], Deborah Gasparri[a] and Giuseppe Riva[a,b]

*[a] Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy,*
*[b] Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan,*
*Italy*

**Abstract.** Pregnancy is a critical period in a woman's life, a time of great physical and psychological changes. Maternal prenatal anxiety and stress are often present and associated with fear of labor and with possible negative outcomes for both mother and child. To help pregnant women to manage better their affective state and childbirth expectations the mobile app BenEssere Mamma was developed. The app consists of a self-help protocol containing mindfulness meditation and relaxation exercises. The purpose of this investigation is to test the efficacy of BenEssere Mamma as a complementary tool to existing childbirth class on delivery expectancy and psychological wellbeing. Currently, seventy-eight Italian primiparous women have been enrolled in the randomized controlled study including the app group and the control group without intervention. Pre-post comparison showed an improvement in delivery expectations for both groups (less Lack of Confidence, less Fear and Negative Feelings). Concerning psychological wellbeing, all scales remained stable in both groups except for the Autonomy scale which increased in the experimental group while decreased in control group (significant interaction effects). The study is ongoing and a future goal is to investigate post-partum changes. To stimulate a higher use of the app over time, further studies are encouraged to integrate the use of the app with childbirth classes.

**Keywords.** App, pregnancy wellbeing, Positive Technology, Mindfulness

## 1. Introduction

The perinatal period, which includes pregnancy and the first year post birth, represents a phase of potential vulnerability, a period of transition that can be extremely emotionally challenging [1, 2]. Pregnancy is not necessarily associated with feelings of joy, delight, anticipation and excitement, as traditionally considered, but it can be correlated with considerable distress [3,4]. Several studies showed that the incidence of depressive symptoms and anxiety symptoms in pregnancy are respectively about 10-20% [5] and 33-50% [6, 7]. The maternal psychological state influences directly the future physical, mental and cognitive development of the child and the course of the pregnancy. Negative

---

[*] Corresponding Author: Claudia.carissoli@unicatt.it

emotions, such as anxiety and stress, are often associated with a redoubt variability in the fetal cardiac frequency, greater motor activity, various pregnancy complications, pre-term birth and low birth weight and reduced child growth, intellectual, behavioural and socio-emotional problems [8–10]. For all these reasons, prenatal mental health is increasingly a public health issue and it is fundamental to develop and apply effective and cost-effective treatments for maternal mental health. A wide range of interventions have been tested to regulate maternal distress and provide expecting mothers with coping strategies to increase their quality of life (relaxation, mindfulness meditation, yoga therapy, breathing instructions, guided imagery, etc.), showing promising results [11-14].

In recent years, mobile applications (apps) demonstrated good potentialities to help people to manage stress and anxiety [15–17] and they appear particularly suitable to reach mothers-to-be because of their ubiquity and constant availability [18]. Typically these app include several relaxation training approaches, but recently mindfulness meditation has also been successfully included in self-help interventions [19–22] Mindfulness meditation can be described as a "process of bringing a certain quality of attention to moment by moment experience" [23]. This practice has been efficiently used to increase awareness of mental processes and the ability to regulate negative affect, to reduce emotional distress and maladaptive behaviour [24]. Many websites and pregnancy-related apps are already available in the market, but they are mostly informative: they provide a large range of general information about pregnancy, fetus development, maternal nutrition, advice and information about specific diseases such as gestational diabetes, but only few products are focused on increasing mental health and psychological wellbeing.

Starting from these premises, the app BenEssere Mamma was developed: it consists of a brief self-help protocol containing mindfulness meditation and guided imagery exercises delivered through a smartphone. The objective of this study is to investigate the effectiveness of the app BenEssere Mamma in positively affecting pregnant women's psychological wellbeing and their delivery expectancy through a pragmatic controlled trial.

## 2. Methods

### 2.1. Participants

Participants were recruited from antenatal childbirth classes organized in three hospitals of Northern Italy. To be included, pregnant women had to be healthy, being able to read and understand Italian and be over 18 years. The app was developed for Android devices: participants who did not own an Android terminal were provided, free of charge, with an Android tablet throughout the trial period. During the first meeting, women received all information about the study and gave their written informed consent to participate in the study.

## 2.2. Material, Procedures and Measure

### 2.2.1. App BenEssere Mamma

BenEssere Mamma is a mobile app that consists in a four-week self-help program for pregnancy wellbeing. The app includes an experiential area with a set of daily relaxation exercises and guided imagery exercises and an emotional awareness area, with a mood journal in which the user can record notes about their emotional state, thoughts and events happening during the day. For further information about the content of the app see Carissoli et al. [18].

### 2.2.2. Procedures

Currently, seventy-eight Italian primiparous women have been enrolled in the controlled study. The psychologist met the women during a childbirth class and gave them information about the study. After having filled in the informed consent, all participants filled in the baseline questionnaires and were randomly assigned to the intervention group (Childbirth class & App BenEssere Mamma - APP; n. 35) or the control group (Childbirth class only - CBC, n. 43). To investigate the app efficacy, a controlled pragmatic trial was used, to maximize applicability and generalizability of results [2], participants were not constricted by guidelines on how to apply the experimental intervention, but strongly suggested to practice daily (five practices a week for four weeks). They were free to choose the time to experience the sessions with the only rule of avoiding any other activity during the sessions. Moreover, no special strategy was used to motivate participants' adherence to the trial protocol. To monitor the adherence to the trial protocol, during the last meeting we asked participants to send us a log file (practice report) from the app to our mailbox containing participant's code and the meditations practiced day by day.

### 2.2.3. Measures

Women filled in the following questionnaires before and after using the app for four weeks. Sociodemographic questions aimed to ask their age, marital status, job title, education, trimester of pregnancy, previous meditation or relaxation experiences, etc.

The intensity of emotions linked to the expectations of childbirth (WDEQ-A) were measured with the Italian version of the Wijma Delivery Expectancy Questionnaire (W-DEQ) [25, 26]. It is a self-report instrument of 33 items and assessed on a 6-point Likert scale, designed to measure the fear of childbirth: the higher the score, the greater the fear of childbirth manifested. It includes three subscales: Fear, Negative Feelings and Lack of Confidence.

The Italian version of Psychological Wellbeing questionnaire (PWB) [27] consists of 84 items ranging from 1 'strongly disagree' to 6 'strongly agree'. The PWB scales measure six dimensions of psychological wellbeing: Autonomy (independence, self-determination), Environmental Mastery (sense of competence in managing the environment), Personal Growth (being open to new experiences, having a feeling of continued development), Positive Relations (positive relations with others), Purpose in

Life (having goals, intentions, a sense of directedness) and Self-acceptance (a positive attitude towards oneself and one's past life) [28].

## 3. Results

### 3.1. Demographic data

Participants were all Italian, primiparous and at the third trimester of pregnancy; their age ranged from 26 to 45 years (M age =33.22 years, SD=4.44). The majority of participants were married or common-law wife (96.1%), fairly well educated (44.8% high school; 44.8% graduate or post-graduate) and almost all worked out of the home (94.8%). Twenty-two percent of them declared some previous experiences in relaxing or meditation techniques, but only 15.4% of them had more than two years of experience. Concerning the use of the app, women made an average of 11.93 (SD=9.78) exercises during the trial instead of the suggested 20.

### 3.2. Fear of Childbirth (WDEQ-A) and Psychological Wellbeing (PWB)

To analyse the main effects (time and group) and interaction effect between time (pre/post) and group (APP and CBC) we performed several repeated measures ANOVA with all psychological variables (Table 1). Results showed that all WDEQ-A factors significantly decreased in both groups over time: women reported less Fear, less Negative Feelings and less Lack of Confidence. No interaction effects have been found concerning the WDEQ-A factors. Concerning the PWB scales, data showed a significant interaction effects in Autonomy: women of App group became more self-determined and independent, while CBC group showed a significant decrease.  Regarding the other PWB scales assessing environmental mastery, personal growth, positive relations with others, purpose in life and self-acceptance, there were no significant differences concerning both main effects and interaction effects.

**Table 1** Results of Repeated Measures ANOVA, Means, Standard Deviations (* significant result).

| | Pre | Post | Time | | Time X Group | | Group | |
|---|---|---|---|---|---|---|---|---|
| | | | F | p | F | p | F | p |
| Fear of childbirth | | | | | | | | |
| App Group | 27.97 (6.82) | 26.76 (5.95) | | | | | | |
| CBC Group | 28.76 (6.34) | 27.09 (6.74) | 4.123 | <.05* | .106 | .746 | .187 | .666 |
| Negative Feelings | | | | | | | | |
| App Group | 6.94 (3.61) | 6.12 (3.38) | | | | | | |
| CBC Group | 7.17 (4.07) | 5.95 (3.27) | 5.234 | <.05* | .197 | .659 | .002 | .965 |
| Lack of confidence | | | | | | | | |
| App Group | 8.26 (2.71) | 7.82 (2.73) | | | | | | |
| CBC Group | 8.64 (2.64) | 7.95 (2.68) | 3.893 | .052* | .189 | .665 | .212 | .646 |
| Autonomy | | | | | | | | |
| App Group | 4.26 (.60) | 4.33 (.58) | | | | | | |
| CBC Group | 4.56 (.62) | 4.42 (.63) | .674 | .414 | 5.727 | <.05* | 2.235 | .139 |
| Env. Mastery | | | | | | | | |
| App Group | 4.54 (.52) | 4.54 (.42) | | | | | | |
| CBC Group | 4.51 (.69) | 4.51 (.64) | .001 | .971 | .001 | .978 | .74 | .787 |
| Personal Growth | | | | | | | | |
| App Group | 4.68 (.50) | 4.70 (.50) | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CBC Group | 4.71 (.38) | 4.64 (.54) | .113 | .738 | .920 | .341 | .020 | .889 |
| Posit. Relations | | | | | | | | |
| App Group | 4.64 (.84) | 4.62 (.85) | | | | | | |
| CBC Group | 4.75 (.85) | 4.70 (.70) | .694 | .408 | .120 | .730 | .274 | .602 |
| Purpose in Life | | | | | | | | |
| App Group | 4.80 (.54) | 4.90 (.69) | | | | | | |
| CBC Group | 4.85 (.62) | 4.72 (.54) | .035 | .851 | 2.347 | .130 | .289 | .592 |
| Self Acceptance | | | | | | | | |
| App Group | 4.56 (.61) | 4.65 (.59) | | | | | | |
| CBC Group | 4.61 (.73) | 4.58 (.62) | .506 | .479 | 1.746 | .190 | .0.06 | .937 |

## 4. Discussions & Conclusion

The goal of the study was to test the effectiveness of the app BenEssere mamma in enhancing positive expectation about childbirth and psychological wellbeing. Women's childbirth expectations improved over the time (less fear, less negative emotion and more confidence) in both groups. This change could be attributed to the childbirth classes' effect, which all participants were following: these courses likely reassured them providing health and specific childbirth information [29]. The level of psychological wellbeing appears stable in both groups for almost all dimensions. The only significant interaction between groups and pre-post comparison is related to the Autonomy scale: the experimental group increased the sense of independence and self-determination while the control group showed a mild reduction. Maybe the attention stimulated by the app towards personal resources and emotion regulation strategies allowed women to feel more competent to regulate their behaviours and more able to resist social pressures.

Several limitations may have influenced these results. First, we have to consider sample characteristics: participants showed a baseline good level of psychological wellbeing and they were well-educated and active workers. Second, the short duration of the trial may have made difficult to obtain significant changes in personal representation of psychological well-being: a change in these consolidated beliefs could need more than 4 weeks of experience. Third, log files reported an irregular practice and lower use than suggested, but to increase self-awareness and mindfulness of one's behavior a regular practice and commitment is recommended. The research is ongoing and data related to post-partum experience will be collected and could clarify whether other changes can appear after the childbirth. More, further studies are needed to investigate whether a more integrated approach with the childbirth classes could achieve more effective results.

## Acknowledgements

## References

[1]   T. Cristescu, S. Behrman, S.V. Jones, L. Chouliaras, and K.P. Ebmeier, Be vigilant for perinatal mental health problems., *The Practitioner*. **259** (2015) 2-3-23.
[2]   S. Matthey, B. Barnett, P. Howie, and D.J. Kavanagh, Diagnosing postpartum depression in mothers and fathers:

whatever happened to anxiety?, *Journal of Affective Disorders*. **74** (2003) 139–147.

[3]   L.M. Howard, P. Piot, and A. Stein, No health without perinatal mental health, *The Lancet*. **384** (2014) 1723–1724.

[4]   L. Stadtlander, Anxiety and Pregnancy, *International Journal of Childbirth Education*. **32** (2017) 32–34.

[5]   J. Evans, J. Heron, H. Francomb, S. Oke, and J. Golding, Cohort study of depressed mood during pregnancy and after childbirth., *BMJ (Clinical Research Ed.)*. **323** (2001) 257–260.

[6]   A.M. Lee, S.K. Lam, S.M. Sze Mun Lau, C.S.Y. Chong, H.W. Chui, and D.Y.T. Fong, Prevalence, Course, and Risk Factors for Antenatal Anxiety and Depression, *Obstetrics & Gynecology*. **110** (2007) 1102–1112.

[7]   K.-A. Grant, C. McMahon, and M.-P. Austin, Maternal anxiety during the transition to parenthood: A prospective study, *Journal of Affective Disorders*. **108** (2008) 101–111.

[8]   P.J. Surkan, C.E. Kennedy, K.M. Hurley, and M.M. Black, Maternal depression and early childhood growth in developing countries: systematic review and meta-analysis., *Bulletin of the World Health Organization*. **89** (2011) 608–615.

[9]   S. Conroy, C.M. Pariante, M.N. Marks, H.A. Davies, S. Farrelly, R. Schacht, and P. Moran, Maternal psychopathology and infant development at 18 months: The impact of maternal personality disorder and depression, *Journal of the American Academy of Child and Adolescent Psychiatry*. **51** (2012) 51–61.

[10]  D. Kingston, and S. Tough, Prenatal and Postnatal Maternal Mental Health and School-Age Child Development: A Systematic Review, *Maternal and Child Health Journal*. **18** (2013) 1728–1741.

[11]  C. Vieten Astin, J., Effects of mindfulness-based intervention during pregnancy on perinatal stress and mood: results of a pilot study, *Archives of Women's Mental Health*. **11** (2008) 67–74.

[12]  C. Urech, N.S. Fink, I. Hoesli, F.H. Wilhelm, J. Bitzer, and J. Alder, Effects of relaxation on psychobiological wellbeing during pregnancy: A randomized controlled trial, *Psychoneuroendocrinology*. **35** (2010) 1348–1355.

[13]  J. Alder, C. Urech, N. Fink, J. Bitzer, and I. Hoesli, Response to induced relaxation during pregnancy: Comparison of women with high versus low levels of anxiety, *Journal of Clinical Psychology in Medical Settings*. **18** (2011) 13–21.

[14]  A.E. Beddoe, and K.A. Lee, Mind-Body interventions during pregnancy, *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. **37** (2008) 165–175.

[15]  D. Villani, and G. Riva, Does interactive media enhance the management of stress? Suggestions from a controlled study, *Cyberpsychology, Behavior, and Social Networking*. **15** (2012) 24–30.

[16]  L. Chittaro, and A. Vianello, Evaluation of a mobile mindfulness app distributed through on-line stores: A 4-week study, *International Journal of Human Computer Studies*. **86** (2016) 63–80.

[17]  F. Pallavicini, D. Algeri, C. Repetto, A. Gorini, and G. Riva, Biofeedback, virtual reality and mobile phones in the treatment of generalized anxiety disorder (GAD): A phase-2 controlled clinical trial, *Journal of CyberTherapy and Rehabilitation*. **2(4)** (2009).

[18]  C. Carissoli, D. Villani, and G. Riva, An emerging model of pregnancy care: The introduction of new technologies in maternal wellbeing., *Integrating Technology in Positive Psychology Practice*. (2016) 162–192.

[19]  E. Warnecke, S. Quinn, K. Ogden, N. Towle, and M.R. Nelson, A randomised controlled trial of the effects of mindfulness practice on medical student stress levels, *Medical Education*. **45** (2011) 381–388.

[20]  V. Sharma, B. Bauer, K. Prasad, A. Sood, and D. Schroeder, P02. 197. Self help intervention to decrease stress and increase mindfulness: a pilot trial, *BMC Complementary and Alternative Medicine*. **12** (2012) P253.

[21]  A. Howells, I. Ivtzan, and F.J. Eiroa-Orosa, Putting the app in Happiness: A Randomised Controlled Trial of a Smartphone-Based Mindfulness Intervention to Enhance Wellbeing, *Journal of Happiness Studies*. **17** (2016) 163–185.

[22]  K.H. Ly, J. Dahl, P. Carlbring, and G. Andersson, Development and initial evaluation of a smartphone application based on acceptance and commitment therapy, *SpringerPlus*. **1** (2012) 1–11.

[23]  J. Kabat-Zinn, Mindfulness-based interventions in context: past, present, and future, *Clinical Psychology: Science and Practice*. **10** (2003) 144–156.

[24]  J. Kabat-Zinn, *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness,* Delta, 2009.

[25]  K. Wijma, B. Wijma, and M. Zar, Psychometric aspects of the W-DEQ; a new questionnaire for the measurement of fear of childbirth, *Journal of Psychosomatic Obstetrics & Gynecology*. **19** (1998) 84–97.

[26]  V. Fenaroli, and E. Saita, Fear of childbirth: A contribution to the validation of the Italian version of the Wijma Delivery Expectancy/Experience Questionnaire (WDEQ), *TPM - Testing, Psychometrics, Methodology in Applied Psychology*. **20** (2013) 131–154.

[27]  C. Ruini, F. Ottolini, C. Rafanelli, C. Ryff, and G.A. Fava, La validazione italiana delle psychological well-being scales (PWB), *Rivista Di Psichiatria*. **38** (2003) 117–130.

[28]  C.D. Ryff, Beyond Ponce de Leon and Life Satisfaction: New Directions in Quest of Successful Ageing, *International Journal of Behavioral Development*. **12** (1989) 35–55.

[29]  R. Darvill, H. Skirton, and P. Farrand, Psychological factors that impact on women's experiences of first-time motherhood: A qualitative study of the transition, *Midwifery*. **26** (2010) 357–366.

# Constructions of blame and responsibility in online interactions

Navpreet JOHAL[a] and Bryn Alexander COLES[*,a]

*Department of Psychology and Counselling, Newman University, UK*

**Abstract.** Background: Online connectivity is becoming increasingly important in everyday life and interactions. Accordingly, there is a growing concern within the UK legal system (and elsewhere), surrounding the notion of cyber crime. Individuals' (particularly celebrities') private photographs are appealing targets for computer hackers. 2014 saw a high profile public release of a large number of illegally obtained, sexually suggestive photographs of celebrities. Research Question: The present paper explores how users of online fora construct notions of blame and culpability in discussions of the 2014 celebrity photo scandal. Method: Eight hundred and thirty (830) comments were drawn opportunistically from naturally occurring online discussions. Data was analysed from a discursive psychological perspective. Results: Three main interpretative repertoires were identified within this data set. 01: blame (attribution of responsibility to a third party); 02: inevitability (that digital data will necessarily end up in the public domain); 03: Neutralisation (the denial of wrong-doing). Discussion: Responsibility for the hack and release of celebrity images is not apportioned to the perpetrators of the hack. Rather, responsibility is assigned to the victims and their security services. This is despite assertions that the online environment is inherently insecure.

**Keywords.** Blame, discursive psychology, neutralisation, online discussion, responsibility

## 1. Introduction

Online connectivity is becoming increasingly important in everyday life and interactions, through the interconnectivity of everyday appliances [1], social networking [2], online banking [3], and the increasing prevalence of the digital economy [4]. Yet many people underestimate how secure their online interactions are [5,6].

Accordingly, there is a growing concern within the United Kingdom (UK) legal system (and elsewhere), surrounding the notion of cyber crime [7,8], and specifically with the illicit distribution of illegally obtained private images online [9].

In 2014 there was a public release of illegally obtained, sexually explicit photographs of celebrities, colloquially dubbed "The Fappening" [10,11]. Almost 500 sensitive images were obtained from more than 100 (predominately female) celebrities, and released online. Media coverage of this event provided a public forum for discussion of the consequences, responsibilities, morality, expectations, entitlements and ideologies

---

\* Corresponding author: a.coles@newman.ac.uk

of womanhood, celebrity status, online privacy and security. How then did members of online communities engage in debates surrounding this leak of private information? How did they seek to construct the meaning and (il)legitimacy of the release of this illicitly obtained material?

A great deal of research energy has been expended exploring why individuals engage in antisocial behavior online. Possible explanations for such transgressive behavior includes the presence of (for example) disorders or deficits of personality [12,13]. However, less effort has been spent in exploring why other Internet users tolerate antisocial and transgressive behaviors online. Thus, the present study aims to explore how members of online fora seek to justify and excuse the release of unlawfully obtained private photographs, and who they seek to blame.

*1.1. Research Question:*

The present paper explores how users of online fora construct notions of blame and culpability in discussions of the 2014 celebrity photo scandal.

## 2. Method

*2.1. Design:*

The present study follows an inductive, social constructionist perspective. The meanings of participants utterances are assumed to be created during interactions between speakers, rather than to be revealed by the analyst [14].

*2.2. Data Selection:*

Eight hundred and thirty (830) comments were drawn opportunistically from naturally occurring online discussions. These discussions took place in the comments section of a British national newspaper, and are publicly available for all to view. The researchers did not need to intervene to elicit comments from any participants. As such, the data can be said to represent a naturalistic record [15]. Data comprises of public responses to the publication of an article concerning the illegal obtaining and distribution of intimate photographs of celebrities in 2014.

*2.3. Analytic Approach:*

Data was analysed from a discursive psychological perspective [14]. Data extracts are presented here verbatim, and as they appeared online – preserving the typographical and syntactical idiosyncrasies of the original source.

## 3. Findings

'Interpretative repertoires' are the building-blocks of meaning, comprising of commonly occurring idioms, tropes and sayings used to convey meaning between speakers [13]. k

Three main interpretative repertoires were identified within this data set. 01: blame (attribution of responsibility to a third party); 02: inevitability (that digital data will necessarily end up in the public domain); 03: Neutralisation (the denial of wrong-doing). These three repertoires are exemplified in the two extracts presented below.

### 3.1. Extract 01: Blame and inevitability

```
01   These celebrities pay big dollars for "security" to guard their person and their
02   property 24/7.
03   I would have to wonder why these security people don't advise their clients
04   on protecting their image and property while online.
05   After a year of Snowden leaks, is there anybody who thinks storing on
06   emailing sensitive data via computer is an act shrouded in one's right to privacy?
07   None of us ask to be a victim of crime. But none of us think either that we can't
08   take basic steps to protect ourselves.
```

Extract 01 begins with an orientation to blame (lines 01–04). The poster here first seeks to naturalise the notion of security by drawing a parallel between online and offline behaviours. The celebrities' person and property must be guarded constantly (lines 01–02). The use of the colloquial 'big dollars' implies that a reasonable sum of money is spent on this activity, and consequently a certain level of service, should be expected in return by the celebrity. However, the word 'security' itself is placed in inverted commas. This may serve to challenge the legitimacy of the term [13], implying instead that celebrities are not getting the value their 'big dollars' should be paying for.

This implication is brought home at lines 03–04, when this poster expands the notion of 'security' from the offline and to the online environment. Here, security personnel are expected to advise (rather than guard) their client. This serves to draw parallels between the celebrities online and offline property and image, both in terms of how the celebrity present themselves, and in terms of how the celebrity should seek to protect themselves.

While this implies that online security is still the purview of the security services, it also served to downgrade their ability to actually implement this security. This downgrade aligns well with the repertoire of inevitability, expressed between lines 05–08. What is important here is that, according to this poster, the celebrity is not expected to take sole responsibility to guard themselves or their own property in either online or offline context.

The leak of the salacious celebrity images is presented as inevitable between lines 05–08. This begins on line 03 with the phrase 'I wonder'. This serves to presents the posters assertion as both speculation (rather than fact), and also as a reasonable assumption. The poster further normalises the leak of online information at lines 05–06. Here, the poster presents the insecurity of online interactions as common knowledge (though this is knowledge which security, rather than celebrity, is expected to act upon – line 03).

That information online is not secure is presented as common knowledge through the use of a rhetorical question. Such devices may be used to invite a conversational partner to agree with the poster through an appeal to consensus [16].

Line 06 ends with an explicit challenge to the right to privacy. This challenge is located within the common knowledge (post-Snowden) that online interactions are liable to be leaked. Of particular interest here is the matter-of-fact way in which this truth-claim is presented [16]. The legitimacy or illegitimacy of leaking sensitive information online

is not challenged. Rather, post-Snowden, online leaks are presented as commonplace, unproblematic and commonly known. Perversely, what should be unproblematic (ones right to privacy) is challenged and dismissed, while what should be problematic (hacking and leaking of information) is normalised and accepted.

This extract ends with a final appeal to consensus [16], displayed through a footing shift from 'I' (line 03) to 'us' (line 07) [17]. Here, the poster acknowledges that the celebrity is a victim of crime. However, they still do not acknowledge the legitimacy of this victimhood. Instead, the extract closes with an explicit implication that the insufficient action was taken by the victim to protect themselves.

In contrast with lines 03–04, line 08 states that these security measures are 'basic steps', as opposed to the kinds of steps which may require outside guidance. What such basic steps might comprise is not elaborated upon, nor is it considered how a hack might necessarily imply a malicious attempt to circumvent such basic steps.

*3.2. Extract 02: Neutralisation*

01   A day hardly goes by without most of these celebs posting selfies in alluring poses
02   showing lots of flesh. These girls shamelessly promote themselves all the time, so
03   girls don't pretend that you are offended.
04   I don't think Jennifer is in the same boat of most of the others, but this wont do you
05   any harm dear.

Extract 02 shows how posters seek to further neutralise the act of leaking explicit information, by denying any harm has come to the victims of the hack [18]. The extract begins by seeking to naturalise and normalise the problematic behaviour. The issue at stake with the hack is the leak of explicit materials. The poster here nor-malises the notion of explicit photographs of the celebrities however (line 01). Through the deployment of the terms 'hardly' and 'most', the wilful release of revealing photographs of these celebrities is presented as common, voluntary occurrence. The sexualization of the victims is further normalised through the use of the terms 'alluring' and 'lots of flesh' (lines 01–02).

In addition to equating the release of intimate photographs with celebrities normal behaviours, the poster here also seeks to diminish the status of the victims by referring to them in the diminutive as 'girls'. In choosing this term over other available labels (e.g. 'celebrity', 'victim', 'women'), the poster thus also manages to challenge the severity of the crime.

The crux of the extract appears at line 03, where the poster accuses the celebrities of only feigning offence. The celebrities cannot be upset at the leak of their private images, as such images are consistent with their 'alluring selfies' (line 01) and 'shamelessness' (line 02). Thus, the celebrities are not true victims of the hack, and are not entitled to present a negative reaction to it.

This poster acknowledges one celebrity (only) as exceptional insofar as they ('Jennifer') are not like the other celebrities. However, despite this exception, Jennifer is still denied 'victim' status [18], as the poster explicitly denies that such a hack will do her harm (lines 04–05).

Extract 02 then shows two ways in which the poster seeks to neutralise the leak of celebrity images [18]. They began with a denial of wrong doing, justified through comparisons to celebrities own propensity to pose for alluring or suggestive images (lines 01–02). As the release of the illicitly obtained images is consistent with the celebrities

own behaviour, no wrong-doing has occurred. Secondly, the poster implicitly denies injury to the celebrity at line 03, and explicitly denies injury at lines 04–05.

## 4. Discussion

The present paper has demonstrated how users of online fora construct notions of blame and neutralise responsibility in discussions of the 2014 celebrity photo scandal. The present analysis has also revealed two tensions within posters' accounts of the online hack. 01: The celebrity victim both is, and is not, responsible for protecting themselves online. 02: The online hack both is, and is not, a crime.

Blame is not attached to the hackers who compromised the celebrity iCloud accounts and leaked the information online. Rather, blame is apportioned to the victims of the crime, who did not take sufficient steps to protect themselves and their online image / property (extract 01, 07–08). Blame is also attached to security personnel, who should protect the celebrity online as well as offline (extract 01, line 03).

This apportioning of blame is achieved through a discourse of inevitability, where it is presented as common knowledge that information online is not likely to remain private. Even the right to privacy online is challenged (extract 01, lines 05–06).

The final step taken in apportioning blame is to remove the sense of 'blameworthiness' from the act of hacking and leaking celebrity photographs online at all. This is achieved through a normalisation of sexualised images of celebrities (their alluring selfies – extract 02, lines01–02), and the denial of harm caused by the leak (extract 02, lines 04–05).

Perversely, it is the victim, rather than the perpetrator of the crime, who is held to account.

This holds potentially serious implications for members of the online community. More and more social and professional domains are moving online (for example, through the Internet of Things, and online banking). However, the online environment is presented as inherently insecure, and incapable of being secured. Individuals are also expected to both protect themselves, and accept that they cannot be protected online. If these arguments transpose into other online contexts (such as Internet banking), then is any online interaction tenable?

In extract 02, the poster seems to imply that suffering harm as a result of illegal online interactions is the benchmark for outrage. Yet these two extracts also throw into question the notion of harm. Is harm to property or image different from financial harm? Would posters online discourses be different if it was financial information stolen from celebrities (or lay people), rather than image and reputation?

## 5. Conclusion

Responsibility for the hack and release of celebrity images is not apportioned to the perpetrators of the hack. Rather, responsibility is assigned to the victims and their security services. This is despite assertions that the online environment is inherently insecure (with this insecurity normalised as a feature of the technology). Blame is also absent when harm is absent – celebrities are denied the right to privacy, and the right to be harmed by a violation of their privacy. Further, this is presented as common

knowledge amongst all individuals. Finally, posters have been shown to argue that where there is no harm, there is no crime.

The most concerning aspect of the present analysis are the tension between the acknowledgement and denial of wrongdoing, and the shifting of responsibility onto others. Such patterns of rhetoric indicate that changing maladaptive online behaviours is likely to be difficult. Human actors may not be motivated to moderate their own online behaviours, as long as they are capable of assigning responsibility to another entity.

## References

[1] F. Xia, L. T. Yang, L. Wang, and A. Vinel, Internet of things. *International Journal of Communication Systems*, **25**(9), (2012), 1101–1102.

[2] B. A. Coles and M. West, Weaving the internet together: Imagined communities in newspaper comment threads, *Computers in Human Behavior*, **60**, (2016), 44–53.

[3] T. Pikkarainen, K. Pikkarainen, H. Karjaluoto, and S. Pahnila,. Consumer acceptance of online banking: an extension of the technology acceptance model. *Internet research*, **14**(3), (2004), 224-235.

[4] D. Tapscott. *The digital economy: Promise and peril in the age of networked intelligence* (Vol. 1). New York: McGraw-Hill. 1996.

[5] G. R. Milne, L. I. Labrecque and C. Cromer, Toward an understanding of the online consumer's risky behavior and protection practices. *Journal of Consumer Affairs*, **43**(3), (2009), 449–473.

[6] R. Von Solms, and J. Van Niekerk. From information security to cyber security. *Computers & Security*, **38**, (2013), 97–102.

[7] S. Gordon and R. Ford. On the definition and classification of cybercrime. *Journal in Computer Virology*, **2**(1), (2006), 13–20.

[8] Computer Misuse Act (1990). Retrieved on February 15,2017 from http://www.legislation.gov.uk/ukpga/1990/18/contents

[9] M. Salter and T. Crofts. Responding to revenge porn: Challenges to online legal impunity. in L. Comella and S. Tarrant (eds) *New Views on Pornography: Sexuality, Politics, and the Law*, (2015), 233–256.

[10] B. J. Strawser and D. J. Joy. Cyber Security and User Responsibility: Surprising Normative Differences. *Procedia Manufacturing*, **3**, (2015), 1101–1108.

[11] R. Fallon. Celebgate: Two methodological approaches to the 2014 celebrity photo hacks. *International Conference on Internet Science*, (pp. 49-60). Springer International Publishing. (2015)

[12] E. E. Buckels, P. D. Trapnell and D. L. Paulhus. Trolls just want to have fun. *Personality and Individual Differences*, **67**, (2014), 97–102.

[13] B. A. Coles and M. West, Trolling the trolls: Online forum users constructions of the nature and properties of trolling. *Computers in Human Behavior*, **60**, (2016), 233-244.

[14] J. Potter, Discursive psychology: Between method and paradigm, *Discourse & Society*, **14**(6), (2003), 783–794.

[15] C. Griffin, Being dead and being there: Research interviews, sharing hand cream and the preference for analysing naturally occurring data, *Discourse Studies*, **9**(2), (2007), 246–269.

[16] J. Potter and D. Edwards. Nigel Lawson's tent: Discourse analysis, attribution theory and the social psychology of fact. *European Journal of Social Psychology*, **20**(5), (1990), 405–424.

[17] E. Goffman. Footing. *Semiotica*, **25**(1-2), (1979), 1–30.

[18] D. Strutton, S. J. Vitell and L. E. Pelton. How consumers may justify inappropriate behavior in market settings: An application on the techniques of neutralization. *Journal of Business Research*, **30**(3), (1994), 253–26

# Modes of Cyberstalking and Cyberharassment: Measuring the negative effects in the lives of victims in the UK

Antony BROWN[a,*] , Marcia GIBSON[a] and Emma SHORT[a]

[a] *NCCR, University of Bedfordshire, UK*

**Abstract.** Cyberstalking may occur solely in the digital realm, or may form part of a wider campaign targeting individuals on and off-line. The impact cyberstalking has on victims may differ depending on the type. In this paper, we use Sheridan and Grant's (2007) classifications of, "Proximal with offline", "Online only" and "Cross-over" stalking types. These classifications are applied to responses gathered from 278 victims of cyberstalking and cyberharassment through the 2011-2014 ECHO survey. We analyse the responses to first classify the type of stalking experienced and then the reported number and types of effects in the life of the victims on a per-group basis. Using chi-square analysis, we identify that victims in the case of proximal and Cross-over stalking are significantly more likely to report negative changes to their work, relationships and financial lives and to report more negative changes in these areas than those experiencing online only. In addition, in the relationship category Cross-over cases provoke significantly more changes than proximal cases. This indicates that cases where the stalker moves from being an online presence to a proximal presence have an extreme impact and therefore should be treated with the utmost concern, both in terms of support and safeguarding strategies.

**Keywords.** Cyberstalking, Cyberharassment, Work, Relationship, Financial, Impact

## 1. Introduction

Cyberharassment is threatening behaviour or unwanted advances directed at another using the Internet and other forms of computer communications; whereas cyberstalking involves the repeated and deliberate use of the Internet and electronic communication tools to frighten, intimidate or harass someone. According to the Office for National Statistics [1] in the UK, harassment offences, including those incorporating a digital element, rose by 62 percent to 112,564 incidents in 2015, compared to the previous year.

---
* Corresponding Author: antony.brown@beds.ac.uk.

It should be noted these are merely reported incidents and are likely therefore to constitute only the tip of the iceberg in terms of prevalence. Indeed, according to Tokunaga and Aune [2], estimates suggest that around 20-40 percent of Internet users will experience some form of cyberstalking carried out against them. Cyberstalking may involve a combination of in-person attacks and attacks that are mediated purely through technological channels. Paladin, the United Kingdom's stalking advocacy service report that since 2013, "most stalking now contains a cyber or technological aspect" [3]

In this paper we analyse responses to questions regarding the types of negative impacts cyberstalking and cyberharassment have had on the lives of those having experienced them. We used data gathered from 278 self-identifying victims of cyberstalking and online harassment. The primary data are responses gathered through the 2011-2014 ECHO ("electronic communication harassment observation") survey. We find that the experiences described by victims within this dataset, fit the definitions of both online harassment and cyberstalking.

We then apply Sheridan and Grant's [4] classification of stalking types to ascertain whether different forms of stalking have differing levels of impact. Their classification was developed through analysis of responses of 1,051 self-defined victims of stalking sourced mostly from the UK, US and Australia and hence is a useful classification as applied to our dataset which is derived from the UK. 858 of the responses Sheridan and Grant analysed were classified based on the nature of their stalking experience as, "Purely online", "Cross-over", "Proximal with online" and "Purely offline". Here cross-over denotes cases where the stalking is initiated online and then moves offline and proximal with offline includes cases where the stalking begins offline, but the attacker also utilises the medium of the Internet to continue harassment of the victim. This classification may be useful to us when judging the impact of cyberstalking in-context, however in this paper we extend these definitions to include all forms of electronically mediated cyberstalking behaviours (e.g. we include those orchestrated via mobile phone and SMS text message as well as other technologies that may be used to conduct stalking behaviours).

In this paper, due to using the Web as the primary means of dissemination for ECHO, we do not seek to compare prevalence of cyberstalking with that of offline stalking. One thing the data does allow us to do however, is to compare the number of negative impacts of cyberstalking and cyberharassment reported between the purely online, cross-over, and proximal with online groups.

## 2. Method

The primary data used are responses gathered through the 2011-2014 ECHO ("electronic communication harassment observation") survey. Specifically, the data used in this analysis is derived from two questionnaires (ECHO versions 2.0 and 2.1), of which 2.1 is an extension of 2.0 with additional questions concerning participant demographics (e.g. ethnicity, whether they consider themselves to have a disability, sexual orientation,..). These ECHO questionnaires provide a unique and detailed insight to cyberstalking and online harassment cases.

*2.1. Effects on relationships*

Participants were asked, "Have you experienced any changes in your relationships?" Options offered were: Lost touch with friends/family, Gave up social activities, Relationship break-up and Other (followed with a free-text response).

*2.2. Effects on other people*

Participants were asked, "Has this experience adversely affected other people in your life? If yes, which of the following?" Options offered were: Affected my children, Affected my partner, Affected other members of my family, Affected my acquaintances, Affected my friends – offline, Affected my friends – online, Affected my work colleagues, Affected my neighbours , Affected people I know through chat rooms and networking sites and Other (followed with a free text response).

*2.3. Effects on electronic communications technology use*

Participants were asked, "Has the harassment resulted in a reduction in your use of electronic communications? If so, which ones?" Options offered were: Social networking sites (e.g.Facebook, Twitter, Linkedin), Instant messaging services(e.g. Windows live messenger, Yahoo messenger, Trillion, Skype), Webmail (e.g. Gmail, Hotmail, Yahoo), Work email, Mobile phone calls, Mobile texts, Physical environment (being approached in person by the harasser), MMORPG (World of Warcraft, EVE Online etc...),, Other online game, Online Dating and Other (followed with free text response).

*2.4. Financial effects*

Participants were asked "Have you experienced any changes in your financial situation?" Options offered were: Lost money, Expense of security measures, Legal expenses, Annual leave used up on stalking related problems, Changed/sold car, Moved home, Expense of therapy, Expense of fixing property damaged by harasser (e.g. buying a new computer, buying a new phone) and Other (followed with free text response).

*2.5. Classifying the reported behaviours in-line with Sheridan and Grant's types*

We used responses to the questions, "In which environment did you first meet/encounter your harasser?" to ascertain whether the stalking started off as cyberstalking or traditional stalking and then, "In which environments have you experienced harassment? (Select all boxes that apply)" to ascertain whether the stalking behaviours were experienced in the physical world, via digital technologies or both. For example if a participant told us they first encountered their stalker face-to-face and then that same participant selected any digital environments in response to the second question, we classified the stalking campaign against them as, "proximal", whereas if a participant told us they first encountered their attacker online and then indicated they had experienced harassment in physical environments, this would be classified as, "Cross-over". Those who met their attacker online and experienced only online harassment are

classified as "online only" cases. All other combinations were classified "Offline Only" or "Unknown" and are outside the scope of this paper.

We use the Pearson's chi-squared test for statistical independence, the null hypothesis being that there is no difference between the negative life effects of the various classifications of stalking. We reject this null hypothesis if the resulting chi-squared statistic is less than 0.05. In these cases we determine that there is a difference in the effects of the different classification types.

### 2.6. Participant demographics

### 2.6.1. Stalking type experienced:

Table 1 provides a breakdown by stalking type.

**Table 1.** Breakdown of participants by type of harassment

| Classification | Count | Percentage |
|---|---|---|
| Proximal | 135 | 44.3% |
| Online only | 91 | 29.8% |
| Cross-over | 35 | 11.5% |
| No harassment | 25 | 8.2% |
| Unknown | 17 | 5.6% |
| Offline only | 2 | 0.7% |
| Total | 305 | 100 |

In all demographics and results that follow, analysis is based on the 278 participants left after removing those 25 who did not self-identify as having experienced some form of harassment or who were classified as having experienced offline only stalking (2 participants).

### 2.6.2. Gender and Age:

The gender breakdown of participants was: Male: 56 (20.1%), Female: 214 (76.9%), Undisclosed: 8 (2.8%). 14 participants chose not to disclose their age. For the 264 that did:

**Table 2.** Age demographics of respondents to the ECHO 2 questionnaire

| Gender | Mean Age | Mode Age | Median Age | Std. Dev. |
|---|---|---|---|---|
| Female | 34.5 | 39 | 36 | 11.06286 |
| Male | 39.1 | 30 | 40.5 | 13.74074 |
| All | 36.7 | 36 | 36 | 11.7367 |

## 3. Results

**Table 3.** Percentage of cases experiencing particular types of changes in their lives as a result of cyberstalking, broken down by type.

| Type of Change | Proximal | Online Only | Cross-over | p |
|---|---|---|---|---|
| **Worklife** | 71.9% | 53.8% | 68.6% | **0.0186** |

| | | | | |
|---|---|---|---|---|
| **Relationships** | 78.5% | 56.0% | 85.7% | **0.0002** |
| **Other People** | 87.4% | 80.2% | 85.7% | 0.3332 |
| **Financial** | 63.0% | 44.0% | 68.6% | **0.0061** |
| **Online behaviour** | 80.7% | 79.1% | 82.9% | 0.8876 |

Comparing the different types of case, we looked at which areas the respondents experienced changes in their life due to the harassment. A chi-square test indicates that for working life, relationships and financial changes, where the Online Only cases have a lower percentage reporting changes in these areas, is not independent of the case type. This suggests that Proximal and Cross-over cases cause more changes in these areas, but that all types have a high likelihood of causing changes to relationships with acquaintances and with a victim's online behaviour.

No significant differences were noticed in the effects on 'Other people' or 'Usage of electronic communications' categories related to the type of harassment. The results for the other categories are presented below:

*3.1. Mean average per respondent number of effects experienced in working life by stalking type*

**Table 4.** *Mean per respondent number of worklife effects experienced*

| Type of Change | Mean | >1 effects | 1 effect | No Effects |
|---|---|---|---|---|
| **Proximal** | 1.259259 | 31.852% | 40.000% | 28.148% |
| **Online Only** | 0.846154 | 18.681% | 35.165% | 46.154% |
| **Cross-over** | 1.514286 | 37.143% | 31.429% | 31.429% |

Proximal and Cross-over have significantly (**p** = 0.03309) more effects in the worklife of victims than in online only cases.

*3.2. Mean average per respondent number of effects experienced in relationships by stalking type*

**Table 5.** Mean per respondent number of family effects experienced

| Type of Change | Mean No. Effects | >1 effects | 1 effect | No Effects |
|---|---|---|---|---|
| **Proximal** | 1.37037 | 41.481% | 37.037% | 21.481% |
| **Online Only** | 0.89011 | 25.275% | 30.769% | 43.956% |
| **Cross-over** | 1.828571 | 65.714% | 20.000% | 14.286% |

Cases involving Cross-over stalking/harassment have significantly (**p** = 0.03619) more effects reported than Proximal or Online Only.

### 3.3. Mean average per respondent number of changes in financial situation by stalking type

**Table 6.** Mean per respondent number of online communication  effects experienced

| Type of Change | Mean No. Effects | >1 effects | 1 effect | No Effects |
|----------------|------------------|------------|----------|------------|
| **Proximal** | 1.888889 | 49.630% | 13.333% | 37.037% |
| **Online Only** | 0.769231 | 18.681% | 25.275% | 56.044% |
| **Cross-over** | 2.028571 | 45.714% | 22.857% | 31.429% |

Proximal and Cross-over are significantly more likely to cause more financial effects (p=6.421 E-05) to the victim than online only stalking.

### 4. Conclusion

Previous work [4] considers the different types of cyberstalking lying on a scale based on the amount of cyber involvement with least to most: Offline Only, Proximal, Cross-Over and Online Only. With differences in effects being associated with the amount of cyber involvement. However, our results indicate that the amount of cyber-involvement may not explain the differences entirely. Cross-Over cases rather than lying between Proximal and Online Only in terms of effects, actually have their own unique characteristics.

Overall, the findings from a psychological perspective indicate that the victims of harassment whether proximal, Cross-over or purely online endure high levels of negative effects and changes to their life. The changes victims make to their lives are generally due to becoming more suspicious of people, more withdrawn or presenting with emotional distress, which affects the personal aspects of life associated with day-to-day living. In addition, those who reported more life changes due to the harassment are more likely to present with anxiety and fear, and although on-line stalking causes less life changes as demonstrated here, the sense of not knowing who the culprit is in online stalking or if the offender may make a face-to-face appearance must be extremely intimidating.

Cases where there is real life contact are more likely to cause changes in the victim's lives in terms of their worklife, their financial status and their close relationships. Importantly, they are not only more likely to cause a change in these areas but also to cause more changes, leading to a higher impact on the victim's life. Whilst Cross-over cases have been treated as a variation on proximal cases with more reliance on technology, we have identified a difference in the effects on victims close relationships, where Cross-over cases cause more changes than the other types. One hypothesis is that the intrusion of someone unknown from outside into the lives of your close friends and family causes more disruption. This paper considers just one aspect of cyberstalking/harassment and future work will be done to determine any other differences in the effects of the mode attack.

### References

[1] Office for National Statistics, Statistical bulletin: Crime in England and Wales: Year ending September 2015, Office for National Statistics, Online, 2016. [Cited 2017 May 10] Available from

[2] *http://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/bulletins/crimeinenglandandwal es/yearendingseptember2015*

[3] R. Tokunagaand and K. Aune, Cyber-Defense: A Taxonomy of Tactics for Managing Cyberstalking. *Journal of Interpersonal Violence,* **10**(32) (2015), 1-25.

[4] L. Richards, Stalking and Harassment - a Shorthand Guide about Digital and Cyberstalking. 1st ed. Paladin, Online, 2013. [Cited 2017 May 10] Available from *http://paladinservice.co.uk/wp-content/uploads/2014/11/Digital-and-Cyber-Stalking-Toolkit-2013.pdf*

[5] L.P. Sheridan and T.Grant, Is cyberstalking different?. *Psychology, Crime & Law,* **13**(6) (2007), 627-640.

# SECTION IV

## ORIGINAL RESEARCH

Health care is one of the areas that could be most dramatically reshaped by these new technologies.

Distributed communication media could become a significant enabler of consumer health initiatives. In fact they provide an increasingly accessible communications channel for a growing segment of the population.

Moreover, in comparison to traditional communication technologies, shared media offer greater interactivity and better tailoring of information to individual needs.

*Wiederhold & Riva, 2004*

# The Sensorimotor Dimension of the Networked Flow: An Exploratory Study Using an Interactive Collaborative Platform

Alice CHIRICO[a*], Alessandro D'AUSILIO[b], Serena GRAZIOSI[c], Francesco FERRISE[c], Alberto GALLACE[d], Cedric MOSCONI[e], Marie Jasmine CAZZANIGA[e], Valentino ZURLONI[f,g], Massimiliano ELIA[f], Francesco CERRITELLI[h,i,j] Fabrizia MANTOVANI[f,g] Pietro CIPRESSO[k], Giuseppe RIVA[a,k], Andrea GAGGIOLI [a,k]

[a]*Dep. Psychology, Università Cattolica del Sacro Cuore, Italy*
[b]*IIT - Istituto Italiano di Tecnologia - Neurophysiology, Ferrara, Italy*
[c]*Politecnico di Milano, Department of Mechanical Engineering, Italy*
[d]*Dep. Psychology and Milan Centre for Neuroscience; University Bicocca, Milan, Italy*
[e]*Dep. Psychology; University of Milano Bicocca, Milan, Italy*
[f]*Sciences for Education - University of Milano-Bicocca - Milan, Italy*
[g]*CESCOM  - University of Milano-Bicocca – Milan, Italy.*
[h]*Centre for Osteopathic Medicine Collaboration, Pescara, Italy*
[i]*University of Chieti-Pescara, Pescara, Italy*
[j]*ITAB- University of Chieti-Pescara, Pescara, Italy*
[k]*IRCCS Istituto Auxologico Italiano, Italy*

**Abstract.** Joint action - the cooperation with other individuals to achieve a shared motor goal, is a crucial ability for human survival. This process takes place when actors are synchronized at a sensorimotor level. However, the experiential correlates of sensorimotor synchronization are not fully understood. The aim of this study was to investigate the relationship between the experience of flow and social presence in a sensorimotor collaborative task. 12 female couples (mean age = 22.33; S.D. = .815) and 12 male couples (mean age = 22.88; S.D. = .789) were involved in a tower-building task across 10 consecutive trials using the COLLEGO platform [1]. Couple members alternated their leader/follower role. Platform recorded time stamp (ms) and position of each selected object when it was picked/released, providing a measure of performance. Thereafter, participants' level of flow (Flow State Scale), an intrinsically motivating state of consciousness, and social presence (Networked Minds Social Presence Inventory), i.e., the feeling of being with other Selves in a real or virtual environment, were assessed. Flow and Social presence correlated positively at a global level. Having clear goals was negatively associated with performance, while awareness and merging with one's own actions correlated positively with performance. Task duration correlated negatively with attentive and behavioral dimensions of social presence, but positively with cognitive and emotional dimensions. Results are discussed according to the Networked Flow model assuming a positive correlation between social presence and flow at the base of the highest levels of collaborative performance.

---

* Corresponding Author: alice.chirico@unicatt.it

## 1. Introduction

Being able to coordinate with another individual is one of the key assets of human survival and progress. This basic ability is called "*joint action*", which is deemed as "*any form of social interaction whereby two or more individuals coordinate their actions in space and time to bring about a change in the environment*' [2, 3]. The relevance of joint action is related to the possibility to affect the environment according to each partner's intention, thus facilitating the emergence of a social unit [4]. A social unit emerges when individuals' intentions are bound together to an extent that they perceive themselves as a part of the same coherent system and this status is called *entitativity* [4, 5]. One of the mechanisms underlying the emergence of such condition is interpersonal synchronization [6, 7] which can facilitate group performance [8]. The impact of synchronization on performance may be mediated by the emergence of a collective mind, which allows organizing individuals' ability towards a shared goal and outcome [8]. In other words, people feel mutually and positively related, experiencing a feeling of mutual connectedness [4], global perceptual fluency and shared attention [9] when they are able to coordinate with the actions of another partner [9]. This, in turn, would increase group performance. Despite the relevance of experiential correlates of synchronization, their relationship with group performance is nearly unexplored. Recently, Gaggioli et al. [10-13] proposed the Networked Flow model (NF) that assumes a relationship between all these experiential dimensions and group highest performances. NF suggests that an increasing group synchronization, which embraces all levels of group collaboration, can contribute to the emergence of optimal group collaboration. To this aim, two conditions need to be established. First, the group should develop a shared intersubjective space in which all members' intentions converge. Authors identified this space with the highest level of *Social Presence* [14-16]. Secondly, the complex experience of *group flow* takes a part in the emergence of the Networked Flow [17-19]. Group flow and highest levels of Social Presence can be deemed as high-level experiential correlates of interpersonal synchronization, supporting excellent group performances. To test these assumptions, we carried out a preliminary study in which we manipulated interpersonal synchronization through a joint-action task (i.e., the tower-building task) using the COLLEGO platform[†]. Interpersonal synchronization is a complex phenomenon that is difficult to capture in the lab. Therefore, we used the COLLEGO platform [1], that offers a valid and ecological tool to study correlates of synchronization (i.e., from the sensorimotor level to the experiential one) and their relationship with group performance.

## 2. Methodology

We included 24 couples of participants from Italy. 12 female couples (mean age = 22.33; S.D. = .815) and 12 male couples (mean age = 22.75; S.D. = .678) were involved in a

---

[†] COLLEGO project: https://collego.wordpress.com/2016/10/21/collego/

tower-building task across 10 consecutive trials using the COLLEGO platform for joint-action [20]. They were required to build a tower of colored wooden blocks using only one hand, and positioning a cube at time. Each trial, the experimenter assigned the role of "leader" (i.e., the member who began the sequence of cubes) or "follower" (i.e., the member who had to follow the leader's cube sequence). Participants had to alternate their leader/follower role to build the tower jointly, using 6 cubes each. Cubes were placed on a platform composed of two Arduino-sensitized block surfaces in front of each participant. When a cube was picked/released, time stamp (ms) and position of selected objects were recorded [figure 1]. Participants' performance and degree of synchronization was continuously assessed by the platform. At the end of each session, experiential correlates of interpersonal synchronization were assessed. Specifically, participants were required to report their level of Flow (Flow State Scale- FSS) [21] and Social Presence (Networked Minds Social Presence Inventory- NMSPI) [14, 22] associated to the task.
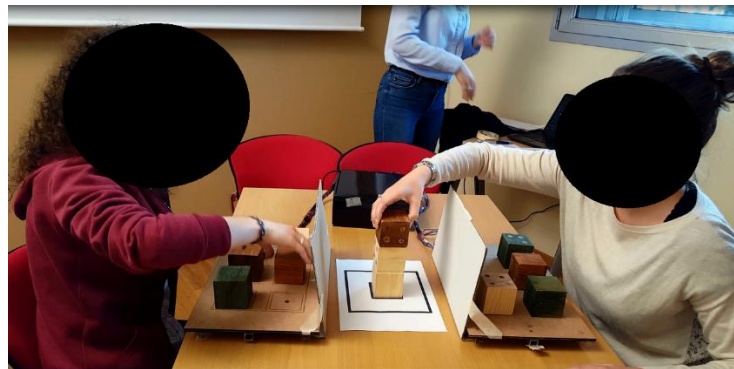


**Figure 1.** Two participant involved in the Tower-building task using the COLLEGO platform.

## 3. Results

Since the level of analysis of the variables is the group level, we aggregated individual scores of Flow, social presence and performance to the group level by calculating the average and standard deviation of individual scores for each pair. Further, we carried out correlation analyses to explore potential relationships among Flow, Social Presence and group performance. Performance was calculated from the timestamp computed with respect to the first cube that was lifted.

Findings showed that Flow and Social Presence correlated positively at a global level ($r = .428$; $p<.005$). Having clear goals ($r = .521$; $p<.05$) was negatively associated with performance, while feeling totally involved into the action was associated with a higher performance ($r = - .416$; $p< .05$). At the same time, task duration was negatively associated with cognitive (perceived attentional engagement in odd trials: $r = .515$ $p< .05$; perceived attentional engagement in even trials: $r = .421$; $p< .05$) and behavioral dimensions of social presence (perceived behavioral interdependence: $r = .497$; $p< .05$). Specifically, when individuals paid more attention to themselves than to their partner, their group performance decreased. At the same time, when members perceived to be dependent on the partner but that partner did not depend on them, their performance

decreased. On the other hand, when participants began the trial feeling emotionally connected with their partner, they performed better (perceived emotional contagion: r = -.427; p< .05).

Finally, the experience of mutual comprehension emerged as relevant for outperforming. Specifically, when participants felt that their partners were able to understand their intentions, the couple performed better (duration: r = - .409; p.05).

## 4. Discussion and Conclusion

The ability of synchronizing with other partners is a driver of optimal performances and it seems to be mediated by different experiential outcomes [4]. However, the relationship between these outcomes, synchronization and performance is nearly unexplored. We carried out a preliminary study manipulating interpersonal synchronization through a joint-action task, assessing its experiential correlates, as well as their relationships with group performance. To this end, we used the COLLEGO sensitized platform in order to detect continuous performance and variations of interpersonal synchronization in an ecologically valid way. We discussed results considering the Networked Model of group collaboration, which assumes that high Social Presence and Flow experiences contribute to the emergence of optimal group performance. A progressive multi-level synchronization among members would act as a requirement for the emergence of Social Presence and Flow. Here, we manipulated the degree of low-level synchronization between members involved in a joint-action task, to investigate the impact on concurrent group experiences and performance. First, we found a positive correlation between Social Presence and Flow, supporting the main assumption of the model. More, at the performance level, the feeling of being totally aware of one's own actions was positively related to group performance. Being too concentrated on one's own task is negatively correlated with group outcomes. This is in line with previous findings on the role of attention on group performance [10]. However, when members perceived clear goals about the task, their performance decreased. Maybe they considered the task too easy to put more effort in it. At the behavioral level, members should not feel to be fully dependent from their partner to reach a better performance. It is possible that a lack of balance in terms of perceived behavioral dependence affected the general synchrony between partners. This would lead to a "break" in the information flow at a lower level affecting others higher levels [20, 23, 24]. Further, when members perceived that their partner could understand their intentions, they performed better. Indeed, it was noted that synchrony combined with shared intentionality produced the greatest level of cooperation [25]. Finally, the emotional component of interpersonal synchronization has been investigated widely [26], however, its relationship with group performance has to be clarified. In this study, we offered a preliminary evidence of a positive relationship between emotionality and performance.

This study proved that the NF model might offer a valid perspective on group collaboration. This model integrates the cognitive, emotional, and behavioral dimensions involved in the collaborative process from the lower sensorimotor level to the higher empathetic one. The Networked Flow represents a new integrative perspective on the relationship between low sensorimotor levels and high experiential levels of group collaboration.

Given the increasing relevance of interpersonal synchronization in several domains, such as in the clinical and therapeutic field [6, 9, 27, 28], these findings may support the use of this paradigm both as a diagnostic and intervention tool. It might be possible to plan a computational therapy based on this tools assessing the evolution of a therapeutic relationship. Alternatively, this paradigm could be used to monitor group performance in a team work by detecting which level of collaboration should be improved. In other words, this paradigm acts as a starting point for a new way of conceptualizing and treating human-computer (HC) and human to human (HH) interactions. This is crucial in a world in which humankind is dealing with interactive technologies in every moment of individuals' life.

## References

[1].    A. Chirico, et al., *COLLEGO: An Interactive Platform for Studying Joint Action During an Ecological Collaboration Task*, in *Pervasive Computing Paradigms for Mental Health 6th International Symposium, MindCare 2016, November 28-29*. in press: Barcelona, Spain.

[2].    S. Butterfill, Joint action and development. *The Philosophical Quarterly*, 2012. **62**(246): p. 23-47.

[3].    N. Sebanz, H. Bekkering, and G. Knoblich, Joint action: bodies and minds moving together. *Trends in cognitive sciences*, 2006. **10**(2): p. 70-76.

[4].    K.L. Marsh, M.J. Richardson, and R.C. Schmidt, Social connection through joint action and interpersonal coordination. *Topics in Cognitive Science*, 2009. **1**(2): p. 320-339.

[5].    D.T. Campbell, Common fate, similarity, and other indices of the status of aggregates of persons as social entities. *Systems Research and Behavioral Science*, 1958. **3**(1): p. 14-25.

[6].    W.S. Condon, The relation of interactional synchrony to cognitive and emotional processes. *The relationship of verbal and nonverbal communication*, 1980: p. 49-65.

[7].    M. Davis, *Interaction rhythms: Periodicity in communicative behavior*. Human Sciences Pr., 1982

[8].    P. Valdesolo, J. Ouyang, and D. DeSteno, The rhythm of joint action: Synchrony promotes cooperative ability. *Journal of Experimental Social Psychology*, 2010. **46**(4): p. 693-695.

[9].    L.K. Miles, L.K. Nind, and C.N. Macrae, The rhythm of rapport: Interpersonal synchrony and social perception. *Journal of experimental social psychology*, 2009. **45**(3): p. 585-589.

[10].   A. Gaggioli, et al., Networked Flow in musical bands. *Psychology of Music*, 2017. **45**(2): p. 283-297.

[11].   A. Gaggioli, et al., *The Cognitive Foundations of Networked Flow: Intentions, Presence, and Social Presence*, in *Networked Flow*. 2013, Springer. p. 21-53.

[12].   C. Galimberti, et al., Bridging Minds: A Mixed Methodology to Assess Networked Flow. *Stud Health Technol Inform*, 2015. **219**: p. 33-6.

[13].   G. Riva, L. Milani, and A. Gaggioli, *Networked Flow: comprendere e sviluppare la creatività di rete*. 2010: LED.

# Educational Robotics to Improve Mathematical and Metacognitive Skills

Filippo LA PAGLIA[a,*], Caterina LA CASCIA[a], Maria Margherita FRANCOMANO[b], and Daniele LA BARBERA[a]

[a] *Department of Experimental Biomedicine and Clinical Neuroscience, University of Palermo, Italy*

[b] *Secondary School "Antonino Pecoraro" of Palermo, Italy*

**Abstract.** This paper describes the use of robotic kits as tools in developing mathematical and metacognitive skills, as the planning, reasoning and problem-solving capabilities in young students. A sample of 30 students involved in an extra-curricular laboratory based on robotics activities (10 meetings; three hours each, once a week). Quantitative and qualitative data showed that robotics activities may be intended as a new metacognitive environment that allows students to improve the attitude in mathematics, or increase the propensity to reflect on themselves and on their own learning, and higher-level control components, such as forecasting, planning, monitoring and evaluation exercises and problems related to implementation.

**Keywords.** Educational Robotics, Metacognition, Learning, Problem solving, New Technology

## 1. Introduction

Educational robotics is a powerful, flexible, teaching and learning tool enabling students to construct knowledge by controlling robots while using specific programming languages [1]. Furthermore, robotic toys present unique opportunities for teachers of young children to integrate mathematics learning with engaging problem-solving tasks. The use of robotics can help students to develop problem solving strategies while engaging them in exploring and understanding mathematics, science and technology concepts [2-3]. Furthermore, some studies have shown that educational robotics has a positive impact on learning, especially in relation to areas, such as Science, Technology, Engineering, and Mathematics [4-6]. Other empirical researches showed that playing with robots allows students to improve their planning, reasoning and problem-solving capabilities [7, 8] and metacognitive skills [9].

The robotic kits are designed as constructible and programmable devices which allow children to shape their robot, design its mechanisms and command its sensors and actuators. In particular, Robotic kits allow users to build and to program small mobile

---

* Corresponding Author: filippolapaglia@gmail.com; filippo.lapaglia@unipa.it

autonomous robots into the physical environment [10]. During the game with such kits, children first build the robot body and then create a program in order to assign it an artificial intelligence (e.g., create a robot able to move into a maze or create a robot able to move and change its behavior if it faces an obstacle). Finally, subjects test the robot performance into the physical environment in order to verify its success/failure. The final test is quite important because users can instantaneously see what they have planned for the robot and verify if they behave the way they were planned to. This visual process encourages children to reflect on their program thus making mathematical concepts "more accessible to reflection" [11].

Metacognition is a key element for the process and performance in using robotics education to teach problem solving skills. Metacognition was positively related to knowledge mastery, post-training performance, and self-efficacy.

In general, metacognition consists of two basic processes occurring simultaneously: the first of them is monitoring the progress of learning; the second is making changes or adapting learning strategies as subjects perceive they are not doing so well [12]. Specifically, metacognitive skills include monitoring the progress of learning, correcting errors, and changing strategies when needed [13]. From this perspective, the whole experience of playing with robots may be considered as a metacognitive process which leads users to become more aware and conscious of their way of thinking, learning, and organizing the game itself.

In line with previous research [14], we implemented a sample of students attending a secondary school involved in a robotics laboratory, in order to check the improvement of their metacognitive skills related to the mathematics, through the use of robotic kits.

## 2. Methods

### 2.1 Participants

Sixty healthy students all attending the first classes of a secondary School of Palermo (Italy) were randomly selected and assigned to the control and the experimental group, each composed of thirty subjects (15 Male and e 15 Female; mean age: 11 years, range 10-12). The whole experimental group was then divided into six subgroups.

**Table 1**: Population characteristics

|  | Experimental group | Control group |
|---|---|---|
|  | $n = 30$ | $n = 30$ |
| Age (Mean ± SD) | 11 | 11 |
| (range) | 10-12 | 10-12 |
| Gender (M, F) | 15,15 | 15,15 |

### 2.2 Instruments and procedure

The study is articulated in assessment of the metacognitive skills and beliefs related to the acquisition of subject's mathematical knowledge, educational robot activities for the experimental group and second measurement of the two group metacognitive skills

The Metacognitive skills were evaluated individually, during the pre-test and the post-test assessment, using the following test: Questionario di Matematica e Metacognizione-MM [15] encompassing three sections: *attitudes*, *belief*, *control processes* influencing math learning.

The questionnaire allows several qualitative observations such as exploring the presence of specific mathematics skills and some aspects of metacognition in mathematics. The section "A" concerning attitudes, presents situations which can be faced by students who have to solve math problems and operations. They are invited to respond "often", "sometimes", "never or almost never". The items, all relating to mathematics, can be classified mainly in two distinct areas: one refers to the experiences and attitudes towards the discipline, the other refers to behaviors and approaches to solving mathematical problems.

The section "B" presents statements regarding the most common metacognitive beliefs in mathematics  (e. g., *If I am not able in mathematics, then I think to be a fool; a math problem must be resolved soon, or does not resolve anymore).* Students are invited to express an opinion with answers "true" or "false". The items refer to the three main types of mathematical beliefs: skill, discipline and learning.

The section "C" investigates higher-level control processes: forecasting, planning, monitoring and evaluation. In this section, students have to solve mathematical exercises, operations and problems. In some cases they only have to read the question and then to answer about the difficulty degree of the problems, without doing the calculation; while in other cases they have to resolve problems by following the precise instructions and then have to answer some questions.

Furthermore, during all the construction and programming sessions, metacognitive strategies were registered using observational grids that provided quantitative and qualitative indicators about: frequency of checks made by subjects to verify if the correct bricks were taken and assembled; frequency of spontaneous self-corrections, frequency of trough-other corrections made by the experimenters.

### 2.3  Educational robot activities

The laboratory activities involved a LEGO Mindstorms robot assembled as a small vehicle, equipped with three ultrasonic sensors at the front, one pointed straight ahead, and the other two set at about 45° left and right respectively, and a LED color light mounted on top which could be shone red, green or blue.

According to previous researches [7-9, 14], each group of the experimental group was provided with a robotic kit and it was involved in an extra-curricular laboratory based on robotics activities (10 meetings; three hours each, once a week). The participants have to build a robot body and, subsequently, they have to create a program in order to assign it an artificial intelligence.

After the familiarization with the hardware and software elements of the kit, all the students were given construction and programming tasks with an increasing level of difficulty, as measured by the number of bricks, which had to be manipulated for constructing the robot body and by the number of drives, which had to be linked to create a specific robot behavioral repertory.

Each of the tasks provided opportunities for subjects to program and observe the robotic toy and to reflect on the toy's movement. The dynamic actions of the toy created

a "shared moment" which was highly visual and in turn provided opportunities for shared attention and group work.

Each group performed different programming tasks having an increasing level of difficulty measured by the number of commands necessary for programming the robot.

The subjects were requested to perform the following tasks:

- Build and program a robot able to move along a linear route;
- Program the robot able to move and describe a geometric figure as a square;
- Program the motors and the color detection sensor – Create and program a robot able to move and change trajectory if there is a red line along its route;
- Program the motors, the color detection sensor and the ultrasonic sensor – Create and program a robot able to move and shoot balls if there an object along its route.

## 3   Results

The effectiveness of treatment was analyzed through repeated measures ANOVA, with two levels of the between-subject Group factor (experimental group and control group) and two levels of the within-subject Time factor (pre-test and post-test), respectively, on scores: the *attitude, belief, and control.*

For the multivariate test there did not appear to be any main effect between-subject factor Group ($F_{3-58}$=2,176; n.s.); whereas within-subject time factor ($F_{3-58}$=9,435; p<.005) it's statistically significant. A main effect of Time x Group interaction ($F_{3-58}$=3,162; p<.01) has been presented as well.

The univariate tests showed that the Group factor does not statistically affect any of the considered variables, whereas the Time factor statistically affects only the score related to the dimension of Control ($F_{1-58}$=10,744; p=.000) but not those related to the dimension of Attitudes and Belief. Equally, the effect of Time x Group interaction is statistically significant only for the variable Control ($F_{1-58}$=3,662; p= .010).

As reported in Table 2, although the post-test scores increase in both groups, from pre to post-test, the increase in the experimental group is higher than the one shown by the control group.

For the Attitude variable, the difference between experimental group and control group is statistically significant: the subjects of the experimental group increased their positive attitudes towards mathematic from pre to post-test, ($F_{1-58}$=6,270; p<.01); the variable Metacognitive Control increase in the experimental group is higher than the one shown by the control group ($F_{1-58}$=9,055; p<.01).

**Table 2.** Repeated Measures ANOVA between subject and within subject (before and after training)

| | Experimental group | | | | Control group | | | |
|---|---|---|---|---|---|---|---|---|
| | Pre-test | | Post-test | | Pre-test | | Post-test | |
| | **M** | **DS** | **M** | **DS** | **M** | **DS** | **M** | **DS** |
| **Belief** | 55,570 | 4,385 | 52,103 | 7,394 | 51,510 | 8,695 | 54,700 | 6,187 |
| **Attitude** | 58,400 | 8,084 | 62,427 | 5,433 | 52,817 | 9,855 | 54,480 | 8,927 |
| **Control** | 54,193 | 7,524 | 58,060 | 6,887 | 56,287 | 11,575 | 56,857 | 12,219 |

On the basis of indicators of observational grids, was also calculated an indexes that measured metacognitive skills based on control the: *Index of programming self-correction*, which was based on the percentage rate between the total numbers of programming commands that users changed and the total number of downloads.

Furthermore, the indexes that measure of the claim for external aids, were calculated during programming sessions: *Index of programming help requests* that was calculated on the ratio between the total number of trough-other corrections and the total number of download made by user were also calculated.

As showed in figure 1, during the last programming sessions the experimental group showed more metacognitive actions based on controlling and retrieving errors: an increases in the programming self correction index and a descreases in the programming help request index.

**Figure 1**. Index of programming self-correction and Index of programming help requests
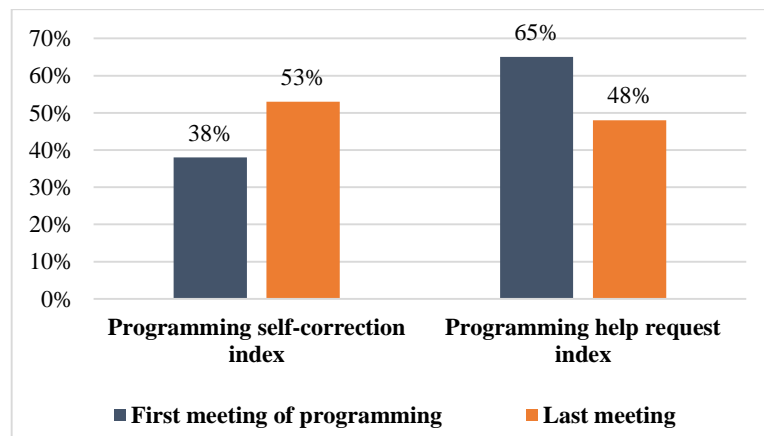


## 4    Conclusions

The results of the analyses carried out within the present study confirm previous data about *robot activities*, even with an increase of the sample [14].

The results showed an increase in post-test performance for the experimental group if compared with the control one.

Specifically, our results suggest that using robot kits improves the attitude towards mathematics and it also increases the attitude to reflect on themselves and on their own learning, and higher-level control components, such as forecasting, planning, monitoring and evaluation exercises and problems related to implementation.

Throughout the activities, each experimental subgroup has actively monitored, reflected, and adjusted their processes in regards to strategically solve the problems and had their metacognitive skills increased. Students were able to successfully identify problems, negotiate modifications to design and programming, and implement the necessary changes to complete the set of activities with their robots.

In general, our results show that the training with robotic kits may help to develop the awareness and the metacognitive abilities. Indeed, the results showed that the involvement and the improvement of the logical reasoning ability, allows subjects to anticipate and to plan the sequence of the actions needed to solve a particular behavioral task.

## References

[1] J. Chambers, M. Carbonaro. Designing, developing, and implementing a course on LEGO robotics for technology teacher education. *Journal of Technology and Teacher Education*, **11** (2003), 209–241.

[2] S. Norton, C. McRobbie, I. Ginns. Problem solving in a middle school robotics design classroom. Research in Science Education, **37** (3) (2007), 261–277.

[3] S. Portz. LEGO League: Bringing robotics training to your middle school. Tech Directions, **61**(10) (2002), 17–19.

[4] B. Barker, & J. Ansorge. Robotics as means to increase achievement scores in an informal learning environment. Journal of Research on Technology in Education, **39**(3) (2007), 229–243.

[5] S. Hussain, J. Lindh, & G. Shukur. The effect of LEGO training on pupils' school performance in mathematics, problem solving ability and attitude: Swedish data. In Educational technology and society, **9** (2006), 182–194.

[6] G. Nugent, B. Barker, N. Grandgenett, & V.I. Adamchuk. Impact of robotics and geospatial technology interventions on youth STEM learning and attitudes. Journal of Research on Technology in Education, **42**(4) (2010), 391–408.

[7] B. Caci, A. D'Amico, & M. Cardaci, Costruire e Programmare Robots, *Tecnologie Didattiche*, **27**(3), (2002), 36–40

[8] B. Caci, A. D'Amico, & M. Cardaci, New frontiers for psychology and education: robotics, *Psychological Reports*, **94** (2004), 1372–1374.

[9] F. La Paglia, B. Caci, D. La Barbera, M. Cardaci, Using robotics construction kits as metacognitive tools. A research in an Italian Primary School, *Studies in Health Technology and Informatics,* **154** (2010), 110–114.

[10] O. Miglino, H.H. Lund, & M. Cardaci, Robotics as an Educational Tool, *Journal of Interactive Learning Research*, **10**(1) (1999), 25–48.

[11] S. Papert, *Mindstorms: Children, Computers, and Powerful Ideas*, Basic Books, New York, 1980.

[12] W. Winn, & D. Snyder, Cognitive perspectives in pyschology. In D.H. Jonassen, ed. *Handbook of research for educational communications and technology*, New York: Simon & Schuster Macmillan (1996), 112–142.

[13] D.S Ridley, P.A. Schutz, R.S. Glanz, & C.E. Weinstein, Self-regulated learning: the interactive influence of metacognitive awareness and goal-setting, *Journal of Experimental Education,* **60**(4) (1992), 293–306.

[14] F. La Paglia, R. Rizzo, D. La Barbera, Use of robotics kits for the enhancement of metacognitive skills of mathematics: a possible approach, *Studies in Health Technology and Informatics*, **167** (2011), 26–30.

[15] B. Caponi, G. Falco, R. Focchiatti, C. Cornoldi, & D. Lucangeli, *Didattica metacognitiva della matematica*, Erickson, Trento, 20

# Measuring Prejudice and Ethnic Tensions in User-Generated Content

Olessia KOLTSOVA[a,*], Svetlana ALEXEEVA[a,b], Sergey NIKOLENKO[a,c], Maxim KOLTSOV[a]

[a] *National Research University Higher School of Economics, Russia*
[b] *St. Petersburg State University, Russia*
[c] *Steklov Mathematical Institute at St. Petersburg, Russia*

**Abstract.** With the spread of social media, ethnic prejudice is becoming publicly available to widening audiences and may have serious offline consequences. This creates demand to detect prejudice and other signs of ethnic tension in user-generated texts, and this task is absolutely different from measuring prejudice with surveys – an approach traditionally developed in psychology. In this work we use a hand coding instrument based on psychological definitions of prejudice and sociological methods of questionnaire construction. Compared to our previous research, we double our hand-coded collection that reaches 14,998 unique user texts retrieved from the Russian language social media. We then train computer classification algorithms to "guess" prejudice as detected by human coders and show significant improvement in quality compared to our earlier results. Still, as not all aspects of prejudice get detected sufficiently well, we analyze potential causes of low quality and outline directions for further improvement.

**Keywords.** Ethnicity, prejudice detection, user content, machine learning.

## 1.   Introduction.

The role of prejudice for interethnic anxiety, contact and conflict has been a long-studied topic in ethnic psychology and political science [1-2]. Recent explosive growth of social media has allowed prejudiced views to spread to large audiences with potentially increased risks of offline spill-over [3], which has led to new research tasks of measuring and monitoring online ethnic prejudice and/or tolerance. Unlike polls, user texts contain only what users choose to share and are often ambiguous. Ultimately, their influence is limited to the meanings that readers manage to extract from them, therefore, the key to prejudice detection in texts is interpretation by ordinary people. Accurate detection begins with a set of well-elaborated questions to human coders designed to overcome text ambiguity and human subjectivity as much as possible. However, with millions of texts online the next step is to teach computer to automatically "see" what humans see

---

[*]Corresponding Author: ekoltsova@hse.ru

in texts. Development of automatic methods of prejudice detection is the main goal of this research.

## 2.    Related work.

Although there are many approaches to prejudice in psychology and social science, it has been noted by Quillian [4] that most of them rely on early Allport's definition which views prejudice as "an antipathy based on faulty and inflexible generalization" [5], while the positive counterpart of prejudice is usually referred to as positive stereotype. With some exceptions [6] prejudice is thus usually seen as a type of attitude; therefore, methods to reveal it are usually survey-based and include a large variety of scales [7] most often focusing on ethnic prejudice. To the best of our knowledge, psychology has never sought to detect (ethnic) prejudice expressed in "natural" texts – that is, those produced by the objects of study for the purposes other than prejudice research.

This line of inquiry has been developing in linguistics, communication and media studies. The most elaborated approach by van Dijk [8-9] is, however, aimed at revealing deep and complex structures of prejudiced text with sophisticated discourse analysis. A stricter measurement instrument is offered by Ponarin and colleagues [10], still neither approach scales for large amounts of texts that are increasingly available online.

Contemporary computer science and computational linguistics offers a number of methods to automatically detect various text features, however, prejudice-related methods are being in their cradle. Most often, researchers attempt to detect hate speech that is vaguely defined and ideologically burdened [11-12]. Very little attention is paid to the development of instruments for manual text mark-up that are later used as the ground truth for testing automatic instruments.

To our knowledge, there are no works aiming at detecting presence of ethnic conflict or other inter-ethnic tension in texts although some works seek to predict generalized offline conflict with social media data [13-14], including Russian-language content.

## 3.    Research goals and data.

This research elaborates on our earlier work [15] in which we offered a pilot instrument for prejudice and conflict detection based by Ponarin and colleagues [10] and other sources. In that research we obtained a decent level of quality that, nevertheless, has room for development. In this work we improve our earlier results and increase the number of prejudice aspects that we are able to detect. We examine when and how the quality of the instrument can be augmented and analyze in-depth when and why automatic methods work poorly. We outline directions of inquiry that may lead to further improvement.

We used data from the same collection of 2,660,222 user texts mentioning at least one of 115 post-Soviet ethnic groups. This collection covers a two-year period and embraces all Russian language social networking sites. It is fully described by Koltsova and colleagues [15]. However, here we increase our sample for hand coding from 7,181 to 14,998 unique texts.

Prejudice and conflict are detected along with their positive counterparts to make results more sound. Overall prejudice and positive stereotyping are detected with a combination of two core questions: (a) whether the text is devoted to the topic of

ethnicity, i.e. whether the ethnic status of the character(s) matters for the meaning of the text; and (b) what is the overall attitude of the text author to the character described with an ethnonym – positive, negative or neutral. The second question is given to coders only if the topic of ethnicity is present, because only if the ethnic status of the character is important, the attitude to this character may be based on it and, therefore, may be prejudiced.

To detect more nuances of prejudice we ask if the ethnic characters are seen as superior/inferior, aggressors/victims, dangerous/non-dangerous, and if the call for violence against them is present. We also ask if the mentioned character is an individual or the generalized group as we hypothesize that stereotyping is related to generalizations. We, indeed, find that in around 88% of interpretable instances ethnic characters are generalized mentions of ethnic groups.

For conflict detection, we use questions asking if inter-ethnic conflict or positive inter-ethnic interaction are mentioned in the text. For tension detection, we use the questions about presence of general negative and positive sentiment; we think that on the aggregate level, prevalence of negative sentiment in texts about a certain ethnic group can indicate tensions related to it. Finally, we use a number of control and filtering questions.

We get each text coded by at least three independent persons, and as one text may contain multiple ethnonyms we obtain 32,701 unique instances of ethnonyms in texts detected, albeit not all of them detected by multiple coders.

As we have already experimented with feature selection and feature weighting (unigrams against bigrams+unigrams, and tf-idf weights against raw frequencies) and found they have a modest effect on the quality of our instrument, our two major assumptions are about the effects of collection size and inter-rater agreement. The latter in our case may depend both on coding quality and on the ambiguity of the issues being coded; unfortunately, it is difficult to differentiate between them because there seems to be no ground truth other than the opinion of coders.

### 4.    Results.

In this research we replicate our classification procedure from Koltsova and colleagues [15] on the enlarged collection. We train logistic regression with scikit-learn library with the best parameters from the previous research thus "teaching" the computer to guess what humans think about the texts. For that purpose, we average their scores and round them to obtain distribution of our texts over the "true" (human-driven) classes. We then check the work of our algorithm against these classes with traditional quality metrics: recall (the ability of the algorithm to find all texts of a given true class) and precision (the ability to find only those texts that are truly of a given class). Not all classes are of equal interest for us, but those that are not interesting (e.g. texts without any attitude) prevail in numbers. As prevailing classes usually contribute most to the quality of classification, and are simultaneously better predicted, we focus our attention on precision and recall for our target classes – e.g. for texts with conflict vs texts without conflict. Therefore, it is for these classes that we report the gain over the baseline algorithm: a classifier that randomly assigns classes to texts / instances, albeit keeping the true class proportion.

We start from the core question about attitude towards ethnic characters (see Table 1). We see that both quality metrics have improved significantly compared to the previous research [15]. The only exception is recall for positive attitude detection.

However, we do not see much improvement for the variables related to inter-group interaction and general sentiment (Table 2). With our collection being doubled, the quality has increased only by a few percent and it has even dropped for recall in positive sentiment. Although in any case we exceed the baseline, this situation is surprising as usually an increase in collection size is thought to be important for quality.

**Table 1**. Attitude to ethnic characters expressed in user texts: quality of prediction.

|  | Precision | Recall | F1-score |
|---|---|---|---|
| Class -1 (negative attitude) | 0,61 | 0,36 | 0,45 |
| Class 0 (neutral attitude) | 0,73 | 0,93 | 0,82 |
| Class +1 (positive attitude) | 0,67 | 0,36 | 0,47 |
| Average | 0,67 | 0,55 | 0,58 |
| Gain over random baseline for class -1 | 0,44 | 0,19 | 0,28 |
| Gain over random baseline for class +1 | 0,46 | 0,14 | 0,25 |
| Gain over previous research for class -1 | 0,18 | 0,15 | 0,17 |
| Gain over previous research for class +1 | 0,18 | 0,03 | 0,08 |

The major difference of the *attitude* variable from the rest is that from a text-level feature it has become an instance-level feature which means that the increase in collection size has been dramatic – from 7 to 32 thousand entries. In the earlier research we analyzed data for only one ethnonym for each of 7,181 texts, while here we used the full data. The quality has increased despite some 11 thousand of instances were coded only by one coder and other 12 thousand got graded by two coders who diverged in 2,824 cases. Also, 9,925 texts contain multiple ethnonyms, who received different average grades on attitude in 2,375 cases and opposite grades in 640 cases. Although we did not filter out those cases either, the quality is still good.

**Table 2.** Presence of positive and negative sentiment, inter-ethnic conflict and positive inter-ethnic interaction in user texts: quality of prediction.

|  |  | Precision | Recall | F1-measure |
|---|---|---|---|---|
| Negative sentiment | Class 1 (has neg. sent.) | 0,81 | 0,87 | 0,84 |
|  | Average | 0,75 | 0,73 | 0,74 |
|  | *Gain over prev. research, class 1* | *+0,05* | *+0,09* | *+0.07* |
| Positive sentiment | Class 1 (has pos. sent.) | 0,66 | 0,36 | 0,46 |
|  | Average | 0,72 | 0,64 | 0,65 |
|  | *Gain over prev. research, class 1* | *+0,03* | *-0,08* | *-0,06* |
| Inter-ethnic conflict | Class 1 (has conflict) | 0,70 | 0,64 | 0,67 |
|  | Average | 0,71 | 0,71 | 0,71 |
|  | *Gain over prev. research, class 1* | *+0,03* | *+0,07* | *+0,06* |
| Positive interaction | Class 1 (has pos. interaction) | 0,61 | 0,30 | 0,41 |
|  | Average | 0,70 | 0,62 | 0,63 |
|  | *Gain over prev. research, class 1* | *+0,03* | *+0,03* | *+0,04* |

We then assume that the quality of classification may depend on inter-rater agreement: the classes that humans find difficult to discern between may indeed possess fewer lexical differences and thus be harder to detect automatically. We compute several inter-rater agreement metrics on subsets of cases that got three grades each. We then compare our variables by the following metrics: Krippendorf's alpha, Fleiss' kappa, average pairwise Cohen's kappa, average pairwise agreement, the share of cases with three coinciding grades, the share of cases with two coinciding grades, and the ratio between these two shares both in general and for target classes specifically. The

differences between these metrics for different variables are in most cases not too high, and we do not observe any clear relation between them and the quality of classification. Therefore we do not repost the values here.

Instead, we have found in literature [16] that positive classes are usually harder to predict than negative which is what we observe in our case. We, nevertheless, exceed the quality reported in [16]. We also observe that using tf-idf weights instead of raw frequencies highly prioritizes precision over recall, and although the overall F1-measure is usually higher with tf-idf weights in developing alert systems for early detection of ethnic tensions, recall might be more important.

Next, we examine class sizes for all variables, including those that could not be modeled before due to their scarcity. We define class size as the number of cases that were coded by at least three coders of whom at least two thirds agreed on a given class plus the number of cases coded by two coders both of whom agreed. We find that call for violence is represented by only 106 instances and presentation of ethnic groups as dangerous – by 601 instances. Most other class sizes start from 1000 although *aggressor* is smaller, still we choose to develop a pilot model for both victim/aggressor and inferior/superior variables (see table 3). These models differ from the others in one respect: only cases representing the target classes have been taken into the analysis with the dominant neutral class being excluded. We obtain good quality for two of the four categories. Although *aggressor* is the smallest class, it is *victim* and *inferior* that are predicted worse, and generally we do not find any correlation between target class size and absolute quality or quality gain over the baseline.

**Table 3.** Treatment of ethnic characters as victims, aggressors, inferior or superior groups in user texts: quality of prediction.

|  | Quality | | | Gain over random classifier | | |
|---|---|---|---|---|---|---|
|  | Precision | Recall | F1 | Precision | Recall | F1 |
| Class 0: victim | 0,54 | 0,44 | 0,48 | 0,07 | 0,15 | 0,11 |
| Class 1: aggressor | 0,70 | 0,77 | 0,73 | 0,16 | 0,06 | 0,11 |
| *Average* | 0,62 | 0,61 | 0,61 | | | |
| Class 0: inferior | 0,65 | 0,64 | 0,64 | 0,19 | 0,18 | 0,18 |
| Class 1: superior | 0,70 | 0,70 | 0,70 | 0,13 | 0,16 | 0,16 |
| *Average* | 0,67 | 0,67 | 0,67 | | | |

## 5.    Conclusion and future research.

In this work we improve our instrument that now shows higher quality in detection of more aspects of prejudice and inter-ethnic tensions in online user texts than before. In particular the system is good at predicting when an ethnic character or a group is presented as aggressor, which allows tracking cases of group-level blame attribution. It is equally good in finding cases when a group is treated as superior over others which allows detecting ethno-centric biases. General negative sentiment is also well predicted; coupled with analysis of ethnonyms mentioned in respective texts it may help analysts determine which ethnic groups are related to this negativism and, therefore, might arouse ethnic tensions.

Some other aspects are predicted with reasonable quality. Among them are the cases in which ethnic characters and groups are treated as inferior which is one of the most direct indications of prejudice. Presence of inter-ethnic conflict is also fairly well predicted being one of the most important elements for constructing early alert systems that can help prevent ethnic conflict both online and offline. Predictions of negative and positive attitude to ethnic characters, as well general positive sentiment and positive inter-ethnic interaction stands relatively high in terms of precision, but quite low in terms

of recall. To date the algorithm fails to find about two thirds of such cases. Shifting from tf-idf term weights to raw word frequencies increases recall up to 45% but results in the drop of precision to as low as 50%.

We also examine dependence of quality of prediction on collection size, target class size and various measures of inter-rater agreement, but we do not find any sound trend. However, so far for all variables we have used as many cases as possible, including those coded by a single coder in order to increase target class size. As the latter does not appear to be crucial, one of the directions for future research is to set stricter inter-rater agreement thresholds for including cases into target classes. With a large proportion of ambiguous texts it may make sense to try fuzzy classification. Finally, there is a lot to try in terms of models other than logistic regression, as well as in terms of enrichment of the data with external information, such as distributed word representations.

## Acknowledgements

## References

[1] L.R.Tropp, The psychological impact of prejudice: implication for intergroup contact, *Group Processes and Intergroup Relations* **6:2** (2003), 131-149.

[2] D.P.Green, L.R.Seher, What role does prejudice play in ethnic conflict? *Annual Review of Political Science* **6** (2003), 509-531.

[3] M.Hsueh, K.Yogeeswaran, S.Malinen, Leave your comment below: can biased online comments influence our own prejudicial attitudes and behaviors? *Human Communication Research* **41:4** (2015), 557-576.

[4] L. Quillian, New approaches to understanding prejudice and discrimination. *Annual Review of Sociology* **32** (2006), 299–338.

[5] G.W. Allport, *The Nature of Prejudice*, Addison, New York, 1954.

[6] E.R. Smith, Social identity and social emotions: toward new conceptualizations of prejudice. In: D.M. Mackie, D.L. Hamilton (eds*) Affect, Cognition and Stereotyping: Interactive Processes in Group Perception,* Academic Press, INC, San Diego, 1993, 297-315.

[7] T. D. Nelson, *Handbook of Prejudice, Stereotyping, and Discrimination,* Psychology Press, New York, 2009.

[8] T.A. van Dijk, *Prejudice in Discourse.* Benjamins, Amsterdam, 1984.

[9] T.A. van Dijk, *Racism and the Press*, Routledge, London, 1991.

[10] E. Ponarin, D. Dubrovsky, A.N. Tolkacheva, R. Akifiev,. Index of press (in)tolerance. In: A. Verkhovsky (ed) *Hate Speech against the Society*, Sova, Moscow, 2007, 72-106 (in Russian).

[11] N.D. Gitari, Z. Zuping, H. Damien, J. Long, A lexicon-based approach for hate speech detection. *International Journal of Multimedia and Ubiquitous Engineering* **10**, (2015), 215–230.

[12] W. Warner, J. Hirschberg, Detecting hate speech on the world wide web. *Proceedings of the Second Workshop on Language in Social Media (ACL-2012)*, (2012), 19–26.

[13] M. Rosell, C. Mårtenson, F. Johansson, P. Hörling, M. Malm, S. Truvé, J. Brynielsson, Detecting emergent conflicts through web mining and visualization, *European Intelligence and Security Informatics Conference,* (2011), 346-353.

[14] T. Delavallade, L. Mouillet, B. Bouchon-Meunier, Monitoring event flows and modeling scenarios for crisis prediction: application to ethnic conflicts forecasting. *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems* **15**:supp01, (2007), 83-110.

[15] O. Koltsova, S. Nikolenko, S. Alexeeva, O. Nagorny, S. Koltcov, Detecting interethnic relations with the data from social media, *Proceedings of the Second International Conference "Digital Transformation & Global Society",* (2017) (forthcoming).

[16] M. Thelwall, K. Buckley, G. Paltoglou, D. Cai, A. Kappas, Sentiment strength detection in short informal text. *Journal of the American Society for Information Science and Technology* **61:12**, (2010), 2544–2558.

# Attention and Social Cognition in Virtual Reality: The effect of engagement mode and character eye-gaze

Brendan ROONEY[a], Katalin BALINT[b], Thomas D. PARSONS[c*], Colin BURKE[a], Tess O'LEARY [a], Sharon Chi Tak LEE [a], and Caroline MANTEI[a]

[a]*University College Dublin, Ireland*
[b]*University of Augsburg, Germany*
[c]*Computational Neuropsychology and Simulation (CNS) Lab, Department of Psychology, University of North Texas, Denton, Texas USA*

**Abstract.** Technical developments in virtual humans are manifest in modern character design. Specifically, eye gaze offers a significant aspect of such design. There is need to consider the contribution of participant control of engagement. In the current study, we manipulated participants' engagement with an interactive virtual reality narrative called Coffee without Words. Participants sat over coffee opposite a character in a virtual café, where they waited for their bus to be repaired. We manipulated character eye-contact with the participant. For half the participants in each condition, the character made no eye-contact for the duration of the story. For the other half, the character responded to participant eye-gaze by making and holding eye contact in return. To explore how participant engagement interacted with this manipulation, half the participants in each condition were instructed to appraise their experience as an artefact (i.e., drawing attention to technical features), while the other half were introduced to the fictional character, the narrative, and the setting as though they were real. This study allowed us to explore the contributions of character features (interactivity through eye-gaze) and cognition (attention/engagement) to the participants' perception of realism, feelings of presence, time duration, and the extent to which they engaged with the character and represented their mental states (Theory of Mind). Importantly it does so using a highly controlled yet ecologically valid virtual experience.

**Keywords.** Virtual Reality; Social Cognition; Virtual Human; Attention

## 1.  Introduction

The current study seeks to examine the contribution of perceptual and conceptual cues on feelings of presence using a virtual environment. The role of perceptual cues will be explored through the manipulation of avatar eye gaze to either give no eye contact or natural semi-regular eye contact to the viewer. Using eye gaze to examine the contribution of perceptual cues on presence is ideal because the avatar's eye gaze behavior can be standardized, meaning that differences between participants can be

---
* Corresponding Author, thomas.parsons@unt.edu.

attributed entirely to these manipulations. The conceptual influence on presence will be investigated through the provision of instructions that, prior to viewing the virtual reality video, make salient the narrative based aspects or those that encourage attention to the design of the video as an artefact. With the common finding that a user's mental state affects the virtual reality experience [1, 2], the provision of narrative information to the participants should allow them to engage further with the virtual environment. Examining perceptual and conceptual variables together will expand the understanding of how these variables work independently and in combination to affect feelings of presence in the virtual environment. This effect will be further explored by considering the participants perception of time as an index of their feelings of presence[3, 4]. Identifying the conditions under which virtual reality users experience a sense of presence can improve practical applications while yielding valuable insights into human cognition.

Hypothesis one predicts that self-report duration and passage of time judgments will be significantly related to presence as measured by the ITC-SOPI [5]. The second hypothesis predicts that a significant difference will be observed between the four conditions, as created by the use of two conceptual and two perceptual cues, in levels of experienced presence. More specifically, those participants in the third condition who received eye contact as well as the narrative cue will experience the highest degree of self-reported presence. Furthermore, a secondary aim of this research is to utilize participant's experience of time perception

to assess the effectiveness of the ITC-SOPI as a measure of presence. Self-reported time perception is based on the same sense of conscious awareness that can affect levels of presence [6], and exploring time perception and self-reported presence together can contribute to establishing a more reliable measure of presence in virtual environments.

## 2.   Methods

This study used an independent group, experimental design that consists of two independent variables. The first independent variable was eye gaze behavior, which had two levels (eye contact or no eye contact) and the second independent variable was the conceptual cue, which also had two levels (narrative-based or artefact based). Participants were randomly assigned to four conditions (narrative-based conceptual cue with avatar eye contact, narrative-based conceptual cue with no avatar eye contact, artefact-based conceptual cue with avatar eye contact, and artefact-based conceptual cue with no avatar eye contact). Self-report measures of time perception and presence served as the dependent variables. Time perception included duration judgments, accuracy scores and passage of time judgments. Presence was measured using the Spatial Presence, Engagement, Ecological Validity and Negative Effects subscale of the ITC-SOPI [5].

### 2.1 Participants

The University's Institutional Review Board approved the study. Twenty participants, from a university campus (6 males, 14 females, age range 18-30 years, mean age = 22 years, SD = 8.4 years) volunteered for this study. Participants were randomly allocated to one of the four conditions while maintaining a gender balance.

*2.2 Measures and Procedure*

The sample video was run on an ASUS computer using the Oculus program and the Oculus Rift headset and the sound was controlled on a One Concept NHT 1051 speaker system. Participants viewed the test video through the Oculus Rift headset, which was presented in a pre-existing virtual environment through the program "Coffee Without Words".



**Figure 1.** Screenshot of female avatar during "Coffee Without Words" video in the eye contact condition.



**Figure 2.** Screenshot of male avatar during "Coffee Without Words" video in the eye contact condition
The video was programmed to differ depending on the condition that participants were assigned to. Participants in conditions 1 and 2 received no eye contact from the avatar,

and the video was programed so that the avatar "should ignore player" during the entire duration. Participants in conditions 3 and 4 received contact from the avatar, which consisted of full gazes that lasted between 7 and 13 seconds and short gazes that lasted between 1 and 1.5 seconds. The neutral period in between gazes was programmed to be between 10 and 20 seconds. Participants were gender matched to the avatar they viewed in the video, which can be seen in Figures 1 and 2. During the video the user was seated at a table in a coffee shop across from the avatar, no other action took place.

*Self-reported time perception*: Self-reported perception of time was measured using two retrospective questions immediately after participants watched the virtual reality test video, "Coffee Without Words": 1) "Estimate how long in minutes and seconds that the video lasted for" was a retrospective duration judgment; and 2) "At what rate did time seem to pass in the virtual environment compared to normal?" was a retrospective passage of time judgment that required participants to indicate, on a 5-point scale (1-5), their experience of time passage during the video.

*Presence:* The participant's feelings of presence in the virtual environment were measured using an adapted version of The ITC-Sense of Presence Inventory (ITC-SOPI)[5].

*Validity of conceptual cues*: To determine whether the conceptual cues, either narrative-based or artefact-based, were having the desired effect on the user's experience of the mediated environment, participants were asked if during the virtual session they were "mostly thinking about the fictional story of this café scenario" or were "mostly thinking about how this café and the character were designed". Participants indicated their opinion of both of these statements on a seven-point Likert scale (1-7).

*Controlling familiarity:* The current study controlled for the potentially confounding familiarity of the avatars used in the "Coffee Without Words" video by asking participants "did the character in the virtual environment look like anyone you know" and if "Yes" was selected they were asked to "please tell us who the character looked like". This allowed the researcher to consider the effect of the familiarity of the character when evaluating participant's responses. Four participants indicated that the character in the virtual environment reminded them of someone they knew (3 in the eye contact condition and 1 in the no-eye-contact condition).

*2.3 Results*

Failing to support hypothesis one, no significant correlation was observed between any time perception and presence variables. Thus, the perceived experience of time for participants during the virtual reality video was not significantly related to their experience of presence within the mediated environment.

No significant group differences were observed in the extent to which participants reported attending to the video as a narrative, $t(43) = -.661$, $p>.05$, or an artefact, $t(43) = -.216$, $p>.05$, indicating that the instruction manipulation was unsuccessful. For this reason, the groups based on conceptual cue were collapsed and group differences in perceptual cue (eye-contact) were explored.

No significant difference was observed between the eye-contact conditions in terms of their scores on the Spatial Presence subscale, $F(1,49) = .12$, $p > .05$. This means that differences in scores on the Spatial Presence subscale did not arise from avatar eye gaze behavior. Scores on the Engagement subscale were also not found to differ significantly due to perceptual cues, $F(1,47) = 3.49$, $p > .05$.

Results revealed a significant group effect of perceptual cue (avatar eye-contact) on participants' perceived ecological validity of the video, $F(1,49) = 5.54$, $p < .05$, that is, the degree to which the experienced the video as perceptually natural or representative of the real world. Results revealed that participants in the condition with no eye-contact reported that the video was higher in terms of ecological validity (M = 4.58, on a 7-point scale) compared to their eye-contact counterparts (M = 3.88 on a 7-point scale). Thus participants in the condition with no eye contact rated the video as more natural. Those participants also reported significantly higher levels of negative effects (e.g. headache, dizziness) from the virtual reality (M = 2.64 on a 7-point scale), when compared to those in the eye-contact condition (M = 2.01), $F(1,49) = 8.23$, $p < .01$. Although it is notable that these scores are quite low across the conditions.

## 3. Discussion

The contribution of perceptual and conceptual cues on feelings of presence within a virtual environment was examined using measures of time perception and self-reported feelings of presence. Results revealed no significant relationship between any time perception and presence variables. Thus, the perceived experience of time for participants during the virtual reality video was not significantly related to their experience of presence within the mediated environment. Also, a negative correlation was observed between passage of time and duration and accuracy scores, suggesting that duration and passage of time judgments reflect different aspects of the experience of time.

Perceptual cues were manipulated by programming gender-matched avatars in the virtual reality video, "Coffee Without Words", to give either semi-regular eye contact or no contact at all to the user. Conceptual cues were manipulated by providing either narrative based information through a relevant background story, or artefact based information relating to the design of the virtual environment, to participants prior to viewing the video. Conceptual cue manipulation was deemed unsuccessful by findings that participants in each group did not differ in terms of how much they attended to narrative or artefact aspects of the video.

Following this, conceptual conditions were collapsed and analyses focused on comparisons between participants who differed in terms of the perceptual cue. In other words, we compared groups of participants who experienced no eye-contact from the avatar with those who experienced natural semi-regular eye contact. Here we observed no effect of perceptual cues on reported spatial presence or engagement. It is possible that the conceptual and perceptual manipulations were not strong enough to shift participants' experience of an already highly immersive virtual experience.

However, participants who experience no eye-contact perceived the video to be more natural than those who experienced eye-contact. This finding is not in line with our predictions based on previous work [7, 8, 9]. Cautiously we suggest that participants may

have rated the lack of eye-contact as more natural in a situation where they sat opposite a stranger they did not know. In this situation perhaps participants would not expect eye contact and so reported the lack of eye-contact as more natural.

In summary, this study observed no effect of manipulating the conceptual context of a virtual reality experience on participants' time perception nor on their self-reported feelings of presence (spatial presence, engagement or ecological validity). Further we report here that manipulating perceptual cues in the form of avatar eye-contact effects participant's perceived realism of the virtual experience, but not their spatial presence nor their engagement. While eye-contact in this case reduced perceived realism, regardless of the direction of the observed effects, our findings demonstrate that perceptual cues are more powerful than conceptual cues in shaping participants' experience of perceived realism in virtual experiences.

## References

[1]     M. Avram, D. Opris, and D. David, The Effects of Expectancies on Presence in Virtual Environments: A Brief Research Report. *Transylvanian Journal of Psychology,* **15** (2014) 21–31.
[2]     D. Nunez, and E. Blake, Conceptual Priming as a Determinant of Presence in Virtual Environments, *ACM Afrigraph*. **1** (2003) 101–108.
[3]     T. Sanders, and P. Cairns, Time perception, immersion and music in videogames, *BCS '10 Proceedings BCS HCI* (2010), 160–167.
[4]     J.H. Wearden, and H. Lejeune, Scalar properties in human timing: conformity and violations, *Q. J. Exp. Psychol.* **61** (2008), 569–87.
[5]     J. Lessiter, J. Freeman, E. Keogh, and J. Davidoff, A Cross-Media Presence Questionnaire: The ITC-Sense of Presence Inventory, *Presence*. **10** (2001) 282–297
[6]     D. Zakay, and R.A. Block, Prospective and retrospective duration judgments: an executive-control perspective, *Acta Neurobiologiae Experimentalis*. **64** (2004) 319–328.
[7]     N. Yee, J.N. Bailenson, M. Urbanek, F. Chang, and D. Merget, The unbearable likeness of being digital: The persistence of nonverbal social norms in online virtual environments, *CyberPsychology & Behavior*. **10** (2007) 115–121.
[8]     J.N. Bailenson, A.C. Beall, J. Loomis, J. Blascovich, and M. Turk, Transformed Social Interaction, Augmented Gaze, and Social Influence in Immersive Virtual Environments, *Human Communication Research*. **31** (2005) 511–537.
[9]     S.Y. Oh, J. Bailenson, N. Krämer, B. Li, M. Cuddon, N. Goharpey, J. Maurer, S. Rosini, A. Tsekouras, and D. Grace, Let the Avatar Brighten Your Smile: Effects of Enhancing Facial Expressions in Virtual Environments, *PLoS One*. **11** (2016) 1–18.

# Self-disclosure online and offline: the Effect of Age

Yadviga SINYAVSKAYA[*],[a] and Olessia KOLTSOVA[a]

[a]*National Research University Higher School of Economics, Laboratory for Internet Studies, Saint-Petersburg, Russia*

**Abstract.** In this research, we study how people of different ages disseminate personal information in a social networking site (SNS) and regulate access to their profiles. We focus on Vkontakte as the most popular SNS in Russia and obtain both observational data on privacy settings and self-reported data on users' offline behavior from 145 respondents. We also reveal the types of information that is most often hidden online. Contrary to our expectations, the results show the negative relationship between age and privacy regulation. In addition, the information about personal preferences and views tends to be more concealed than contact information.

## 1. Introduction

Growth of Social Networking Sites (SNS) has brought about various privacy concerns and risks of which users are not always aware. This unawareness might be stronger among those who were socialized in the "pre-Internet era".

Previous research on age and online privacy yields inconsistent results: some studies point out that personal boundaries become tougher with age [1-2], however others claim them to expand [3-4]. It has also been shown that computer skills and awareness of privacy risks mediate the differences in privacy level between senior and young users [2,4]. One argues that it is related with self-disclosure patterns in face-to-face communication: some people tend to be more open in "real" world rather than in virtual space [5].

This work aims to investigate how people of different ages disseminate personal information in an SNS and regulate access to their profiles. More specifically, we examine the difference between self-disclosure towards friends and strangers in relation to age. As a result, we are able to identify whether openness to friends and strangers in SNS is associated with age. In addition, we were able to find out what types of personal information tend to be disseminated more easily to SNS users, and what types are the most concealed.

## 2. Data and method

We analyzed a sample of 145 users of the most popular Russian SNS VKontakte aged from 14 to 82. All of them have consented to fill in the survey and to give the researcher the level of access to their VKontakte pages they provide to their friends.

Unlike most studies that use self-reported data only, we start from hand-coding user SNS pages and calculating indices of their self-disclosure towards friends and strangers.

---

[*] Corresponding Author: yasinyawskaya@mail.ru

Indexes were calculated using a frequency-based method described in [6]. This approach assigns unequal weights to instances of disclosure of different items, such as telephone numbers or musical tastes. By aggregating these weights, the approach calculates general privacy score for each user.

A simple model to compute the privacy score is the following naive model [6]: If $|Ri|$ denotes the number of users who set $R(i, j) = 1$, then the sensitivity $\beta i$ for binary matrices can be computed as the proportion of users that are reluctant to disclose item i. That is,

$$\beta i = \frac{n - |Ri|}{n}$$

The higher the value of $\beta i$, the more sensitive item i.

The computation of visibility in the binary case requires an estimate of the probability $Pij = Prob\{R(i, j) = 1\}$. Assuming independence between items and users, we can compute $Pij$ to be the product of the probability of a 1 in row $Ri$ times the probability of a 1 in column $|Rj|$ That is, if $|Rj|$ is the number of items for which j sets $R(i, j) = 1$, we have

$$Pij = \frac{|Ri|}{n} \times \frac{|Rj|}{n}$$

Probability $Pij$ is higher for less sensitive items and for users that have the tendency to disclose many of their profile items.The privacy score of user j due to item i, denoted by $Pr(i, j)$ can be any combination of sensitivity and visibility. In order to evaluate the overall privacy score of user j, denoted by $Pr(j)$, we can combine the privacy score of j due to different items. We also evaluate the level of self-disclosure in face-to-face communication via an online survey that partly applies Jourard Self-Disclosure Questionnaire (Jourard, 1959). From it, we have selected 16 aspects that could be matched to respective online behavioral patterns (e.g. disclosure of religious views or cultural preferences). As observational and self-reported data are of different nature, we do not compare them directly.

### 3. Findings

*3.1 Age and Self-disclosure online*

Unsurprisingly, people turn to be more open to their friends than to strangers online, however these two indices of self-disclosure are positively correlated (r=0.575, p<0.01). We also find a weak positive relationship between age and the level of general self-disclosure to strangers (r=0.219, p<0.01), but not to friends. That is, older users provide a bit more information on their accounts to unacquainted people than younger users.

A closer look at the data reveals a mixture of two distributions: a cluster of users with nearly linear dependence between the indices of openness to friends and strangers, and a cluster of those who are firmly closed from online strangers but are highly open to online friends. This distribution is most probably explained by the fact that accounts in these two clusters differ in privacy settings: the former do not limit the access to profile information, while the latter grant access to their data to befriended accounts only. This means that for open accounts the amount of disclosed information both to friends and strangers is a function of the number of fields a user chooses to fill in, while application of privacy settings cuts off strangers from large bulks of the already filled in fields at a time

To overcome a possible bias that may follow from this, the sample was divided into two groups: the former who keep the profile open ("open" accounts, 58 users) and the latter who had applied some privacy settings ("restricted" accounts, 87 users). We compared the amount of information hidden from strangers by closed accounts with the amount of information not provided by open accounts, and we found no statistically significant difference between them. In addition, we found out that closed accounts are more typical of younger users (r=0,326, p<0.01) which turns to be the main reason of the general correlation between age and self-disclosure. However, when studying the groups of open and closed accounts separately, we observe no correlation between the age and the amount of disclosed information within any of these two groups.

To sum up, user age is related to privacy regulation, but not to self-disclosure: younger users are more inclined to regulate the access to their SNS profiles than older individuals.

### 3.2 Sensitivity of profile information and age

The procedure of calculation of individual privacy scores yielded the scores of sensitivity (β) of each profile item – that is, we found out what types of information was most often hidden both from friends and from strangers. We consider this information the most sensitive; figure 1 presents types of information ranked by sensitivity (0 – the most sensitive; 1 – the least sensitive). It turns out that in general the information of personal preferences, views and tastes is the least disclosed, (although home address is the most sensitive of all).

Our point-by-point analysis of relationship between age and specific information disclosure has revealed only one significant relationship: older users tend to disseminate the information about political views a bit more than younger ones (r=0,261, p<0.01).

### 3.3 Self-disclosure online and offline

Levels of offline and online self-disclosure are not correlated; on the whole, respondents report higher levels of offline openness than they actually demonstrate online.

### 4   Conclusion

Our study shows that user age is related to privacy regulation, but not to self-disclosure: younger users are more inclined to regulate the access to their SNS profiles by privacy settings than older citizens. Personal preferences and views get more concealed by users than most contact information, except home address. High sensitivity scores of these profile items may indicate their low value for users who choose not to fill in the respective fields rather than the true desire of individuals to hide their views than. By contrast, low sensitivity of contact information may indicate its high value for increasing individual social capital: it may help users to find like-minded people with similar backgrounds. It turns out also that offline and online realities are not closely related: most people report high levels of offline openness, while their self-disclosure behavior online may vary.
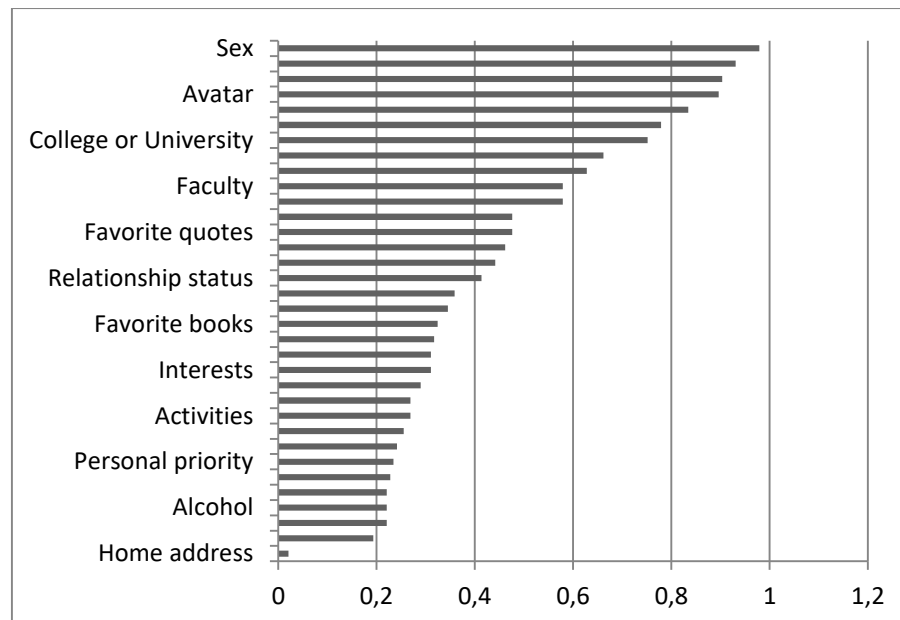
**Figure 1.** The sensitivity of personal information in Vkontakte SNS[*]

## Acknowledgements

## References

[1] S. Livingstone, K. Ólafsson, E. Staksrud, *Social networking, age and privacy.* EU Kids Online, London, UK, 2011.

[2] M. Kezer, B. Sevi, C. Zeynep, L.Baruh, Age differences in privacy attitudes, literacy and privacy management on Facebook, *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, **10** (2016), online doi: 10.5817/CP2016-1-2

[3] M. Madden, A. Lenhart, S. Cortesi, U. Gasser, M. Duggan, A. Smith, M. Beaton, Teens, social media, and privacy, *Pew Research Center*, **21** (2013), 2-86

[4] E. Van den Broeck, K. Poels, M. Walrave, Older and wiser? Facebook use, privacy concern, and privacy protection in the life stages of emerging, young, and middle adulthood, *Social Media and Society*, **1** (2015), doi:2056305115616149

[5] L. Emanuel, G. J. Neil, C. Bevan, D.S. Fraser, S. V. Stevenage, , M.T.Whitty, S. Jamison-Powell, Who am I? Representing the self-offline and in different online contexts, *Computers in Human Behavior*, **41**(2014), 146-152.

[6] E. Zheleva, E.Terzi, L.Getoor, Privacy in social networks, *Synthesis Lectures on Data Mining and Knowledge Discovery*, **3**(2012), 1-85.

---

[*] Smoke = smoking status; Inspiration = sources of inspiration; Personal priority = main thing in life; Important in others = main thing in people; Mobile = mobile phone number; Mode of study = type of university enrollment

# A frame effect in Avatar Customization: how users' attitudes towards their avatars may change depending on virtual context

Stefano TRIBERTI[a,*], Ilaria DUROSINI[a], Filippo ASCHIERI[a,b] Daniela VILLANI[a] , Giuseppe RIVA[a,c]

[a] *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*
[b] *European Center for Therapeutic Assessment, Università Cattolica del Sacro Cuore, Milan, Italy*
[c] *Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan, Italy*

**Abstract.** The sense of "being there" that Virtual Reality/Worlds may promote in users depends on multiple factors, one being the relationship between users and the digital figures representing their agency/identity in the simulation (i.e., avatars). Avatars offer innovative resources for psychological assessment, such as clues about users' self-conception. However, avatar customization may vary depending on the Virtual World context it has to enter. We hypothesize that users may have different attitudes towards avatars created for different contexts; feel more or less represented by different avatars; and that such difference may be influenced by sex, self-esteem (evaluation of one's own self) and self-curiosity (disposition/interest to increase knowledge about one's own inner world). 87 students (45 females) created two avatars to be used in two different virtual contexts (i.e., Leisure vs. Job) and then responded to questions regarding attitudes towards both their own avatars, namely Similarity to Self, to Ideal Self, Attractiveness, and Difficulty in Customization. Moreover, they filled in validated questionnaires on self-esteem (Rosenberg Self-Esteem Scale) and self-curiosity (Self-Curiosity Attitude-Interest Scale). Results showed that Leisure-avatars were perceived easier to customize and more similar to self than Job-avatars. Analysis involving sex as another variable showed that this difference emerged in females specifically. Moreover, Leisure-avatars were also perceived more similar to ideal self than Job-avatars when controlling for self-curiosity. Discussion deals with implications for avatar assessment, in that attitudes towards avatars can be influenced by the virtual context, and by individual characteristics such as one's own disposition to understand him or herself.

**Keywords.** Avatar, Self, Self-Esteem, Self-Curiosity, Context, Virtual Worlds

## 1.  Introduction

Everyday thousands of social media and virtual communities' users interact and communicate by means of avatars, namely digital figures representing humans inside digital environments [1]. In the recent years, avatars attracted the interest of psychological research and a number of studies have been published proposing theories and research on the avatar phenomenon. Avatars are interesting for psychological studies

---
* Corresponding Author: stefano.triberti@unicatt.it

because of two main reasons: on the one hand, the avatar may influence his/her user's
behavior by means of modifying self-perception: this is the process known as "Proteus
effect" [2]. On the other hand, avatars are often created and customized by users
themselves. For this reason, considered as a mean for self-presentation, personalized
avatars may be more or less connected to one's own identity, so that avatars may become
relevant sources of information for psychological assessment, in particular about the
users' self [3,4]. Indeed, numerous studies demonstrated that avatar creation is not a
random process, rather it is influenced by individual factors such as personality, self-
esteem and the discrepancy between actual and ideal self (or in other words, between
how one sees him or herself, and how one desires to be) [3, 5–7]. Less explored is the
effect of *context* on avatar creation instead. For example, Vasalou and Joinson [8]
showed that information about context may influence user behavior while customizing
an avatar:, participants who expected to enter a dating-oriented virtual context, then
created more attractive avatars. These studies show that, although avatars may be more
or less related to one's identity, they can be modified or manipulated depending on
objectives and expectations. In this sense, we hypothesized that avatars may be *changed*
in appearance over time if the user expected to enter different contexts. Indeed, virtual
worlds users often have multiple avatars depending not only on the multiple virtual
platforms they utilize, but also on different objectives to be pursued inside the same
virtual context. Actually, this is consistent with those theories maintaining that the self
is not unique, stable, and monolithic; rather, one can have multiple self-conceptions
(good self, bad self, not-me self, ideal self, etc.) that can be made accessible at a
given moment [9] due to a host of factors that are more or less salient in a social
situation. The term "malleable self " [9] well captures such a dynamic,
multidimensional conceptualization of identity [10]. Consistently, one can have different
*attitudes* towards the multiple avatars that possibly resemble multiple self-conceptions:
for example, one may prefer an avatar over another because it is more attractive, or more
similar to ideal self, or more properly resuming one's preferred characteristics. Such
attitudes may be important to measure and analyzed, because they give information about
users' relationship with their own digital representations and, as a consequence, with
their multiple self-conceptions. Moreover, according to literature, avatar creation as well
as attitudes towards one's own avatars may be influenced by multiple factors.

### 1.1 Sex

One of the factors impacting avatar creation and attitudes towards avatars is sex.
Numerous studies showed that males and females tend to use avatars differently,
specifically they tend to reinforce gender stereotypes and/or to follow gender role
expectations [11] by means of avatar's characteristics and behavior. For instance,
adolescent girls tended to customize avatars with objects (jewelry, make up) that
highlighted the characteristics typical of their gender [3]; analogous results have been
found for children [12]. Moreover, another interesting phenomenon in this context is
gender swapping, namely the choice of some users to represent themselves with an avatar
belonging to the opposite sex. Usually such a behavior is not an indicator of sexual
identity disorder, rather it is enacted for strategic aims (e.g., being treated someway by
other users not aware of one's true sex) or hedonic motives not related to identification
(e.g., a female avatar is chosen just because it is a pleasant virtual object to watch) [13].

### 1.2  Self-esteem

According to Rosenberg and colleagues [14], self-esteem can be considered as the human evaluation of self, concerning beliefs such as personal competence, ability, self-attribution. Recent research revealed that self-esteem can have a central role during avatar customization. Dunn and Guadagno [7] revealed that people with low self-esteem tend to compensate their personality shortcomings with a different representation of self, for instance they strategically modify in the avatar those physical aspects they don't like in their real-life looks.

### 1.3  Self-curiosity

Self-curiosity is a psychological construct that represents the human disposition through the exploration of one's own inner world and the comprehension of one's own psychological functioning. Aschieri and Durosini developed a self-report measure, the Self-Curiosity Attitude-Interest Scale (SCAI) [15,16] that assesses curiosity about self in young adults and adults through seven items. The SCAI scale explores the construct of self-curiosity through two dimensions: 1) *Attitude towards self-curiosity*, and 2) *Interest in increasing knowledge of self*. On the one hand, the first factor assesses the disposition and cognitive propensity that people have to explore their aspect of self. Instead, the second factor describes the human interest in the exploration of their inner psychological processes. Research revealed that self-curiosity is related to a number of psychological constructs, and some of them may be important to self-presentation related processes such as avatar customization (e.g. self-reflection and mentalization) [15,16].

To date no studies have been carried out on the relationship between self-curiosity and avatar creation. As referred, the psychological construct of self-curiosity may be connected with the human tendency to discover the inner world. As a possible hypothesis, during avatar customization more self-curious people may be prone to create a version of themselves more similar to their own self-perception.

## 2.  Methods

The objective of the present research was to investigate differences among users' attitudes towards different avatars created for different contexts. 87 Italian participants (45 females, 42 males) between 18 and 36 years old ($M = 24.02$, $SD = 3.57$) recruited among university students created two avatars to be used in order to enter two different virtual contexts: 1) an online Leisure and 2) a Job-related social network. Avatars were created using the same platform, *WeeWorld*. After the creation of each avatar, participants responded to some specific questions. These questions were used in order to investigate participants' attitudes towards each avatar they created. They were:

- "How much is your avatar similar to how you really are?" (*Similarity to Self*);
- "How much is your avatar similar to how you would want to be?" (*Similarity to Ideal Self*);
- "How much attractive is your avatar?" (*Attractiveness*);

- "How much did you find this avatar difficult to customize?" (*Difficulty in Customization*)

Moreover, according to the variables possibly influencing avatar customization and attitudes towards different avatars, participants were asked to fill in the validated Italian versions of questionnaires on self-esteem (Rosenberg Self-Esteem Scale [14,17] and self-curiosity (SCAI; Self-Curiosity Attitude-Interest Scale [15,16]).

## 3. Results

In order to investigate differences among users' attitudes towards avatars created for leisure and job-related social network virtual contexts (within-subject variable), repeated-measures analysis of variance (ANOVA) were computed. Results highlighted that avatars created for Leisure virtual context were perceived significantly more *easy to customize* ($F(1,86) = 7.96$, $p = .006$; $\eta^2=.085$) than avatars created for a Job-related virtual context (Leisure: M=1.47, SD=.76; Job: M= 1.69, SD=.97). Also, Leisure avatars (M=3.29, SD=.75) are perceived significantly more *similar to self* ($F(1,86) = 10.09$, $p = .002$; $\eta^2=.105$) than Job avatars (M=2.99, SD=.84). Repeated-Measures Analysis of Covariance (ANCOVA) was computed in order to investigate whether self-esteem and Self-curiosity influenced participants' attitudes towards their two avatars. Results revealed that avatars created for entering into Leisure virtual context (M=3.03, SD=.91) were perceived more *similar to users' ideal self* than avatars created for Job condition (M=2.87, SD=.89) when controlling for self-curiosity ($F(1,84) = 4.42$, $p = .039$; $\eta^2=.050$). Finally, we run a Mixed-Design Analysis of Variance (ANOVA) with the two-level within-subjects variable (Participants' attitudes) and the two-level between subjects variable (Sex). The result was as follow: $F(1,85)=10.45$; $p=.002$; $\eta^2=.109$, with females perceiving Leisure avatars more similar to self (*M*=3.40; *SD*=.72) and Job avatars less similar to self (*M*=2.82; *SD*=.89); instead, no differences emerged between the two avatars for males (Leisure: *M*=3.17; *SD*=.76; Job: *M*=3.17; *SD*=.76).

## 4. Discussion and Conclusions

The present research investigated whether multiple avatars created by the same users may be differently perceived. Specifically, as avatars tend to have some relationship with their creators' Selves, it is possible that users would develop different attitudes towards them, in that they represent different aspects or versions of one's own self. Such information may be important while designing cyber-psychological interventions based on avatars' customization, since self-representation is an activity sensitive to contextual and social influences. In the present research, participants created two avatars for entering two different virtual contexts (leisure and job). Then, they responded to questions about both avatars and the overall creation process. First results show that the avatars created for the leisure-related context were perceived as more similar-to-self and less difficult to customize than their job-related counterparts. This seems to partially confirm that avatar creation is a process related to users' identity. Indeed, participants in our sample were university students. For this reason, they were probably more inclined to imagine themselves in leisure than in work contexts, in that work is still not part of

their everyday life; in this sense, avatars showing casual physical looks, wearing casual clothes and expressing passions/hobbies by accessories were perceived as more similar to their own representations of self, and also the customization process resulted more quick and immediate. However, another result shows that Leisure avatars were perceived more similar to self in females specifically. As previously said, literature [3,11] showed that people customizing avatars tend to reinforce gender roles and stereotypes. It is possible that females customizing avatars for a leisure context found more gender-related customization options (various feminine clothes, jewelry, hairstyle…) and were able to create more detailed representation of their "gendered" Selves.

Moreover, the present research investigated whether the attitudes towards digital representations of oneself may be influenced by personality traits and individual tendencies/abilities. While self-esteem did not lead to significant results, it emerged that the tendency to increase knowledge about one's own inner world (self-curiosity) [15,16] may influence the perception of leisure avatars as more similar to Ideal Selves.

Ideal self can be described as a perfected version of one's self perception. Although most of classic and recent research is focused on the discrepancy between ideal self and real/actual self as an important factor impacting people well-being [18], some scholars noticed that the capacity for the creation of an ideal self is stronger in some personalities than in others [19]. In this sense, it is possible that people with a higher self-curiosity (both attitude and interest towards the self) are more prone to construe, modify and detail an ideal version of themselves. For this reason, when customizing their avatars, highly self-curios participants maybe relied on ideal self as well as on actual self-representation, and lately identified leisure avatars as similar to ideal self too.

As a whole, these results stress the relevance of both context and internal psychological features on the results of psychological assessment. Self-representations planned to be used in formal, structured environments are less informative of personality features than those designed for informal activities. However, probably when people know themselves better, they tend to depict themselves in more complete and fulfilling manners than those with less access and interest in exploring their inner world. In conclusion, the present research shows that, as well as self-conception, one's digital representations may be multiple and various. Psychologists planning to use avatars to assess users' self-conception should take into consideration that these digital representations of self may be influenced by the virtual context they act in and, in virtue of this, they may represent different aspects of one's vision of him or herself, and may be influenced by sex differences and attitudes towards self-knowledge.

## References

[1]    S. Triberti and A. Chirico, Healthy Avatars, Healthy People, in: G. Graffigna, (Ed.) *Transforming Healthcare Practice through Patient Engagement*, IGI Global, Hersey, PA (2016),

[2]    N. Yee, J.N. Bailenson, and N. Ducheneaut, The Proteus Effect: Implications of Transformed Digital Self-Representation on Online and Offline Behavior, *Communication Research* **36** (2009), 285–312.

[3]    D. Villani, E. Gatti, S. Triberti, E. Confalonieri, and G. Riva, Exploration of virtual body-representation in adolescence: the role of age and sex in avatar customization, *Springerplus* **5** (2016).

[4]    D. Villani, E. Gatti, E. Confalonieri, and G. Riva, Am I my avatar? A tool to investigate virtual body image representation in adolescence, *Cyberpsychology, Behavior and Social Networking* **15** (2012), 435–440.

[5]     T. Mancini and F. Sibilla, Offline personality and avatar customisation. Discrepancy profiles and avatar identification in a sample of MMORPG players, *Computers in Human Behavior* **69** (2017), 275–283.

[6]     K. Fong and R. a. Mar, What does my avatar say about me? Inferring personality from avatars, *Personality and Social Psychology Bulletin* **41** (2015), 237–249.

[7]     R.A. Dunn and R.E. Guadagno, My avatar and me – Gender and personality predictors of avatar-self discrepancy, *Computers in Human Behavior* **28** (2012), 97–106.

[8]     A. Vasalou and A.N. Joinson, Me, myself and I: The role of interactional context on self-presentation through avatars, *Computers in Human Behavior* **25** (2009), 510–520.

[9]     H. Markus, Self-schemata and processing information about the self, *Journal of Personality and Social Psychology* **35** (1977), 63–78.ws

[10]    D. Oyserman, *Social Psychology: Handbook of Basic Principles*, New York, Guilford Press, 2007.

[11]    N.L. Muscanell and R.E. Guadagno, Make new friends or keep the old: Gender and personality differences in social networking use, *Computers in Human Behavior* **28** (2012), 107–112.

[12]    A. Inal, H. Sancar, and K. Cagiltay, Children's Avatar Preferences and their Personalities, in: *Proocedings of the Society for Information Technology & Teacher Education International Conference*, Orlando (2006).

[13]    S. Huh and D. Williams, Dude looks like a lady: Gender swapping in an online game, in: W.S. Bainbridge (Ed.) *Online Worlds: Convergence of the Real and the Virtual,* Springer, London (2010).

[14]    M. Rosenberg, *Society and the adolescent self-image.* Princeton, Princeton University Press (1965).

[15]    F. Aschieri and I. Durosini, Development of the self-curiosity attitude-interest scale, *TPM - Testing, Psychometrics, Methodology in Applied Psychology* **22** (2015), 327–347.

[16]    F. Aschieri, I. Durosini, M. Locatelli, M. Gennari, and J.D. Smith, Factor structure invariance and discriminant validity of the Self-Curiosity Attitude-Interest scale, *TPM - Testing, Psychometrics, Methodology in Applied Psychology* **23** (2016), 139–148.M..

[17]    Prezza, F.R. Trombaccia, and L. Armento, La scala dell'autostima di Rosenberg: Traduzione e validazione Italiana, *Bollettino Di Psicologia Applicata* **223** (1997), 35–44

[18]    D. Ogilvie, The undesired self: A neglected variable in personality research, *Journal of Personality and  Social Psychology* **52** (1987).

[19]    D. Schecter, The ideal self and other, *Contemporary Psychoanalysis* **10** (1974), 103–115.

# How virtual embodiment affects episodic memory functioning: a proof-of-concept study

Cosimo TUENA[a,c,*], Silvia SERINO[a,b], Alexandre GASTON-BELLEGARDE[c,d], Eric ORRIOLS[c,d], Dominique MAKOWSKI[c,d] Giuseppe RIVA[a,b], Pascale PIOLINO[c,d,e]

[a]*Department of Psychology, Università Cattolica del Sacro Cuore, Largo Gemelli, 1, 20100, Milan, Italy*
[b]*Applied Technology for Neuro-Psychology Lab, IRCCS Istituto Auxologico Italiano, Via Magnasco, 2 20149 Milan, Italy*
[c]*Memory and Cognition Laboratory, Paris Descartes University, Sorbonne Paris Cité, Institute of Psychology, Boulogne-Billancourt, France*
[d]*INSERM UMR S894, Center for Psychiatry and Neurosciences, Paris, France*
[e]*Institut Universitaire de France (IUF), France*

**Abstract.** Recent theories in the field of embodied cognition have pointed out the role of the body for episodic memory, i.e. the memory for personally experienced events. Although virtual embodiment has been used traditionally to investigate the different components of bodily self, it provides great advantages to manipulate the whole embodied experience. In the current study, we manipulated three different levels of virtual embodiment ("full embodiment", "medium embodiment", and "low embodiment"). All participants were asked to navigate in three different virtual cities and memorize all the events that they encountered within each environment. We evaluated the effect of different level of embodiment on the main feature of the recall and recognition (*i.e.,* what events have occurred) and sense of presence. Data emerge with interesting consequences on embodied cognition hypothesis. Accordingly, findings are discussed giving an innovative view of virtual reality as an embodied tool able to influence cognitive processes such as episodic memory.

**Keywords.** Embodiment, Episodic Memory, Embodied Cognition, Virtual Reality

## 1. Introduction

Episodic memory is a neurocognitive system which allows humans to remember personally experienced events (what) in their spatiotemporal context (where and when) along with their perceptual and affective details [1, 2]. One crucial element of episodic memory is binding, the process that connects these features [3]. Episodic retrieval is accompanied by autonoetic consciousness (*i.e.,* the ability of mentally travelling in subjective time in past and future events) assessed by RKG paradigm (Remember, Know and Guess paradigm) [4, 5].

Embodied cognition researchers have been recently drawn the attention to the body as being crucial for cognition [5]. As the mind shapes the body, the body shapes our

---

[*] Corresponding Author: cosimotuena@gmail.com

cognitive processes. In particular, embodiment can be defined as the effect of our body on cognition (*e.g.,* memory, language, attention, action) [6]. This effect occurs thanks to a sensorimotor simulation that can be defined as the process that allows the re-enactment of previous perceptual configuration. In particular, sensorimotor details lead to better memory performances due to a better encoding elaboration and useful traces during retrieval [8]. This effect was also shown when interacting within virtual environments by means of input devices [9, 11].

Virtual reality (VR) provides powerful multisensory experiences while interacting in simulated environments and can be conceptualized as an embodied technology [10]. Virtual embodiment can be successfully induced by visuomotor synchronicity that enables to alter self-consciousness [11]. Indeed, Kilteni *et al.* [14] showed that immersive VR is an effective tool in manipulating embodiment (*i.e.,* self-location, body ownership and sense of agency). Moreover, embodiment in a virtual avatar provides a rich interactive experience in simulated environments; this interaction could be exploited to enhance cognition, such as episodic memory [13]. Finally, VR offers standardized trials for studying episodic memory in ecological context similar to real life conditions [8].

The main aim of this study was to study whether different virtual embodiment levels (full, medium and low) have an impact on episodic memory recall and recognition. We expect that full embodiment condition, confirmed by high embodiment scores at the questionnaire, would have high level of presence compared to medium and low condition and that full embodiment leads to better recall and recognition performances compared to medium and low condition.

## 2.   Method

### 2.1 Participants and Design

14 young participants (7 males and 7 females; mean age = 22, SD = 2.08) with no history of psychiatric or neurologic disorders were recruited. The experiment was carried out as a within-group counterbalanced study.

### 2.2 Material

In the present study three virtual cities were created at the Memory and Cognition laboratory using Unity 3D and in-house software (Editomen and Simulmem). The three cities were built with a single main street with two turns; each city was composed of three virtual blocks of the same size. Along the path buildings and other city elements (*e.g.,* cars, traffic lights, signals) were placed. Each city was composed by five relevant landmarks (*e.g.,* church, green skyscraper, temple, gas station, parking, playground) and five events (*e.g.,* woman asking the time, break-dancers, couple kissing, dog barking, guitarist playing a song). For each city, landmarks and events were unique and placed along the sidewalks in order to have the same amount of events and landmarks per side across the path (*i.e.,* four on the left sidewalk, four on the right sidewalk and two at the end of the road in the middle). Landmarks and events were placed along the path: three of them where placed at the beginning, four in the middle and three at the end. Microsoft Kinect was used to detect knees and arms movements.

Participants watched the navigation with Oculus Rift DK2 from a first-person visual perspective. We connected Kinect V2 for Windows with Oculus Rift DK2 on Windows

8.1 64 Bits, Area 51 Alienware (i7-3.30Ghz; 16Go RAM; GC: Geforce Titan X), which was used to launch the virtual environments and the recognition task.

*2.3 Procedure*

Each participant read and signed the consent form. Then, they were informed that they would have to navigate in three different cities and they were informed that after navigation their memory would be tested. Participants were randomly allocated to the full, medium and low condition and each city was also randomly paired to one of embodiment conditions. For the *full condition* participants saw their avatar in a mirror in a virtual room. In order to induce virtual embodiment, they were asked to stand upright in front of the Kinect and raise slowly each limb at a time five times. Then they were placed in a training virtual city and they were asked to march in place to walk and to touch their forehead with their right or left arm to turn. After they familiarized with the interaction, the virtual task began. In the *medium condition* participants saw the navigation executed by the experimenter by means of keyboard. In the training phase, they were instructed by the experimenter on how to follow a passive navigation in the virtual environment (*i.e.,* "You will see the navigation of someone in the city. Touch your right forehead when you "see" the path turning on the right"; touch your left forehead when you "see" the path turning on the left", "Move your foot on the spot when the path continues"). Finally, in the *low condition* participants were asked to stand upright and watch still the navigation executed by the experimenter with arrow keys. In the last conditions the Kinect was turned off since no embodiment (*i.e.,* no avatar) was provided; participants watched the navigation by means of the head-mounted display. In the medium condition a synchronous walk of a passive navigation was performed, while in the low condition the participant was asked to stay still and simply watch the passive navigation. In each condition, participants were told to memorize all the events that they will encounter within the environment and pay attention to perceptive details such as colors and spatial and temporal contexts (*e.g.,* on the right or left, temporal order). Participants were also asked to pay attention and memorize the buildings, shops, and the other elements present in the city.

After each navigation, participants underwent a distractive task (ten minutes). Neuropsychological tests were administered and short presence questionnaire (feeling of presence) was filled in. The latter was specifically designed for this experiment but based on the one administered by Lessiter *et al.* [14]. Embodiment questionnaire used by Piryankova *et al.* [17] were administered only for the full embodiment condition, since in the other conditions no avatar was provided. The questionnaire investigated location, ownership and agency. We used a short version adapted for the current study. Then, episodic recall was tested with a standard procedure developed by Memory and Cognition Lab [*e.g.,* 10, 18]. Participants were assessed on what (*i.e.,* events and landmarks) on a free recall and recognition task. For the free recall assessment, the experimenter asked the participants to recall the main elements encountered along the navigation (five minutes max.). To each correct response one point was assigned in a grid by the experimenter. Free recall was calculated by summing the points. Therefore the maximum score was ten for each recall session; additional items, which were not considered relevant (*e.g.,* cars, bins), were in any case recorded in the grid. This task was administered after each condition. At the end of the session a computer-based recognition task was carried out. We used the Neuropsydia module for Python [19] to build the task. The computer displayed an element (*e.g.,* an event or a landmark) and the participant had

to answer ("Yes" or "No") with the mouse whether he/she saw or did not seethe image in one of the cities. 30 images were presented, 15 were actually in the cities, whereas 15 were distractors; nine of the images were events, six were landmarks for both actual items and distractors. If their answer was "Yes" their recognitions were assessed with the RKG paradigm [20] and both source memory for the city in which they thought had encountered the item and for the embodiment condition. Therefore, they had to indicate if they saw the item in the first, second or third city and if they were in the full, medium or low condition.

## 3. Results

In order to analyze embodiment questionnaire scores for full embodiment and presence questionnaire a paired sample t-test was performed. We performed one-way within-groups ANOVA for each total free recall and recognition scores for total scores and event and landmark sub-scores. Paired t-test was conducted for post-hoc analysis. In the analysis, one subject was excluded due to virtual sickness in the full embodiment condition. Significance level was fixed at $\alpha = .0167$ for Bonferroni correction and at $\alpha = .05$ for t-test.

### 3.1 Embodiment Questionnaire

The paired sample t-test revealed a significant difference in the scores for ownership (M = 3.59, SD = 0.74) and location (M = 4.54, SD = 1.13), [t(12) = -3.59, p = .004]. A significant difference was found also for ownership scores and agency scores (M = 4.77, SD = 1.42), [t(12) = -3.03, p = .001]. Finally, any difference was found for location and agency scores [t(12) = -3.03, p = .577].

### 3.2 Presence Questionnaire

Repeated measures ANOVA showed a significance [F(2,24) = 6.592, p = .005, $\eta_p^2$ = .355] in the presence questionnaire scores. Post hoc comparisons reveled statistically significant results (p = .013) between full embodiment (M = 3.22, SD = 0.43) and low embodiment (M = 2.66, SD = 0.58) and between medium condition (M = 3.18, SD = 0.34) and low condition (p = .010). Finally, no difference was found in the scores between full and medium conditions (p = .801).

### 3.3 Free recall task

Repeated measures ANOVA did not highlight significant differences for free recalls on scores across the three conditions. Free recalls regardless the type of item (*i.e.,* event or landmark) did not show statically significant results [F(2,24) = .044, p = .957, $\eta_p^2$ = .004]. Any significance was found for free recall for events [F(2,24) = .209, p = .813, $\eta_p^2$ = .017] and landmarks [F(2,24) = .947, p = .402, $\eta_p^2$ = .073]. Last, any significance was found for non-relevant items [F(2,24) = .888, p = .424, $\eta_p^2$ = .064].

### 3.4 Recognition task

Repeated measures ANOVA did not show statistically significant differences for correct item recognition across the three conditions [$F(2,24) = .293$, $p = .749$, $\eta_p^2 = .024$]. Again any significance was found for item (what) recognition depending on the type of item, respectively [$F(2,24) = 1$, $p = .383$, $\eta_p^2 = .077$] for events and [$F(2,24) = 1$, $p = .383$, $\eta_p^2 = .077$] for landmarks. Any significance was found for Remember responses [$F(2,24) = .794$, $p = .466$, $\eta_p^2 = .062$], Know responses [$F(2,24) = .409$, $p = .669$, $\eta_p^2 = .033$] and Guess responses across the three conditions regardless the type of item. Finally, source scores (respectively city and city paired with condition) regardless the type of item, did not evidence any statistically significant results [$F(2,24) = 1.531$, $p = .237$, $\eta_p^2 = .113$]. However, interesting trends are reported in Table 1 for what recognition and source memory scores.

**Table 1.** Mean (M) and standard deviation (SD) for item and source recognition evidence a positive effect of the high embodiment condition on recognition memory.

|  | Full embodiment | Medium embodiment | Low embodiment |
|---|---|---|---|
| Item recognition | M = 3,36, SD = 1.04 | M = 3,08, SD = 1.19 | M = 3,15, SD = .80 |
| Source city | M = 3,08, SD = 1.26 | M = 2,31, SD = 1.11 | M = 2,69, SD = .95 |
| Source city and condition | M = 3,00, SD = 1.14 | M = 2,23, SD = 1.16 | M = 2,15, SD = 1.28 |

**Discussion/Conclusion**

In the present study we aim at investigating the effect of virtual embodiment on episodic memory functioning. Results partially overlap with our hypothesis. First, embodiment questionnaire revealed that location and agency were greater than ownership. When comparing our median scores with median scores for each subscale obtained by Piryankova *et al.* [17] , we observed that only our agency score was higher, however overall scores were similar to the ones reported by Piryankova and co-authors. Interestingly, the feeling of presence in the full embodiment was greater than low condition, confirming how self-location and sense of presence are complementary concepts in constructing spatial representations for the body and the environment [12]. However, medium embodiment also showed higher feeling of presence compared to the low condition. These results highlight how motor control also affects sense of presence without an avatar, conferring a critical role of action-intention comparison. The link between intentions, actions and presence was reported by Triberti and Riva [21] and, indeed, in the medium embodiment condition even though the participants did not have the decisional level on the navigation their pantomimed actions were successfully paired with navigational changes. The sense of presence in immersive virtual context might be more related to self-location and agency rather than ownership. These findings confirm the importance of embodiment for the sense of presence, however the sensorimotor involvement, even if simulated (*i.e.,* medium embodiment), contributes to provide presence within virtual environments. Moreover these results evidence that the methodology used to induce presence was correctly designed.

Concerning the episodic scores no effect of condition was found. However, trends in Table 1 indicate a positive effect of full embodiment on episodic memory. Indeed, source memory reflects recollection and is linked to autonoetic consciousness [20]. Finally, some studies showed that active navigation enhance episodic recall endorsing the embodied cognition theories [*e.g.,* 10, 11, 22]. However, the previous experiments

used non-immersive environment and to our knowledge, this is the first study that aims at investigating the effect of embodiment with active interaction on episodic memory.

The main limit of the present experiment is the sample size; it is probable that the number of participants mainly affected the results. Future directions for the current study are to enlarge the sample and extend the analysis to the other episodic features investigated by means of recall and recognition tasks (*e.g.,* where, when, binding).

## References

[1] E. Tulving, Episodic memory and common sense: how far apart?, *Philosophical Transcription of the Royal Society London B Biological Sciences* **356**(1413) (2001), 1505–1515.A.N. Author, Article title, *Journal Title* **66** (1993), 856–890.

[2] S. C. Prebble, D. R. Addis, and L. J. Tippett, Autobiographical memory and sense of self, *Psychological Bulletin* **139**(4) (2013), 815–840.

[3] G. Plancher, V. Gyselinck, S. Nicolas, and P. Piolino, Age effect on components of episodic memory and feature binding: A virtual reality study, *Neuropsychology* **24**(3) (2010), 379–390.

[4] M. A. Wheeler, D. T. Stuss, and E. Tulving, Toward a theory of episodic memory: the frontal lobes and autonoetic consciousness, *Psychological Bulletin* **121**(3) (1997), 331–354.

[5] P. Piolino, B. Desgranges, and F. Eustache, Episodic autobiographical memories over the course of time: Cognitive, neuropsychological and neuroimaging findings, *Neuropsychologia* **47**(11) (2009), 2314–2329.

[6] M. Wilson, Six views of embodied cognition, *Psychonomic Bulletin & Review* **9**(4) (2002), 625–636.

[7] K. Dijkstra & L. Post, Mechanisms of embodiment, *Frontiers in Psychology* **6**:1525 (2015).

[8] H. D. Zimmer & L. Cohen, R, *Memory for action: A distinct form of episodic memory?* Oxford University Press, 2001.

[9] B. M. Brooks, E. A. Attree, F. D. Rose, B. R. Clifford, and A. G. Leadbetter, The Specificity of Memory Enhancement During Interaction with a Virtual Environment, *Memory* **7**(1) (1999), 65–78.

[10] N. Jebara, E. Orriols, M. Zaoui, A. Berthoz, and P. Piolino, Effects of enactment in episodic memory: A pilot virtual reality study with young and elderly adults, *Frontiers in Aging Neuroscience* **6**:338 (2014).

[11] G. Plancher, J. Barra, E. Orriols, and P. Piolino, The influence of action on episodic memory: A virtual reality study, *Quarterly Journal of Experimental Psychology* **66**(5) (2013), 895–909.

[12] G. Riva, From virtual to real body: Virtual reality as embodied technology, *Journal of Cyber Therapy and Rehabilitation* **1**(1) (2008), 7–22.

[13] B. Lenggenhager, T. Tadi, T. Metzinger, and O. Blanke, Video Ergo Sum: Manipulating Bodily Self-Consciousness, *Science* **317**(5841) (2007), 1096–1099.

[14] K. Kilteni, R. Groten, and M. Slater, The Sense of Embodiment in Virtual Reality, *Presence: Teleoperators and Virtual Environments*, **21**(4) (2012), 373–387.

[15] C. Repetto, S. Serino, M. Macedonia, and G. Riva, Virtual Reality as an Embodied Tool to Enhance Episodic Memory in Elderly, *Frontiers in Psychology* **7**:1839 (2016).

[16] J. Lessiter, J. Freeman, E. Keogh, and J. Davidoff, A Cross-Media Presence Questionnaire: The ITC-Sense of Presence Inventory, *Presence: Teleoperators and Virtual Environments* **10**(3) (2001), 282–297.

[17] I. V. Piryankova *et al.*, Owning an overweight or underweight body: Distinguishing the physical, experienced and virtual body, *PLoS One* **9**(8) (2014).

[18] G. Plancher, A. Tirard, V. Gyselinck, S. Nicolas, and P. Piolino, Using virtual reality to characterize episodic memory profiles in amnestic mild cognitive impairment and Alzheimer's disease: Influence of active and passive encoding, *Neuropsychologia* **50**(5) (2012), 592–602.

[19] D. Makowski & L. Dutriaux, Neuropsydia.py: A Python Module for Creating Experiments, Tasks and Questionnaires, *Journal of Open Source Software* (in review).

[20] J. M. Gardiner, Episodic memory and autonoetic consciousness: a first-person approach, *Philosophical Transcription of the Royal Society of London B Biological Sciences* **356**(1413) (2001), 1351–1361.

[21] S. Triberti & G. Riva, Being present in action: A theoretical model about the 'interlocking' between intentions and environmental affordances, *Frontiers in Psychology* **6**:2052 (2016).

[22] H. Sauzéon *et al.*, The use of Virtual Reality for episodic memory assessment: Effects of active navigation, *Experimental Psychology* **59**(2) (2012), 99–108.

# SECTION V

# CLINICAL OBSERVATIONS

Cybertherapy is a field that is growing rap-idly due to today's technology and informa-tion boom.

Virtual reality and advanced technologies have been used successfully to in a variety of healthcare issues, including treatment of anxiety disorders and phobias, treatment of eating and body dysmorphic disorders, neuropsychological assessment and rehabili-tation and distraction during painful or un-pleasant medical procedures.

The novel applications of these technologies yield many advantages over traditional treatment modalities, and the disadvantages that accompanied the first trials of virtual reality are quickly being addressed and eliminated.

Virtual reality peripherals such as data gloves, physiological monitoring and Inter-net worlds are swiftly demonstrating their usefulness in cybertherapy applications.

*Wiederhold & Wiederhold, 2004*

# Virtual reality-based software for the treatment of fibromyalgia: a case study

Ferran VILALTA-ABELLA [*a], Marta FERRER-GARCIA [a], José GUTIÉRREZ-MALDONADO [a]

[a] *Department of Clinical Psychology and Psychobiology, Universitat de Barcelona, Spain*

**Abstract.** The aim of this study was to explore the efficacy and acceptance of virtual reality-based software for pain reduction (*VirtualPain*) in a 53-year-old female with fibromyalgia (FM), a chronic pain syndrome. Treatment consisted of four 60-minute sessions. Each session involved 40 minutes of cognitive behavioral therapy (CBT) and 20 minutes of exposure to *VirtualPain* software. *VirtualPain* consists of a recreation of the human body in which the pain or lack of pain experienced by the participant in each body part (e.g., hand or knee) is represented by color, movement and sound. During exposure, the patient modified these characteristics to increase her sensation of control over the pain. In our study, the software was displayed on a stereoscopic laptop with a 17' screen. Pain intensity was assessed on a visual analog scale (VAS, from 0 to 10). Before and after the treatment, the patient completed the Pain Anxiety Symptoms Scale Short Form (PASS-20), the Pain Catastrophizing Scale (PCS) and the Pain Self-Efficacy Scale (CPSS). During each session, the patient reported the amount of extra medication for pain consumed during the week. Follow-up was conducted at 6 and 12 months. The patient showed a substantial reduction in anxiety, catastrophic thoughts and pain perception, and improved self-efficacy after treatment. Most importantly, at 6-month follow-up (after six months without treatment) results were maintained, but at 12-month follow-up (after the patient had been allowed to use *VirtualPain* at home for 6 months) the clinical improvements increased. The addition of *VirtualPain* to a CBT intervention reduced pain intensity and psychological symptoms (anxiety, catastrophism and low self-efficacy) in a patient with FM. Controlled studies with large samples are now needed to assess the specific additional contribution of *VirtualPain* to CBT in the treatment of fibromyalgia.

**Keywords:** treatment, pain, virtual reality, patient, self-efficacy, anxiety, fibromyalgia

## 1. Introduction

Fibromyalgia (FM) is a disabling disorder, with a population prevalence of 2.4% [1]. The most common symptoms are generalized pain throughout the body, paresthesia of the limbs, fatigue, sleep disturbances and concentration difficulties [2, 3]. The perception of pain is not only a physical phenomenon; it also involves emotional and psychological variables. Patients' attitudes, beliefs, expectancies, thoughts, learning history and socio-cultural context must all be borne in mind [4, 5]. Patients must assess the level of demand of a situation and their personal resources in order to learn how to cope with this stressful experience [6]. Patients suffering from FM have a maladaptive

---

coping style, as well as an external locus of control. They believe that they are powerless to reduce their pain [7], which lowers their quality of life and increases the pain intensity [8]. Cognitive-behavioral therapy (CBT) is the most effective psychological treatment for reducing depressive symptoms and catastrophizing and enhancing perceived self-efficacy [9]. Virtual reality (VR) has demonstrated efficacy in the reduction of acute [10, 11] and chronic pain [12]. However, information on its use in the treatment of FM is still lacking [13].

In *VirtualPain*, the participant manipulates three variables which embody the pain experienced in different parts of his/her own body: color, speed of movement, and sound. The software allows the patient to tailor his/her perception of pain and represent it in a 3D avatar [14]. First, the patient selects the color that best represents his/her perception of pain and the color that best represents the absence of pain. Any color can be chosen. Using this information, the software itself generates a pain continuum from 0 (color of absence of pain) to 10 (color of pain). Second, the participant chooses the sound from a selection representing either the countryside or the beach that best represents the absence of pain. The sensations of pain and rigidity are represented by the sound of cracking wood. Sound values range from 0 (the sound of absence of pain: countryside or beach) to 10 (the sound of pain). Finally, the user selects one of the 27 painful body areas drawn from the updated diagnosis of FM, proposed by Wolfe [3]. Each selected body part has a movement speed which varies according to the self-reported individual's perception from 0 to 10. A score of 0 represents smooth speed, and a score of 10 a severe speed reduction. To sum up, the virtual environment provides a representation of individuals' pain through three continuous features of parts of the avatar's body: color (pain and absence of pain), movement (speed) and sound (cracking wood vs. countryside or beach). Once the features of pain and absence of pain have been established, the patient is asked to rate, on a visual analogue scale (VAS) from 0 (no pain) to 10 (extreme pain), the level of pain experienced in a specific body part. Then, the software gives the appropriate color, sound and movement to the selected body part according to the VAS score.

In the case study, *VirtualPain* was used with three main aims. The first was to assess the acceptability and usability of the software in a patient with FM. The second was to assess the efficacy of the software in combination with CBT to reduce perceived pain intensity and associated symptomatology (catastrophism, anxiety and low self-efficacy). Additionally, extra medication for pain consumption was evaluated. Finally, the third aim was to determine the specific efficacy of the software when it was used without CBT.

## 2. Method

*Patient data*

The patient was a 53-year-old woman who lived with her husband and two daughters. She had an active job. The patient identified the first symptoms of FM 19 years ago, but the official diagnosis was made 16 years ago. Her daily medication is Triptizol (0/0/1) and Dolocatil 1g (1/0/0).

*Description of the treatment*

A weekly one-hour session was conducted for four weeks. During the first 40 minutes of each session, CBT techniques were applied and, during the last 20 minutes, the patient was exposed to *VirtualPain*. CBT consisted of psychoeducation about the

FM's symptomatology and the causes of pain, and coping skills training. Exposure to *VirtualPain* consisted of three steps. First, the patient specified the features of pain and absence of pain (color, sound and movement). Second, the patient selected a body part (the most painful one at that moment) and reported the level of pain experienced on a VAS from 0 to 10; with this information, the software gave a color, sound and movement to the selected body part. Third, the patient was encouraged to feel as if she was the avatar and, eventually, to modify its characteristics (color, sound and speed of movement) using three slides displayed on the screen. Thus, by modifying the virtual representation of the pain, the patient could also modify the perception of its intensity. In each session, the patient was exposed to a minimum of one painful area. When the pain intensity was less than 40% of the pain that was initially reported, the patient could choose another body part to work on.

The virtual body was displayed on a 3D laptop with specific software to create a stereoscopic effect that was duly processed by polarized glasses. Headphones were also used. In order to clarify the specific effect of VR exposure, an AB method was used during follow-up. Thus, during the first 6-month follow-up (phase A), the patient did not receive any intervention (except prescribed medication). However, during the period of time from follow-up at 6 months (baseline) to follow-up at 12 months (phase B), the therapist gave the *VirtualPain* software to the patient, so that she could use it at home. Self-efficacy, catastrophism, pain anxiety and frequency of extra pain medication were assessed at pre-treatment, post-treatment, 6-month follow-up and 12-month follow-up. At 12-month follow-up, the acceptability and usability of the *VirtualPain* software were also assessed.

*Measures*

The Pain Anxiety Symptoms Scale Short Form (PASS) [15] measures anxiety experienced with pain. Subsets of the questionnaire are cognitive anxiety ($\alpha$ = .86), escape-avoidance ($\alpha$ = .75), fear ($\alpha$ = .82), physiological anxiety ($\alpha$ = .81) and total anxiety ($\alpha$ = .91). The scale has 20 items rated with a Likert scale of 0 to 5.

Chronic Pain Self-Efficacy Scale (CPSS) [16] is a questionnaire to measure expectations of pain. This scale has 22 items, which are divided into 3 factors: self-efficacy for pain management (PSE) ($\alpha$=.86), self-efficacy for coping with symptoms (CSE) ($\alpha$=.91) and self-efficacy for physical function (FSE) ($\alpha$=.91).

The Pain Catastrophizing Scale (PCS) [17] assesses catastrophic thoughts related to pain. Its 13 items are scored on a Likert scale of 5 points (0 = not at all, 5 = all the time). The questionnaire has a total score ($\alpha$ = .87) and three subscales: rumination ($\alpha$ = .87), magnification ($\alpha$ = .66) and helplessness ($\alpha$ = .78).

Pain intensity was assessed by means of a visual analogue scale (VAS) [18] ranging from 0 (no pain) to 10 (extreme pain).

The frequency of extra medication was recorded using a weekly self-report sheet.

The acceptance and usability of software were assessed by means of four VAS-based questions, scored from 0 (do not agree) to 10 (agree absolutely) addressing the level of pleasantness, usability, usefulness and realism of the software.

## 3. Results

One of the main objectives of this study was to assess the efficacy in FM treatment of an intervention consisting of cognitive-behavioral techniques and exposure to *VirtualPain*, and to explore the specific effect of administrating *VirtualPain* alone. As shown in Table 1, perceived pain intensity diminished during exposure sessions.

Table 1. Exposure to *VirtualPain*

|  | Session 1 | | | Session 2 | | | Session 3 | | | Session 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Pre | Post | Time | Pre | Post | Time | Pre | Post | Time | Pre | Post | Time |
| Mean | 3.29 | 2.10 | 171 | 1.01 | .36 | 80 | 6.07 | 3.09 | 194 | 6.17 | 2.39 | 215 |
| SD | 0.55 | 1.36 | 48.93 | .06 | .28 | 28.28 | .59 | .64 | 52.71 | .23 | .55 | 29.61 |
| Min | 2.97 | .95 | 101 | .93 | .16 | 60 | 5.09 | 2.51 | 144 | 5.98 | 1.89 | 183 |
| Max | 4.11 | 4.04 | 213 | 1.05 | .55 | 100 | 6.56 | 4.02 | 280 | 6.49 | 3.002 | 244 |

*Note*: SD = standard deviation; Min = minimum value of pain; Max = maximum value of pain; Pre = measure of pain (VAS) before exposure to *VirtualPain*; Post = measure of pain (VAS) after exposure to *VirtualPain*; Time = time of exposure of *VirtualPain*.

Likewise, pain anxiety, low self-efficacy and catastrophic thoughts were substantially reduced at post-treatment (Table 2). Most importantly, at 6-month follow-up (phase A) the results were mostly maintained. Only the scores for the cognitive anxiety subscale of PASS-20 and painlessness subscale of PCS were higher at the first follow-up. However, at the 12-month follow-up (phase B), the patient showed a great improvement in all the outcomes. All the scores on the anxiety and catastrophism subscales substantially diminished, and self-efficacy considerably increased. Furthermore, at 6-month follow-up, the patient no longer used extra medication. It is important to note that during phase B, the patient could self-administer *VirtualPain* at home, in contrast with phase A.

Another aim of this study was to assess the acceptability and usability of *VirtualPain*. At 12-month follow-up, the patient declared that she was very satisfied with the software and reported high levels of pleasantness (9), usability (9), usefulness (10) and realism (10). She also expressed that she felt able to cope with pain.

**Table 2**. Questionnaires of anxiety, catastrophism, self-efficacy and medication

|  | PASS-20 | | | | PCS | | | CPSS | | | Med |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Cogn | EE | Fear | Phy | Rum | Mag | Help | PSE | FSE | CSE |  |
| Pre | 16 | 10 | 11 | 12 | 6 | 3 | 10 | 200 | 430 | 510 | 5 |
| Post | 11 | 11 | 6 | 8 | 0 | 0 | 0 | 400 | 690 | 660 | 3 |
| 6-month follow-up | 15 | 11 | 7 | 3 | 2 | 1 | 4 | 400 | 680 | 690 | 2 |
| 12-month follow-up | 3 | 2 | 0 | 0 | 0 | 1 | 4 | 500 | 880 | 790 | 0 |

*Note*. Pre= measures before treatment; Post = measures after treatment; Cogn = cognitive; EE = escape/avoidance; Psy = psychological anxiety; Rum = rumination; Mag = magnification; Help = helplessness; PSE = self-efficacy for pain management; FSE = self-efficacy for physical function; CSE = self-efficacy for coping with symptoms (CSE); Med = medication

## 4. Conclusion

This case study provides information about the efficacy of an intervention consisting of four sessions combining CBT techniques and virtual reality exposure using *VirtualPain* software in a 53-year-old female with FM. The patient showed a substantial improvement on completion of the combined treatment. Catastrophic thoughts and pain anxiety, which are strongly associated with pain perception [21], diminished considerably after treatment (CBT + *VirtualPain*).

Likewise, a significant reduction in extra medication was observed. However, the most impressive results came from the model AB used during follow-up. At 6-month follow-up, after 6 months without psychological treatment, the patient maintained the improvement achieved post-treatment. Most interesting, at 12-month follow-up, after self-administering *VirtualPain* software for six months as the only psychological intervention, all the assessed variables improved much more than at 6-month follow-up, and the patient reported that she no longer used rescue medication. These results provide valuable information about the potential benefits of using *VirtualPain* software in FM treatment.

The patient reported that she was satisfied with the software-based intervention and reduced her perceived pain by means of exposure to *VirtualPain*. Furthermore, she described the software as easy to manage and pleasant, which showed good acceptability. Other authors have reported that VR-based software is usually well-accepted for treatment purposes [19].

A major limitation of this study is that it does not include a baseline prior to treatment. However, an AB model was used during follow-up to establish a baseline prior to the self-administration (at home) of *VirtualPain*. In future studies, it would be appropriate to add more phases (ABAB) to clarify the effect of treatment and each of its components. Despite the limitations of this study, the results are positive and should lead to future randomized, controlled studies to assess the efficacy of this new software.

## 5. References

[1] A.J. Mas, L. Carmona, M. Valverde, B. Ribas. Prevalence and impact of fibromyalgia on function and quality of life in individuals from the general population: results from a nationwide study in Spain. *Clinical and Experimental Rheumatology,* **26(4)** (2008)*,* 519-526.

[2] J. Rivera, C. Alegre, F.J. Balina, J. Carbonell, L. Carmona, B. Castel, A. Collado, J.J. Esteve, F.G. Martínez, J. Tornero, M.A. Vallejo, J. Vidal, J. Documento de consenso de la Sociedad Española de Reumatología sobre la Fibromialgia, *Reumatología Clínica,* **2(1)** (2006), 55-66.

[3] F. Wolfe, D.J. Clauw, M.A. Fitzacharles, D.I. Goldenberg, R.S. Kazt, P. Mease, A.S. Russell, I.J. Russell, J.B. Winfield, M.B. Yunus. Preliminary Diagnostic Criteria for Fibromyalgia and Measurement of Symptom Severity. *Arthritis Care & Research,* **62(5)** (2010)*,* 600-610.

[4] R. Melzack. The McGill Pain Questionnaire. Major properties and scoring methods, *Pain,* **1**(1975), 227-299.

[5] R. Melzack. From the gate to the neuromatrix. *Pain,* **S 6**(1999), S121-126.

[6] R.S. Lazarus, S. Folkman. *Stress, Appraisal, and Coping*. Springer, New York, 1984.

[7] B. Rodero, B. Casanueva, J.V. Luciano, M. Gili, A. Serrano-Blanco, J. García-Campayo. Relationship between behavioural coping strategies and acceptance in patients with fibromyalgia síndrome: Elucidating targets on interventions. *BMC MusculoskeletalDisorders,* **Jun29** (2011).

[8] M. Martín-Aragón, M.A. Pastor, A. Lledó, S. López-Roig, M.C. Perol J. Rodríguez-Marín. Percepción de control en el síndrome fibromiálgico: Variables relacionadas. *Psicothema,* **13** (2001), 586-591.

[9] A. Minelli, A. Vaona, Effectiveness of cognitive behavioral therapy in the treatment of fibromyalgia syndrome: a metaanalytic literature review.*Reumatismo*, **64(3)** (2012), 151-157.

[10] H.G. Hoffman, D.R. Patterson, G.J. Carrougher, S.R. Sharar. Effectiveness of virtual reality-based pain control with multiple treatments. *The Clinical Journal of pain,* **17(3)** (2000), 229-235.

[11] H.G. Hoffman, G.T. Chambers, W.J. 3rd Meyer, L.L. Arceneaux, J.W. Russell, E.J. Seibel, T.L. Richards, S.R. Sharar, D.R. Patterson. Virtual reality as an adjunctive non-pharmacologic analgesic for acute burn pain during medical procedures. *Annals of Behavioral Medicine,* **41** (2011), 183-191.

[12] J. Gutierrez-Maldonado, O. Gutierrez-Martinez, D. Loreto, C. Peñaloza, R. Nieto. Presence, involvement and efficacy of a virtual reality intervention on pain. *StudHealthTechnolInform,* **154** (2010), 97-101.

[13] R. Herrero, D. Castilla, Y. Vizcaíno, G. Molinari, A. Garcia-Palacios, C. Botella. Avances en el tratamiento psicológico de la fibromialgia: el uso de la realidad virtual para la inducción de emociones positivas y la promoción de la activación comportamental. Un estudio piloto. *Revista Argentina de Clínica Psicológica,* **22(2)** (2013), 111-120.

[14] F. Vilalta-Abella, J. Gutierrez-Maldonado, J. Pla-Sanjuanelo. Development of a virtual environment based on the perceived characteristics of pain in patients with fibromyalgia. *Annual Review of Cybertherapy and Telemedicine,* **219** (2015), 158-162.

[15] A.E. López-Martínez, R., Esteve, C., Ramírez-Maestre. The Spanish version of the Spanish pain anxiety symptoms scale (PASS-20): preliminary data on its reliability, validity and factorial structure. *European Journal of Pain Supplements*, **5** (2011), 265.

[16] K.O. Anderson, B.N. Dowds, R.E., Pelletz, W.T., Edwards, C., Peeters-Asdourian. Development and initial validation of a scale to measure self-efficacy beliefs in patients with chronic pain. *Pain*, **63** (1995), 77-84.

[17] M.J.L. Sullivan, S., Bishop, J., Pivik. The pain catastrophizing scale: development and validation. *Pschol. Assess.*, **7** (1995), 524-532.

[18] W.I. Campbell, S. Lewis. Visual analogue measurement of pain. *The Ulster Medical Journal*, **56(2)** (1990), 149-154.

[19] A., García-Palacios, R., Herrero, Y. Vizcaíno, M.A., Belmonte, D., Castilla, G., Molinari, R.M., Baños, C. Botella. Integrating Virtual Reality with Activity Management for the Treatment of Fibromyalgia: Acceptability and Preliminary Efficacy. *Clinical Journal of Pain*, **31** (2015), 564-572.

[20] A. Lledó-Boyer, M. Pastor-Mira, N. Pons-Calatayud, S. López-Roig, J. Rodríguez-Martín, S. Bruehl. Control beliefs, coping and emotions: Exploring relationships to explain fibromyalgia health outcomes. *International Journal of Clinical and Health Psychology,* **10(3)** (2010), 459-476.

[21] P., Meredith, J., Strong, J.A., Feeney. Adult attachment, anxiety, and pain self-efficacy as predictors of pain intensity and disability. *Pain*, **123** (2006), 146-154

# Two-phases innovative treatment for anorexia nervosa: The potential of virtual reality body-swap

Silvia SERINO[a,*], Alice CHIRICO[b], Elisa PEDROLI[c], Nicoletta POLLI [d,e], Chiara CACCIATORE[d,e], Giuseppe RIVA [a,b]

[a]*Department of Psychology, Università Cattolica del Sacro Cuore, Largo Gemelli, 1, 20100, Milan, Italy*
[b]*Applied Technology for Neuro-Psychology Lab, IRCCS Istituto Auxologico Italiano, Via Magnasco, 2 20149 Milan, Italy*
[c]*UO di Endocrinologia e malattie Metaboliche, IRCCS Istituto Auxologico, Milano*
[d]*Dipartimento di Scienze Cliniche e di Comunità, Università degli Studi di Milano*

**Abstract.** It is known that experiencing body as one's own depend on the integration of different bodily signals (i.e., proprioceptive, tactile, visual, vestibular inputs). In the current study, a group of female participants suffering from Anorexia Nervosa (N=23) viewed within a first-person perspective a virtual body with a skinny belly substituting their own physical body in two experimental conditions (i.e., synchronous vs. asynchronous visual-tactile stimulation). This allowed us to investigate whether illusionary ownership over a virtual body would result in differences in body representation (as measured by asking participants to estimate their body size) before and after a multidisciplinary treatment provided in a center of excellence. Before treatment, there was a significant distortion in body representation, especially as concerns the estimation of the circumference of the abdomen and the hips. After the treatment, the most interesting result is a decrease in the body-size distortions in abdomen. This innovative approach, if further investigated, may be useful for anorectic patients for specifically improving body representation disturbances.

**Keywords.** Anorexia Nervosa, Virtual Reality, Body-Size Distortions

## 1. Introduction

Probably, there is no more familiar feeling than my body belongs uniquely to myself. However, this feeling known as the "sense of body ownership" [1] can be temporally disrupted during neurological conditions [2] or in some experimental settings. A first example is the well-known Rubber Hand Illusion [3], where exposure to a rubber hand being stroked synchronously with one's own (unseen) hand provokes this rubber hand to be perceived as be part of one's own body. Using virtual reality (VR), it is possible to induce the experience that an entire artificial body seen in first-perspective is perceived

* Corresponding Author: s.serino@auxologico.it

as one's own via a multisensory stimulation (i.e., the "body-swap illusion") [4-7]. These "bodily illusions" have proved to be effective in modifying the bodily experience (e.g., [8-11]). The starting point is how we perceive our body. Specifically, a complex information flow from different bodily signals (i.e., proprioceptive, tactile, visual, vestibular inputs) needs to be constantly managed to allow for an integrated and consistent experience of our body as one's own [12, 13]. Then, these multisensory inputs are integrated with stored body information [14, 15]. Sometimes, the process of multisensory integration results as not functional and brings about distorted experience of body. This is the case of patients with Anorexia Nervosa (AN): for example, they usually tend to overestimate haptic stimuli [16], or fail to integrate visual, haptic and proprioceptive signal in a coherent way [17, 18]. Body representation disturbance is a core clinical feature of AN, that means that patients suffering from this disorder experience their body as fatter than what it objectively is.

Given the growing body of evidence supporting the use of "bodily illusions" for modifying the bodily experience [19], in this contribution, we moved from the fundamental research field to the applied one. For the first time, we integrated a two-phase intervention based on VR body-swapping illusion with multidisciplinary treatment provided in a center of excellence. We tested whether the illusion of being the owner of a virtual body could impact on body size estimation, as a measure of change in body representation.

## 2.    Methodology

23 female participants suffering from AN ($M_{age}$ = 22.76 years, SD = 4.64 years; $M_{BMI}$ = 15.50, SD =2.14) took part in the study. Each patient watched within a first-person perspective a virtual skinny belly replacing their own physical body in two experimental conditions (i.e., synchronous vs. asynchronous visual-tactile stimulation) before (T1) and after (T2) a multidisciplinary treatment provided in a center of excellence.

### 1.1  Experimental procedure

Participants were invited to embody in a skinny avatar virtual body (the same for all participants) (avatar waist circumference: 73.94 cm; mean actual waist circumference in the sample: 85.70 cm, SD = 6.27 cm) which stands upright in an empty room. All participants wore a head-mounted display (HMD; Oculus Rift DK2) connected to a portable computer (HP TRUE VISION with CPU Intel_ Core_i7) to see the first-person perspective avatar. Participants saw a virtual hand stroking their virtual body either synchronously or asynchronously with the real hand of the experimenter touching their real body. These two conditions were administered in a counterbalanced order to all participants. The illusion of touching was reproduced in VR using the Razer Hydra Portal 2 Bundle (a motion tracking device connected to the portable computer). Participants were required to estimate the width and circumference of their shoulders, abdomen, and hips before the experimental session and after each condition (i.e., synchronous and asynchronous).

## 3. Results

Before the treatment, participants demonstrated a general tendency to overestimate their body size. Embodying a virtual body with a skinny belly with a synchronous or asynchronous visuo-tactile stimulation did not affect body size estimations (see Table 1).

Indeed, after the treatment, participants tended to differently respond to the illusion (see Table 2). It is possible to observe a significant decrease in the estimations of circumference the abdomen and hips. Specifically, the Wilcoxon Test (with Bonferroni's adjustments) indicated a significant decrease in the estimations of the ci circumference of the abdomen ($z = -2.352$; $p = 0.019$) and hips ($z = -3.024$; $p = 0.002$), when compared to the baseline.

**Table 1.** Results from body size estimation tasks at T1. Mean and standard deviation of body estimation measures.

| | Pre size estim. | Post size estim. *(synchronous)* | Post size estim. *(asynchronous)* | Chi-square | df | *p* |
|---|---|---|---|---|---|---|
| Shoulder width | 1.03 (0.18) | 1.02 (0.22) | 1.00 (0.18) | 1.386 | 2 | 0.500 |
| Abdomen width | 1.18 (0.33) | 1.19 (0.26) | 1.17 (0.31) | 0.956 | 2 | 0.622 |
| Hip width | 1.20 (0.34) | 1.24 (0.39) | 1.24 (0.37) | 0.822 | 2 | 0.668 |
| Shoulder circumference | 1.34 (0.28) | 1.24 (0.24) | 1.26 (0.28) | 6.156 | 2 | 0.046 |
| Abdomen circumference | 1.52 (0.36) | 1.45 (0.33) | 1.44 (0.34) | 3.217 | 2 | 0.200 |
| Hip circumference | 1.46 (0.46) | 1.36 (0.50) | 1.43 (0.52) | 9.652 | 2 | 0.008 |

**Table 2.** Results from body size estimation tasks at T2. Mean and standard deviation of body estimation measures.

| | Pre size estim. | Post size estim. *(synchronous)* | Post size estim. *(asynchronous)* | Chi-square | df | *p* |
|---|---|---|---|---|---|---|
| Shoulder width | 1.00 (0.13) | 1.02 (0.211) | 0.98 (0.18) | 5.919 | 2 | 0.052 |
| Abdomen width | 1.24 (0.23) | 1.12 (0.29) | 1.16 (0.25) | 1.583 | 2 | 0.453 |
| Hip width | 1.21 (0.23) | 1.19 (0.31) | 1.18(0.34) | 1.420 | 2 | 0.492 |
| Shoulder circumference | 1.35 (1.28) | 1.32 (0.41) | 1.25 (0.32) | 8.842 | 2 | 0.012 |
| Abdomen circumference | 1.57(0.98) | 1.48 (0.62) | 1.45(0.65) | 6.919 | 2 | 0.031 |
| Hip circumference | 1.38 (0.60) | 1.41 (0.52) | 1.39 (0.58) | 1.000 | 2 | 0.607 |

## 4.    Discussion and Conclusion

The results of the current study showed that before treatment there was a significant distortion in body representation, especially as concerns the estimation of the circumference of the abdomen and the hips. After the treatment, the most interesting result is a decrease in the body-size distortions about these two emotional body parts. In the same direction, Keizer and colleagues [11] has recently found that AN patients improved their experience of the body (in terms of an improvement in their accuracy in body size estimations as index of body representation disturbances) after the embodiment in a virtual female avatar thanks to a synchronous stimulation.

However, the causes underlying body representation disturbances in Anorexia Nervosa (AN) are still unclear, but it is known that a disturbed multisensory bodily experience is involved. According to the Allocentric Lock Theory [20, 21], AN patients suffer from an inefficient memory of the body which is responsible for a distorted bodily experience of the actual body. In AN, patients are "locked" to an allocentric memory of their body (i.e., third-person perspective of the body- "I'm fat") which is not updated with new contrasting information perceived from an egocentric perspective (i.e., first person perspective of the body – "I'm extremely thin") [20]. In this direction, further studies exploiting the potentiality of the illusion of being the owner of another virtual body may offer innovative therapeutic chances to temporarily modify the stored allocentric memory of our body by providing new multisensory egocentric inputs [10].

## References

[1]  S. Gallagher, Philosophical conceptions of the self: implications for cognitive science. *Trends in cognitive sciences*, 2000. **4**(1): p. 14-21.

[2]  G. Vallar, & R. Ronchi, Somatoparaphrenia: a body delusion. A review of the neuropsychological literature. *Experimental Brain Research*, 2009. **192**(3), p. 533-551.

[3]  M. Botvinick, & J. Cohen, Rubber hands' feel'touch that eyes see. *Nature*, (1998), **391**(6669), p. 756-756.

[4]  V.I. Petkova, et al., From part-to whole-body ownership in the multisensory brain. *Current Biology*, (2011), **21**(13), p. 1118-1122.

[5]  V.I. Petkova, & H. Ehrsson, If I were you: perceptual illusion of body swapping. *PlosOne*, (2008).

[6]  M. Slater, et al., First person experience of body transfer in virtual reality. *PloS one*, 2010. **5**(5): p. e10564.

[7]  A. Maselli, & M. Slater, The building blocks of the full body ownership illusion. *Frontiers in human neuroscience,* 2013. **7**.

[8]  I.V. Piryankova, et al., *Owning an overweight or underweight body: distinguishing the physical, experienced and virtual body.* (2014).

[9]  C. Preston, & H.H. Ehrsson, Illusory changes in body size modulate body satisfaction in a way that is related to non-clinical eating disorder psychopathology. *PloSone*, 2014. **9**(1).

[10]  Serino, S., et al., Virtual reality body swapping: a tool for modifying the allocentric memory of the body. *Cyberpsychology, Behavior, and Social Networking,* (2016), **19**(2), p. 127-133.

[11]  A. Keizer, et al., A Virtual Reality Full Body Illusion Improves Body Image Disturbance in Anorexia Nervosa. *PloSone*, (2016), **11**(10): p. e0163921.

[12]  A. Maravita, C. Spence, and J. Driver, Multisensory integration and the body schema: close to hand and within reach. *Current biology*, (2003), **13**(13): p. R531-R539.

[13]  A. Tessari, et al., *The sense of body: a multidisciplinary approach to body representation*. 2010, Pergamon.

[14]  M.A.J. Apps, and M. Tsakiris, The free-energy self: a predictive coding account of self-recognition. *Neuroscience & Biobehavioral Reviews*, (2014). **41**, p. 85-97.

[15]  G. Carruthers, Types of body representation and the sense of embodiment. *Consciousness and cognition*, (2008), **17**(4), p. 1302-1316.

[16]  A., Keizer, et al., Tactile body image disturbance in anorexia nervosa. *Psychiatry Research*, 2011. **190**(1),p. 115-120.

[17]  Eshkevari, E., et al., *Increased plasticity of the bodily self in eating disorders.* Psychological Medicine, 2012. **42**(04): p. 819-828.

[18]  L.K.Case, R.C. Wilson, and V.S. Ramachandran, Diminished size–weight illusion in anorexia nervosa: evidence for visuo-proprioceptive integration deficit. *Experimental brain research*, (2012). **217**(1), p. 79-87.

[19]  Serino, S. and A. Dakanalis, Bodily illusions and weight-related disorders: Clinical insights from experimental research. *Annals of Physical and Rehabilitation Medicine,* (2016).

[20]  G. Riva, Out of my real body: cognitive neuroscience meets eating disorders. *Frontiers in human neuroscience*, (2014). **8**, p. 236.

[21]  G. Riva, and S. Gaudio, Allocentric lock in anorexia nervosa: New evidences from neuroimaging studies. *Medical Hypotheses,* (2012). **79**(1), p. 113-117.

# VR-based cue-exposure therapy (VR-CET) versus VR-CET plus pharmacotherapy in the treatment of bulimic-type eating disorders

Joana PLA-SANJUANELO[a*], Marta FERRER-GARCIA[a], Ferran VILALTA-ABELLA[a], Giuseppe RIVA[b,c], Antonios DAKANALIS[d], Joan RIBAS-SABATÉ[e], Alexis ANDREU-GRACIA[e], Fernando FERNANDEZ-ARANDA[f], Isabel SÁNCHEZ[f], Neli ESCANDÓN-NAGEL[g], Osane GOMEZ-TRICIO[h], Virgínia TENA[i], and José GUTIERREZ-MALDONADO[a].

[a] *Department of Clinical Psychology and Psychobiology, Universitat de Barcelona, Spain*
[b] *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*
[c] *Applied Technology for Neuropsychology Laboratory, Istituto Auxologico Italiano, Milan, Italy*
[d] *Department of Medicine and Surgery, University of Milano Bicocca, Milan, Italy*
[e] *Department of Psychiatry and Mental Health, Igualada General Hospital, Spain*
[f] *Department of Psychiatry, University Hospital of Bellvitge-IDIBELL and CIBEROBN, Spain*
[g] *Department of Psychology, Temuco Catholic University, Chile*
[h] *Department of Psychiatry, University Hospital Joan XXIII, Spain*
[i] *Centro ABB Tarragona, Spain*

**Abstract.** Treatment guidelines recommend antidepressant medication for bulimic-type eating disorders either as an alternative to or in combination with cognitive behavioural therapy (CBT). This study compared the efficacy of two second-line treatments of patients with bulimic-type eating disorders resistant to CBT: virtual reality-based cue-exposure therapy (VR-CET) alone or VR-CET in combination with pharmacotherapy. Results showed that bingeing episodes, bulimic symptomatology (the bulimia EDI-3 score) and food cravings (FCQ-T/S) were significantly reduced after both interventions. However, no significant differences were found between the combined intervention and VR-CET alone. Improvements from the treatments continued at the 6-month follow-up. Our results support the use of VR-CET as an effective treatment of bulimic-type eating disorders, reducing bulimic symptoms and food cravings. The addition of antidepressants to VR-CET does not provide any additional benefit.

[*]Corresponding author:joanapla@ub.edu.

## 1.  Introduction

Bulimic-type eating disorders represent a public health problem according to World
Mental Health (WMH) surveys, affecting a broad section of the population [1, 2]. These
disorders include both bulimia nervosa (BN) and variants of BN, of which binge eating
disorder (BED) is the most common [1].

Cognitive behavioural therapy (CBT) is the first-choice treatment for BN and BED
[3, 4]. Although several studies support the efficacy of CBT in treating BE and the
psychopathology associated with BN and BED [5], a significant percentage of patients
do not improve after undergoing CBT [6].

Treatment guidelines recommend antidepressant medication for bulimic-type eating
disorders either as an alternative to or in combination with CBT [7]. Based on studies
showing serotonin system dysfunctions in BN and BED, selective serotonin reuptake
inhibitors (SSRIs) (e.g., fluoxetine) are the most commonly prescribed antidepressants,
reducing binge eating in patients with bulimic-type eating disorders [8]. In general,
randomised controlled trials (RCTs) suggest that combination therapies with certain
antidepressants yield better results than pharmacotherapy alone, but are not more
effective than psychotherapy alone [3, 8, 9].

Cue-exposure therapy (CET), an exposure-based extinction technique [10], has also
been proposed as an effective second-line treatment for patients who show poor or no
response to previous CBT and pharmacological therapy, reducing binge eating and other
psychopathological symptoms in clinical patients [11, 12].

Several constraints of CET have led to its adaptation to virtual reality technology
(virtual reality-based cue-exposure therapy (VR-CET)) [13]. VR-CET has been reported
to reduce food cravings and anxiety [14], as well as eliminating episodes of binge eating
in a BN patient [15] after systematic exposure to virtual food-related contexts and cues.
In view of these findings, the present study aimed to compare the efficacy of two second-
line treatments of patients with BN and BED resistant to CBT: VR-CET alone or in
combination with pharmacotherapy.

## 2.  Methods

### 2.1  Participants and procedure

The sample comprised of 32 outpatients of both sexes diagnosed with BN (*n*=16) or
BED (*n*=16), according to DSM-5 criteria [16], and presenting active episodes of binge
eating behaviour after an initial structured course of CBT. Participants were referred
from five collaborating hospitals in Tarragona (Spain), Barcelona (Spain) and Milan
(Italy).

Seventeen participants were taking a constant dose of antidepressant medication
(i.e., fluoxetine) at the beginning of VR-CET and were allocated to the combined second-

line intervention (VR-CET plus pharmacotherapy), while the other 15 participants underwent VR-CET alone. Due to the non-random patient allocation, we ensured that participants assigned to each group did not differ significantly in terms of sex, age, diagnostic rates, measured body mass index ($kg/m^2$), frequency of binge eating episodes, self-reported bulimic symptoms and food cravings assessed prior to the interventions (all *p* values > .05). During the first session, participants were also assessed by validated VR-based cue-exposure software [14] to construct the exposure hierarchy of 3D interactive situations (environment and food) for use in the VR-CET sessions. The software creates an exposure hierarchy as a result of combining four VR scenarios (kitchen, dining room, bedroom and cafe) and the 10 food items each participant selected as the ones producing the highest levels of craving from a list of 30 virtual food items.

Both interventions consisted of six twice-weekly individual 60-minute sessions over three weeks. During each VR-CET session, participants were exposed to their corresponding virtual environments and food based on the previously established hierarchy. Participants could interact within the virtual environments in real time and move around the scenario, sit at a table, and handle the food displayed using the keyboard and the laptop's mouse. Once seated, craving and anxiety levels were assessed periodically in the participants on a visual analogue scale from 0 to 100. Exposure finished when the reported subjective anxiety decreased by 40% in relation to the level measured when the participant entered the virtual environment. Virtual environments were displayed on a 15.6-inch stereoscopic monitor. Earphones and polarised glasses were also used.

### 2.2 Measurements

Outcome assessment for core behavioural features included frequency (i.e., number) of binge eating episodes during the two weeks prior to beginning the second-line intervention, during the two weeks after the end of the intervention, and during the two weeks after the 6-month follow-up.

The 8-item bulimia subscale of the Eating Disorder Inventory™-3 (EDI-3) [17] was administered to assess the self-reported tendency to engage in episodes of uncontrollable overeating (binge eating) at baseline (intake session), at the end of the second-line intervention, and at the 6-month follow-up.

To assess food cravings, the State and Trait Food Craving Questionnaire (FCQ-T/S) [18] was also administered at baseline, at the end of the intervention, and at follow-up.

### 2.3 Statistical analysis

Given the limited sample size, the non-parametric Friedman test was used to analyse the intervention effects (baseline *vs*. post-treatment *vs*. follow-up) on the psychometric variables of each group (VR-CET plus pharmacotherapy and VR-CET alone).

Post-hoc Wilcoxon signed-rank tests were also conducted with a Bonferroni correction applied (resulting in a significance level set at *p* < .017) to determine specific significant differences in the psychometric variables between the time points (baseline, post-treatment and follow-up) in both groups.

Mann-Whitney U test was used to analyse the between-group differences both post-treatment and at follow-up

# 3　Results

There was a statistically significant difference in the intervention outcomes tested at the three time points (baseline, post-treatment and follow-up) both in the combined VR-CET plus pharmacotherapy ($\chi^2(11) = 165$, $p < .001$) and the VR-CET alone ($\chi^2(11) = 149$, $p < .001$) groups. Post-hoc analyses revealed significant differences in the frequency of bingeing episodes, the bulimia EDI-3 score, the FCQ-T total score and the FCQ-S total score between the baseline and post-treatment time points, and between the baseline and follow-up time points in both treatment groups (Table 1). As displayed in Figure 1, all participants showed significant reductions in the variables assessed post-treatment and at follow-up.

**Table 1.** Differences in the frequency of bingeing episodes (binges), bulimia symptoms (EDI-B), and trait (FCQ-T) and state (FCQ-S) food cravings between the three time points tested (baseline *vs*. post-treatment; baseline *vs*. follow-up; and post-treatment *vs*. follow-up).

|  | **Binges** | | **EDI-B** | | **FCQ-T** | | **FCQ-S** | |
|---|---|---|---|---|---|---|---|---|
| **Combined intervention** | Z | p | Z | p | Z | p | Z | p |
| Baseline - Post-treatment | -3.63 | **<.001** | -3.62 | **<.001** | -3.58 | **<.001** | -3.52 | **<.001** |
| Baseline - Follow-up | -3.53 | **<.001** | -3.47 | **.001** | -3.52 | **<.001** | -3.35 | **.001** |
| Post-treatment - Follow-up | -1.63 | .102 | -1.88 | .059 | -1.97 | .049 | -0.42 | .674 |
| **VR-CET alone** | | | | | | | | |
| Baseline - Post-treatment | -3.30 | **.001** | -3.18 | **.001** | -2.73 | **.006** | -2.59 | **.010** |
| Baseline - Follow-up | -2.99 | **.003** | -2.99 | **.003** | -3.29 | **.001** | -2.80 | **.005** |
| Post-treatment - Follow-up | -0.74 | .461 | -1.18 | .238 | -1.76 | .078 | -0.71 | .480 |
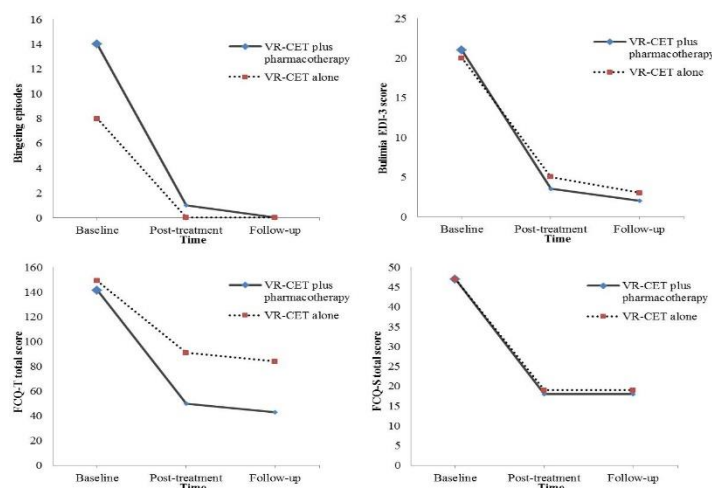
**Figure 1.** Median of the number of bingeing episodes, bulimic symptoms (EDI-3) and food craving levels (FCQ-T/S) at baseline, post-treatment and 6-month follow-up.

Mann-Whitney U test indicated no significant differences between the two intervention groups (combined intervention vs. VR-CET alone) in the number of bingeing episodes ($U = 96.5$, $p = .200$, $r = .23$), bulimic symptoms ($U = 106$, $p = .423$, $r = .14$), and trait ($U = 87$, $p = .126$, $r = .27$) and state food cravings ($U = 114$, $p = .619$, $r = .09$) post-treatment. No significant differences were also found between the two groups for the number of bingeing episodes ($U = 106$, $p = .505$, $r = .12$), bulimic symptoms ($U = 102$, $p = .465$, $r = .13$), and trait ($U = 101$, $p = .451$, $r = .13$) and state food cravings ($U = 93$, $p = .282$, $r = .19$) at follow-up.

## 4    Conclusions

The main objective of this study was to compare the efficacy of two second-line treatments of patients with BN and BED (VR-CET alone vs. VR-CET plus antidepressant medication) who had previously undergone CBT unsuccessfully. In agreement with our previous studies [14, 15], VR-CET reduced the frequency of bingeing episodes, bulimia symptoms and food cravings in CBT-resistant patients. Therefore, VR-CET can be used to improve conventional treatments (i.e., CBT and pharmacotherapy) for bulimic-type eating disorders.

Adapting *in vivo* CET to virtual reality technology offers several advantages such as enabling the therapist to recreate real-world environments containing significant specific stimuli and providing safe contexts for patients, which are generally preferable to full exposure prior to contact with the real world [13].

Our findings support those of other studies investigating the efficacy of pharmacological interventions in both BN and BED [3, 8, 9]. Overall, combined psychotherapy and pharmacotherapy in patients with BN and BED does not provide better results than psychotherapy alone [3]. Our results did not show significant differences in the frequency of bingeing episodes, bulimia symptoms and food cravings post-treatment and at the 6-month follow-up between those receiving the combined therapy (VR-CET plus antidepressants) and those undergoing VR-CET alone. This lead us to conclude that the addition of antidepressants to VR-CET did not provide any additional benefit.

Our study had some limitations such as the non-random patient allocation and the lack of a control group that could have led confounder variables to have an effect on the outcomes measured. Furthermore, the small size of the sample makes it difficult to generalise the present results.

Despite these limitations, our study supports the application of VR-CET in clinical settings and provides evidence that VR-CET is a valid and useful tool for enhancing CBT in BN and BED patients either alone or in combination with medication.

# References

[1] R. C. Kessler, P. A. Berglund, W. T. Chiu, A. C. Deitz, J. I. Hudson, V. Shahly, …. R. Bruffaerts, The prevalence and correlates of binge eating disorder in the World Health Organization World Mental Health Surveys, *Biological psychiatry*, **73** (2013), 904-914.

[2] J. M. Mond, Classification of bulimic-type eating disorders: from DSM-IV to DSM-5, *Journal of eating disorders*, **1** (2013), 33.

[3] F.Van den Eynde, , U. Schmidt, Treatment of bulimia nervosa and binge eating disorder, *Psychiatry*, **7**(2008), 161-166.

[4] National Institute of Mental Health (NIMH). Eating disorders. In *Eating disorders: About more tan food (No. 11-4901),* 2014. Avaiable at: www.nimh.nih.gov/health/publications/eaing-disorders/eating-disorders.pdf

[5] P. J. Hay, A. M. Claudino, Bulimia nervosa., *BMJ of Clinical Evidence*, 2010. Published online 2010 Jul 19. PMCID: PMC3275326.

[6] H.C. Steinhausen, S.Weber, The outcome of bulimia nervosa: findings from one-quarter century of research, *The American Journal of Psychiatry,* **166** (2009), 1331-1341.

[7] *Practice Guideline for the Treatment of Patients With Eating Disorders.* American Psychiatric Association. 3rd ed. Washington, DC: American Psychiatric Publishing, 2006.

[8] D. L. Reas, C. M . Grilo, Pharmacological treatment of binge eating disorder: update review and synthesis, *Expert opinion on pharmacotherapy,* **16** (2015), 1463-1478.

[9] S. L. McElroy, A. I Guerdjikova, N. Mori, A. M . O'Melia, Pharmacological management of binge eating disorder: Current and emerging treatment options, *Therapeutics and Clinical Risk Management,* **8** (2012)*,* 219–241.

[10] A. Jansen, A learning model of binge eating: Cue reactivity and cue exposure., *Behaviour Research and Therapy,* **36** (1998), 257-272.

[11] E. Martinez-Mallén, J. Castro, L. Lazaro, E. Moreno, A. Morer, E. Font, J. Julien, M. Vila, J. Toro, Cue exposure in the treatment of resistant adolescent bulimia nervosa, *International Journal of Eating Disorders*, **40** (2007), 596-601.

[12] J. Toro, M. Cervera, M. H. Feliu, N. Garriga, M. Jou, E. Martinez, E. Toro, Cue exposure in the treatment of resistant bulimia nervosa, *International Journal of Eating Disorders*, **34** (2003), 227-234.

[13] J. Gutiérrez-Maldonado, B. K. Wiederhold, G. Riva, Future Directions: How Virtual Reality Can Further Improve the Assessment and Treatment of Eating Disorders and Obesity, *Cyberpsychology, Behavior, and Social Networking,* **19** (2016), 148-153.

[14] J. Gutiérrez-Maldonado, J. Pla-Sanjuanelo, M.Ferrer-Garcia, Cue-exposure software for the treatment of bulimia nervosa and binge eating disorder, *Psicothema,* **28** (2016), 363-369

[15] J. Pla-Sanjuanelo, M. Ferrer-Garcia, F.Vilalta-Abella, J. Gutierrez-Maldonado, A. Andreu-Gracia, A. Dakanalis, N. Escandón-Nagel , F. Fernandez-Aranda, O. Gomez-Tricio, J. Ribas-Sabaté, G. Riva, I. Sánchez, V. Tena, Using virtual reality for cue-exposure therapy in a case of bulimia nervosa, *Annual Review of CyberTherapy and Telemedicine,* **14** (2016), 155-160.

[16] *Diagnostic and statistical manual of mental disorders.* American Psychiatric Association. Fifth ed. Arlington, VA: American Psychiatric Publishing, 2013.

[17] *EDI 3: Eating disorder inventory-3: Professional manual*. D. M. Garner. Psychological Assessment Resources, 2004.

[18]

[19]  A. Cepeda-Benito, D.H. Gleaves, M.C. Fernández, J. Vila, T.L. Williams, J. Reinoso,
The development and validation of Spanish versions of the State and Trait Food Cravings
Questionnaires, *Behavior Research and Therapy* **38** (2000), 1125-1138.

# An Initial Validation of Virtual Human Administered Neuropsychological Assessments

Thomas D. PARSONS[a,*], Paul SCHERMERHORN[b,] Timothy MCMAHAN[a], Justin ASBEE[a], and Nicole RUSSO[a]

[a] *Computational Neuropsychology and Simulation (CNS) Lab, Department of Psychology, University of North Texas, Denton, Texas USA*
[b] *Soartech, Ann Arbor Michigan USA*

**Abstract.** Appropriate neuropsychological assessments are often not readily accessible due to remote geographical locations. The current study performs construct validation of a virtual human-administered neuropsychological assessment of learning and memory. Construct validity was assessed through comparison of virtual human with face-to-face (human) administered neuropsychological assessments. Computerized (virtual human) learning and memory scores were hypothesized to correlate with traditional measures of learning and memory, but not with tests of executive functions or picture naming. Convergent validity results indicated that AVANT learning and memory tasks correlated significantly with traditional learning and memory tests. Divergent validity was found in that AVANT learning was not correlated with traditional executive functioning or confrontational word retrieval measures. Likewise, no significant correlations were found between AVANT memory and executive function or confrontational word retrieval. Findings suggest that the virtual human tests measure a capacity that is consistent with that assessed by traditional paper-and-pencil measures involving learning and memory; and inconsistent with traditional measures of domains other than learning and memory. We conclude that the virtual human-based computerized assessment is a valid test of learning and memory.

**Keywords.** Virtual Reality; Neuropsychology; Virtual Human; Psychometrics

## 1. Introduction

Neurocognitive dysfunction adversely affects people's ability to perform the complex cognitive and affective processing tasks involved in everyday activities. Neuropsychological assessment is one method for diagnosing acquired disorders of neurocognitive function. Performance on neuropsychological assessments is related to critical life activities such as vocational success, community reintegration, and social autonomy. Neuropsychological measures are frequently part of the overall neurodiagnostic assessment, which includes other techniques such as neuroimaging. Neuropsychological exams are used routinely to assess the clinical relationship between neurologic functioning and cognitive/behavioral dysfunction, as well as to participate in differential diagnosis. The sensitivity of neuropsychological tests is such that they often

---
[*] Corresponding Author, thomas.parsons@unt.edu.

can identify patterns of impairment that are not determinable through other procedures, leading to appropriate treatment recommendations.

While neuropsychological assessments are used routinely to assess neurocognitive dysfunction, appropriate neuropsychological assessment services are often not readily accessible, due to a variety of factors that include long waiting lists, limited clinic hours, and remote geographical locations. Teleneuropsychological approaches have been developed that allow the neuropsychologist to use video teleconferencing to administer neuropsychological measures remotely [1]. A limitation of this approach is that it requires a neuropsychologist to administer the tests and it misses out on valuable data (e.g., response time). Other solutions have involved the development of computer-automated neuropsychological assessments that administer visually mediated information (via a display monitor) without the need for an examiner [2]. However, the capacity for administering a core test battery has been limited by requiring patients to read instructions and by the need for tests that require verbal responses.

A potential resolution to these issues is the development of largely self-administering computerized neuropsychological assessments that can be administered remotely. Advances in virtual environments and virtual human technologies offer promise for overcoming these limitations [3-5]. A recently developed Avatar Administered Neuropsychological Testing (AVANT; see Figure 1) platform has been developed that includes a virtual reality environment in which a virtual human neuropsychologist administered neuropsychological assessment (including word list learning and recall measures).
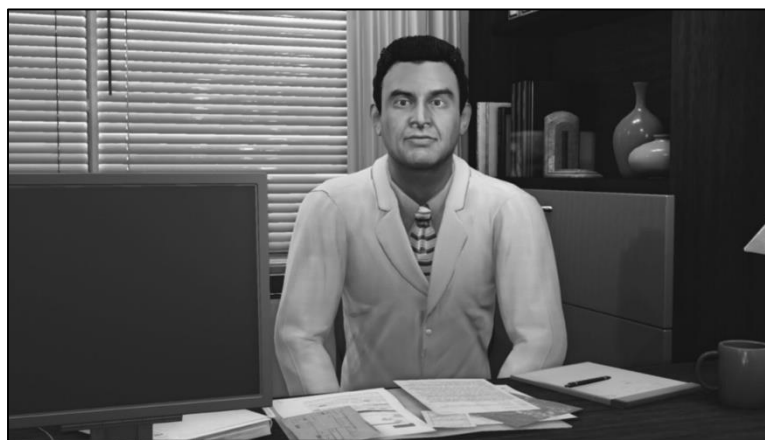


**Figure 1:** Avatar Administered Neuropsychological Assessment Testing.

AVANT's platform provides an interactive, primarily self-administering, experience, allowing for auditorily- and visually-mediated administration (via avatar-based verbal interaction) of cognitive assessment instructions to a real patient. Using speech recognition and a conversational avatar representing a virtual clinician, AVANT allows for avatar-administered neurocognitive assessments that augment a real clinician's ability to assess patients. The AVANT's speech recognition allows for virtual clinician-based administration of word-list learning, confrontation naming, and aural comprehension (see Figure 2). The current iteration of the AVANT word list learning and recall leverages recently validation approaches found in studies using virtual reality-based neuropsychological assessments of learning and memory [6-9].
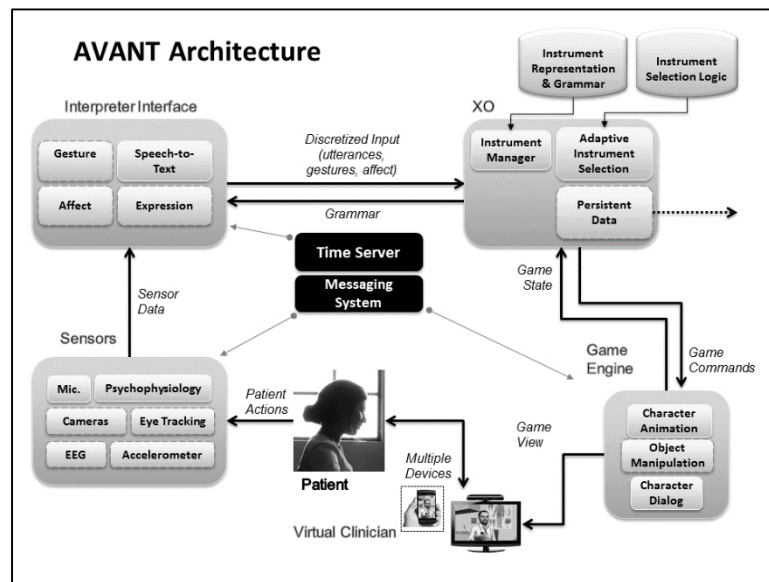
**Figure 2:** Cognitive Architecture and Platform for the Virtual Human Clinician.

The intent of the current study was to perform construct validation of a virtual human-administered neuropsychological assessment of learning and memory. This effort focused on validation of an automated language-based assessment system that is primarily self-administering with clearly presented directions using both visual illustrations and virtual human-based verbal instructions. The current study is an initial attempt at validating the Avatar Administered Neuropsychological Testing (AVANT) Memory Module, virtual human administered measures of learning and memory.

## 2. Methods

We acquired data on the implementation of a virtual human administered assessment of learning and memory (i.e., AVANT) in a normative sample that also received traditional paper-and-pencil tests. We aimed to assess the psychometric properties of the AVANT and paper-and-pencil measures. Hence, scores were correlated with demographic and other performance test measures administered. Standard correlational analyses using a brief demographic survey and pencil-and-paper cognitive tests aided our initial assessment of both the concurrent and divergent validity properties of this form of assessment.

### 2.1 Participants

The University's Institutional Review Board approved the study. A total of 66 college-aged subjects participated in the study (see Table 1). The age range of participants was 19 to 27 years of age (age: M = 20.44; SD = 2.50). Participants were 64% female. The education range of participants was 12 to 15 years (education: M = 13.95; SD = 1.55).

**Table 1**: Demographics

|  | *N* | Percent |
|---|---|---|
| Total Participants | 66 | 100 |
| Gender | | |
| Male | 24 | 36 |
| Female | 42 | 64 |
| Ethnicity | | |
| African American | 9 | 14 |
| Asian | 4 | 6 |
| Hispanic | 22 | 33 |
| Caucasian | 25 | 38 |
| Other | 6 | 9 |
|  | *M* | *SD* |
| Age (years) | 20.44 | 2.5 |
| Education (years) | 13.95 | 1.55 |
| Estimated IQ | 106.36 | 9.8 |

No significant differences were found for age, gender, or education. After informed consent was obtained, basic demographic information was recorded. Participants were also given a medical health history form to assess the presence of any mental or physical disorders that may have hindered their performance. No participants were excluded for responses given on this form.

### 2.2 Design and measures

To examine convergent and discriminant validity we compared the virtual human (i.e., AVANT) to face-to-face (i.e., human) administration of neuropsychological assessments. We hypothesized that the AVANT's learning and memory scores would correlate with traditional neuropsychological measures involving learning and memory, but not with traditional measures involving potential confounds (i.e., executive functions; confrontation naming). Participants completed 1) paper-and-pencil neuropsychological tests administered under standard conditions (face-to-face with a human examiner); and 2) virtual human avatar administered neuropsychological tests of learning and memory.

Convergent validity analyses used the California Verbal Learning Test (CVLT) [10] as it is considered to have important learning and memory components and has been used clinically to estimate memory abilities. Discriminant validity measures included: (a) Color-Word Interference (Stroop) from the Delis–Kaplan Executive Function System (D-KEFS) [11]; and Picture Naming from the Repeatable Battery for the Assessment of Neuropsychological Status [12]. Participants completed both the AVANT tasks and paper-and-pencil neuropsychological tasks. Testing occurred in a quiet, climate-

controlled environment in a university-owned computer lab. The order in which the various tests were administered was counterbalanced across participants.

*Virtual reality learning and memory tasks.* The AVANT Verbal Learning and Memory Test measures episodic verbal learning and memory. The measure examines encoding, recall and recognition of auditory-verbal information. Data is generated that reflects how much a patient learns, errors, and the strategies utilized. The AVANT Verbal Learning and Memory Test evaluates free and cued recall, serial position effects (including primacy and recency), semantic clustering, intrusions, interference and recognition. Two monitors were used: (a) one for displaying the Launcher application, which is used by the examiner (in another room) to monitor the virtual human's administration of the list learning and recall tasks; and (b) another for displaying the participant's view of the virtual environment. A scoring program was employed for data acquisition. This also allowed for key events in the environment to be logged and time stamped with millisecond temporal accuracy.

## 2.3 Data Analytics

All data were analyzed using SAS version 9.1. Descriptive statistics were calculated for participant demographics and for results of the AVANT and the criterion neuropsychological tests. Missing data were imputed by either mean substitution or last case carried forward. Correlations were computed among AVANT Verbal Learning and Memory Test and traditional neuropsychological measures assessing learning and memory. Two-tailed Pearson correlations were used.

## 2.4 Results

Convergent validity results indicated that AVANT word list learning correlated significantly with traditional neuropsychological learning (CVLT Trials 1–4; $r = 0.47$, $p<0.001$). AVANT memory correlated significantly with the traditional neuropsychological memory composite (CVLT free recall after a delay; $r = 0.32$, $p<0.009$; CVLT cued recall after a delay; $r = 0.43$, $p < 0.001$).

Divergent validity results revealed no significant correlations between AVANT learning measures and executive function measures (DKEFS Inhibition/Switching ($r = 0.12$, $p<0.33$); or confrontational word retrieval (RBANS Picture Naming ($r = 0.05$, $p<0.69$). Likewise, no significant correlations between AVANT memory measures and executive function measures (DKEFS Inhibition/Switching (AVANT free recall $r = 0.06$, $p<0.61$; AVANT Cued Recall $r = 0.09$, p 0.44); and confrontational word retrieval (RBANS Picture Naming (AVANT free recall $r = 0.01$, $p<0.91$; AVANT Cued Recall $r = 0.02$, p<0.86).

## 3 Discussion

This study provides preliminary validation of the AVANT's Verbal Learning and Memory. Convergent and discriminant validity were evaluated using neuropsychological tests chosen a priori. Results supported both convergent and discriminant validity. That is, findings suggest that the AVANT measures a capacity that is (a) consistent with that assessed by traditional paper-and-pencil measures involving learning and memory and

(b) inconsistent with that assessed by traditional paper-and-pencil measures assessing neurocognitive domains traditionally assumed to be other than learning and memory.

Our findings should be understood in the context of some limitations. These findings are based on a fairly small sample size. As a necessary next step, the reliability and validity of the test needs to be established using a larger sample of participants to ensure that the current findings are not an anomaly due to sample size. Additionally, the diagnostic utility of the AVANT's Verbal Learning and Memory measures must be determined.

In summary, our goal was to conduct an initial pilot study to validate the AVANT's Verbal Learning and Memory measures through comparison with standard neuropsychological tests for the assessment of healthy participants. We believe that this goal was met. We recognize, however, that the current findings are only a first step in the development of this tool. Many more steps are necessary to continue the process of test development and to fully establish the AVANT's Verbal Learning and Memory measures as a contribution to existing assessment procedures for the diagnosis of memory decline. Although the AVANT's Verbal Learning and Memory measures must be fully validated, current findings provide preliminary data regarding the validity of the VE as a memory measure.

## References

[1] R.L. Kane, and M. Cullum. Teleneuropsychology. In *The Role of Technology in Clinical Neuropsychology*. R. Kane & T.D. Parsons, eds., Oxford University Press, 2017, pp. 89-102.

[2] A.S. Vincent, T. Roebuck-Spencer, K. Gilliland, R. Schlegel. Automated neuropsychological assessment metrics (v4) traumatic brain injury battery: military normative data. *Military medicine*. **177** (2012) 256-269.

[3] T.D. Parsons. Virtual Reality for Enhanced Ecological Validity and Experimental Control in the Clinical, Affective, and Social Neurosciences. *Frontiers in Human Neuroscience* **9** (2015) 1-19.

[4] T.D. Parsons, A. Carlew, J. Magtoto, and K. Stonecipher. The Potential of Function-Led Virtual Environments for Ecologically Valid Measures of Executive Function in Experimental and Clinical Neuropsychology. *Neuropsychological Rehabilitation*, **37** (2017) 777-807.

[5] T.D. Parsons, *Cyberpsychology and the Brain: The Interaction of Neuroscience and Affective Computing*. Cambridge: Cambridge University Press, 2017.

[6] G. Plancher, J. Barra, E. Orriols, and P. Piolino. The influence of action on episodic memory: A virtual reality study. *The Quarterly Journal of Experimental Psychology*, **66** (2013) 895–909.

[7] G. Plancher, A. Tirard, S. Nicolas, and Piolino, P. Using virtual reality to characterize episodic memory profiles in amnestic mild cognitive impairment and Alzheimer's disease: influence of active and passive encoding. *Neuropsychologia*, **50** (2012) 592-602.

[8] G. Lecouvey, J. Gonneaud, P. Piolino, S. Madeleine, E. Orriols, P. Fleury, F. Eustache, and B. Desgranges. Is binding decline the main source of the ageing effect on prospective memory? A ride in a virtual town. *Socioaffective Neuroscience & Psychology* **7** (2017) 1-17.

[9] T.D. Parsons, and A.A. Rizzo. Initial Validation of a Virtual Environment for Assessment of Memory Functioning: Virtual Reality Cognitive Performance Assessment Test. *Cyberpsychology and Behavior,* **11** (2008) 17-25.

[10] D.C. Delis, J. Kramer, E. Kaplan, and B.A. Ober. *CVLT-II: California verbal learning test: adult version*. Psychological Corporation, 2000.

[11] D.C. Delis, E. Kaplan, and J. Kramer. *Delis–Kaplan Executive Function System (D-KEFS): Examiner's manual.* San Antonio, TX The Psychological Corporation, 2001.

[12] C. Randolph, C. *RBANS manual*. San Antonio, TX: The Psychological Corporation, 1998.

# Preventing Post-Traumatic Intrusions using Virtual Reality

Sarah PAGE[a*] and Matthew COXON[a]

[a] *School of Psychological and Social Sciences, York St John University, York, UK*

**Abstract.** Post-Traumatic Stress Disorder (PTSD) research is of upmost importance given the high lifetime risk of experiencing a traumatic event. While there is a successful treatment protocol for PTSD, there can be delays in access and early interventions are lacking. Recent research has suggested that loading working memory with a visuo-spatial task immediately following a traumatic experience can reduce the frequency and development of intrusive trauma-related images. It was hypothesised here that completing a visuo-spatial task in virtual reality could enhance such interventions given its distinct attention-capturing ability. 30 non-clinical participants watched a traumatic film, then engaged in Tetris® on a desktop display, in virtual reality, or sat in silence (control condition). Participants kept a diary of intrusions experienced for the next 7 days. Participants in the virtual reality condition recorded significantly less intrusions over the 7 days than those in the no-task control condition. Using virtual reality was also rated as significantly more engaging than the desktop condition and had the secondary gain of significant post-task mood improvement. Although only initial findings, using virtual reality clearly has the potential to be both a more effective and a more appealing intrusion prevention technique following a trauma.

**Keywords:** Post-traumatic Stress Disorder; Virtual Reality; Immersive Virtual Environment; Distraction; Attention

## 1. Introduction

Post-Traumatic Stress Disorder (PTSD) is a classified psychiatric disorder [1]. Characteristic symptomology includes intrusions, avoidance and hyper-arousal. It can be diagnosed at least a month after a traumatic event [2] for which there is a high lifetime risk [3]. Whilst Cognitive Behavioural Therapy (CBT) is the recommended treatment for PTSD [2], the rate of treatment completion is as low as 8.5% and at one-month post-trauma over 95% of patients exhibit at least one barrier to CBT completion [4]. It is therefore imperative that alternative cost-effective interventions are explored.

Recent research has shown that psychological processing immediately after the trauma is critical [5]. Concerns have been raised about the use of early intervention techniques such as pharmacology [6] and debriefing [7]. Researchers have therefore begun to explore alternative early interventions to help minimise the development of PTSD symptoms [8]. The aim of the present research is to specifically reduce the number of intrusions that may occur. Intrusions are involuntary, multi-sensory, highly-detailed, mental images of the traumatic event [9]. Intrusion reduction is important because they

* Corresponding Author.: sarahjpage17@gmail.com

are recurrent, distressing, central in a diagnosis of PTSD [2] and a precursor to development of the disorder [10].

Recent studies have demonstrated the efficacy of loading Working Memory (WM) to reduce intrusion development [11]. The WM model proposes that recent visual and spatial information is processed separately from verbal and semantic information, by the visuo-spatial sketchpad (VSSP) [12]. It is hypothesised that interfering with the processing of information held in WM reduces the likelihood this information will be subsequently stored in long-term memory. Given that intrusions are primarily visuo-spatial [13] it was hypothesised that loading the VSSP shortly after experiencing a 'trauma' would therefore reduce intrusions. Holmes *et al.,* had participants watch a traumatic film then either play Tetris® or sit quietly. Participants who had played Tetris® experienced fewer intrusions in the following week than the control condition [11]. The authors concluded that loading the VSSP may therefore be an effective means of reducing intrusions following trauma as hypothesised.

However, it is important to note that domain general distraction may have also played an important role in addition to domain specific effects. Concurrent visuo-spatial tasks often carry a memory load and have a sequencing component (as Tetris® does) [14], and such tasks demand domain general cognitive resources in addition to modality specific resources. The effects of interfering visuo-spatial tasks may reflect both a depletion of general-purpose and domain specific resources. It is therefore important to consider whether loading domain general attentional resources, in addition to the domain specific ones, may have a beneficial effect.

Virtual reality (VR) is a particularly attention-capturing medium [15] which places significant demands on domain general resources. When using VR participants interact with a computer generated world usually presented in a head-mounted display (HMD). This ability to divert attentional resources away from real-life experience has already been exploited as a clinical intervention for acute pain management for over a decade [15]. The study reported here therefore exploited this attention capturing quality of VR to investigate whether the combination of VR and a visuo-spatial task may be more effective than the visuo-spatial task in a less immersive medium (desktop-based), or no intervention at all. If so, then this would be indicative that the recruitment of domain general cognitive resources may provide an additional important benefit when attempting to prevent post-traumatic intrusions.


## 2.    Materials and Method

### 2.1 Participants

Thirty participants completed the study, with 10 allocated randomly to each condition (12 males, 18 females; $M$age = 29.07 yrs; $SD$age = 14.50 yrs). Exclusion criteria included a history of treatment for psychiatric disorders, suffering from motion sickness, a heart condition or other serious medical condition, and pregnancy (or suspected pregnancy). Ethical approval was provided by York St John University

### 2.2 Design

A between participants randomised control trial (RCT) was used, with post-trauma concurrent task as the independent variable: no-task control; Tetris® desktop; and Tetris® VR. Participant experience of intrusive images was the main variable of interest, measured through a diary and a standardized self-report measure. Task engagement was measured in the two intervention conditions as a dependent variable. Additional control measures were also taken (see below).

*2.3 Materials and procedure*

Prior to the experiment participants completed self-report measures to indicate current levels of anxiety and depression, proneness to fainting, blood phobia and previous experience of traumatic events. Once initial measures were completed, participants watched a trauma-film as an experimental equivalent of a traumatic experience [16]. The content reflected that used in previous research [11, 17], with some identical scenes including the road traffic accidents, surgery and blood loss. A 20 minute filler task was then completed to reflect the likely delay in commencing an intervention after a trauma [8]. To ensure consistency with previous research [11, 17] a brief reminder of the film was shown to participants prior to intervention.

Participants were assigned to the no-task control, Tetris® desktop or Tetris® VR condition randomly. Participants were instructed to: sit in silence and not touch anything (no task control); play Tetris® on a desktop computer; or play a Tetris® equivalent (BlockOut Rift [18]) using a HMD, the Oculus Rift Development Kit 2. Each task lasted for 10 minutes

Mood was measured pre-film, post-film and after the task using visual analogue scales (VAS), to ensure equivalent mood change across conditions. Following completion of the task, participants also rated task compliance on a VAS. Participants in the intervention conditions also rated enjoyment and difficulty of the tasks. Additionally, they rated how engaged they felt with the task on a VAS. This provided a measurement of how much attention was engaged with the task and therefore an indication of how much the task distracted from processing of the trauma film images.

In line with previous research [11, 17], participants kept a daily diary of intrusions experienced for the seven days which followed. They also rated how accurately they were able to record their intrusions on a VAS and completed the intrusion subscale from the impact of event scale revised (IESr) [19].

3.     **Results**

Preliminary analyses indicated there were no baseline differences between the groups in terms of age, symptoms of anxiety, depressive symptoms, number of previous traumatic experiences, blood phobia, proneness to fainting or gaming frequency (p>.05). These analyses indicate that any significant differences found across conditions are unlikely to be confounded by these variables.

There was a significant deterioration of mood following the trauma film $F_{(2, 27)}=8.17$, p=.008, but a significant interaction was not found between this change in mood and condition (p>.05). Following completion of the 10 minute task, participants again rated their mood. On the basis of previous literature it was predicted that post-task mood would be equivalent across conditions; contrary to expectations there was a

significant difference according to the intervention F(2, 27) = 3.46, p =.042, $\eta^2$=.17). Post-hoc tests showed a significant difference between the no-task control condition and the VR condition (p=.008), no significant differences were found between the Tetris® condition and the other conditions (p>.05). A large effect size was found for the difference in post-task mood between the no-task and VR conditions (d = 1.62), suggesting engaging in a VR game significantly improves mood following a trauma when compared to not engaging in a task.

Task compliance was rated as equivalent across the three conditions (p>.05). Participants in the Tetris® conditions additionally rated task difficulty and enjoyment, these results were not significantly different across the conditions (p>.05), providing assurances that neither difficulty nor enjoyment differed between these two interventions.

Task engagement was rated by participants in the Tetris® conditions, it was found to be significantly different (t(18) = -3.22; p = .005; d = -1.44), suggesting any differences found for the number of intrusions experienced may due to the level of engagement with the task and thereby the ability of the task to distract from processing of the intrusive images. Participants reported being more engaged with the Tetris® VR condition then the Tetris® desktop condition.

### 3.1 Intrusive images

The key dependent variable was the number of intrusions experienced in the seven days following the experiment. Primary analyses found no significant differences across conditions for scores on the IESr scale (p>.05). However, the number of intrusions recorded in diaries in the seven days after viewing the trauma film were significantly different across conditions F(2, 27) = 7.27, p=.003, $\eta^2$=.16. Post-hoc tests indicated a significant difference between the no-task condition and Tetris® VR condition (p=.002). Participants in the Tetris® VR condition reported a lower number of intrusions (*M*=1.7) compared to the control condition (*M*=6.8). No significant differences were found between the Tetris® desktop condition and the other conditions (p>.05).

Supplementary analyses investigated differences in the number of intrusions across the seven days. A significant difference in the number of intrusions experienced over time was found (F(6,162) = 32.51; p <.001); time and condition significantly interacted (F(12,162 = 4.59; p = .001) suggesting intrusions reduced at different rates across conditions. These results need to be interpreted with caution as variance in each condition was not equivalent. Follow-up tests were completed to look into the pattern of intrusions experienced. A significant difference in the number of intrusions reported on day one and day two was found (day one p=.004; day two p = .017), differences in intrusions experienced across the other days was not significant (p>.05).

The difference in intrusions experienced across conditions on day one was large ($\eta^2$=.34) with a slightly smaller effect size found for day two ($\eta^2$=.26). Post-hoc tests showed the significant differences were between the no-task control condition and the Tetris® VR condition, with a large effect size on day one (d = 1.68) and day two (d = 1.67); there were no significant differences between desktop Tetris® and the other conditions (p>.05). The results suggest engaging in a VR game shortly after experiencing a trauma significantly lowers the number of intrusions experienced in the following two days, compared to not completing a task. A significant difference was not found across the other days (p>.05), the number of intrusions experienced in all conditions on these days was very low (less than 1) implying a floor effect.

A final analysis confirmed participants' compliance with completion of the intrusion diary did not significantly differ across conditions (p>.05).

## 4.    Discussion

The purpose of this research was to investigate whether delivering a visuo-spatial task using VR would reduce the number of intrusions experienced post-trauma. Participants that played Tetris® using VR recorded less intrusions, particularly across day one and day two, reported being more engaged with the medium, and reported improved mood after the task. The Tetris® VR condition was therefore an efficient clinical distractor in comparison to the control condition. The results have important clinical implications since it has been shown that the more intrusions experienced within a day of a traumatic experience, the greater the likelihood of developing PTSD [20]. These results imply VR has the potential to reduce the later development of clinical symptoms.

Contrary to expectations, using VR was not shown to be more effective than Tetris® played through a desktop. The low number of participants per condition (n=10) and high variance within the number of intrusions may go some way to explain the null findings. Given this limitation it is not possible to definitively conclude whether domain-specific or domain-general resource interference in WM is the key to intrusion prevention; the finding that VR performed significantly better than the no-task control but desktop Tetris® did not, does suggest that optimising domain-general distraction may be crucial. Nevertheless, further research is clearly needed.

Unlike in previous research post-task mood and number of intrusions experienced were different across the VR and no-task conditions. Post-task mood did not differ in similar research that utilised a desktop version of Tetris® and no-task control condition [cf. 11, 17] implying VR is a medium capable of improving mood following a laboratory-presented trauma. Improvement in mood was also commensurate with increased engagement when using VR [21].

### 4.1 Conclusions

This study has extended the use of VR to intrusion prevention following a trauma. VR was found to significantly reduce the number of intrusions in the seven days following a trauma-film relative to a no-task control condition. Small sample size and high variance within experimental conditions limit the conclusions that can be drawn here. However VR was shown to be significantly more engaging than the desktop Tetris® and was the only intervention condition shown to have a significant advantage over the no-task control group. These findings provide some support for the suggestion that additionally engaging domain-general cognitive resources to a large extent may contribute significantly to intrusion reduction.

## References

[1] *Diagnostic and Statistical Manual of Mental Disorders.* American Psychiatric Association.. Fifth ed. Washington DC, American Psychiatric Association. 2013.

[2] Post-traumatic Stress Disorder (PTSD): the Management of PTSD in Adults and Children in Primary and Secondary Care. Quick Reference Guide. NICE, London, 2005.

[3] N. Breslau, The epidemiology of trauma, PTSD and other posttrauma disorders, *Trauma, Violence, & Abuse* **10** (2003), 198–210

[4] S. Trusz, A. Wagner, J. Russo, J. Love, J. & D. Zatzick, D. F, Assessing barriers to care and readiness for cognitive behavioral therapy in early acute care PTSD interventions, *Psychiatry: Interpersonal & Biological Processes* **74** (2011), 207-23.

[5] E.J. Ozer, S.R. Best, T.L. Lipsey & D.S. Weiss, Predictors of Posttraumatic Stress Disorder and symptoms in adults: A meta-analysis*, Psychological Bulletin* **129** (2003), 52-73.

[6] R. Henry, J. Fishman, & S. Youngner, Propranolol and the Prevention of Post-traumatic Stress Disorder: Is it wrong to Erase the "sting" of bad memories? *The American Journal of Bioethics* **7** (2007), 12–20.

[7] R. McNally, R. Bryant, A., & Ehlers, Does Early Psychological Intervention Promote Recovery from Posttraumatic stress? *Psychological Science in the Public Interest* **4** (2003), 45–79.

[8] A. Dyregrov & S, Regel, Early interventions following exposure to traumatic events: Implications for practice from recent research, *Journal of Loss & Trauma* **17** (2012), 271-291.

[9] J. Krans,, G. Naring, E. Becker, & E. Holmes, Intrusive trauma memory: A review and functional analysis, Applied Cognitive Psychology 23 (2009), 1076-1088.

[10] M. O'Donnell, P. Elliot, W. Lau, & M. Creamer, PTSD symptom trajectories: From early to chronic response. *Behaviour Research and Therapy* **45** (2003), 601–606.

[11] E. Holmes, E. James, T. Coode-Bate & C. Deeprose, Can playing the computer game "Tetris®" reduce the build-up of flashbacks for trauma? A proposal from cognitive science, *PLoS ONE* **4** (2009).

[12] A.D. Baddeley & G. Hitch, *Working memory.* In G.H. Bower (Ed.), The Psychology of Learning and Motivation: Advances in Research and Theory (Vol. 8, pp. 47–89). New York: Academic Press. 1974.

[13] C.R. Brewin & E.A. Holmes, Psychological theories of Post-traumatic Stress Disorder, *Clinical Psychology Review* **23** (2003), 339-376.

[14] M. Smyth & K.A. Scholey, Interference in immediate spatial memory, *Memory & Cognition* **22** (1994), 1-13.

[15] H.G. Hoffman, D.R. Patterson, & J. Carrougher, Use of virtual reality for adjunctive treatment of adult burn pain during physical therapy: A controlled study, *Clinical Journal of Pain,* **16** (2000), 244–250.

[16] E. James, A. Zhu, H. Tickle, A. Horsch, & E. Holmes (2015). Playing the computer game Tetris® prior to viewing traumatic film material and subsequent intrusive memories: Examining proactive interference, *Journal of Behavior Therapy and Experimental Psychiatry*. Advanced online publication.

[17] E. Holmes, E. James, E. Kilford & C. Deeprose. (2010). Key steps in developing a cognitive vaccine against traumatic flashbacks: Visualspatial Tetris® versus verbal Pub Quiz, *PLoS ONE* **5** (2010).

[18] A. Thompson  (2015). BlockOut Rift.

[19] D.Weiss & C. Marmar, The Impact of Event Scale—Revised, New York, Guilford Press, 1996

[20] B. Olatunji & Q, Fan, Q, Anxiety sensitivity and post-traumatic stress reactions: Evidence for intrusions and physiological arousal as mediating and moderating mechanisms. *Journal of Anxiety Disorders* **34** (2015), 76-85.

[21] S. Triberti, C. Repetto & G. Riva, G, Psychological factors influencing the effectiveness of virtual reality–based analgesia: A systematic review, *Cyberpsychology, Behaviour and Social Networking* **17** *(2014)*, 335-345.

# Behavioral, craving, and anxiety responses among light and heavy drinking college students in alcohol-related virtual environments

Alexandra GHIȚĂ[a,*], Marta FERRER-GARCIA[a] and José GUTIÉRREZ-MALDONADO[a]

[a]*Department of Clinical Psychology and Psychobiology, University of Barcelona*

**Abstract.** Drinking-related behavior in college students represents a public concern with consequences for health and academic performance. The aim of the present study was to determine which measures (behavioral and self-reported measures of craving and anxiety) differentiate best between light- and heavy-drinking college students when exposed to a virtual reality (VR) alcohol-cue environment. 25 college students participated in this study, of whom 13 were light drinkers (standard drink units (SDU)/month ≤ 10) and 12 heavy drinkers (SDU)/month ≥ 11). Participants completed the Alcohol Use Disorder Identification Test (AUDIT) before exposure to the VR environment. Heavy drinkers scored higher than light drinkers on AUDIT. The virtual environment consisted of four situations: restaurant, bar, chill-out area, and bedroom, where participants could choose alcoholic or non-alcoholic beverages. An Oculus Rift DK2 headset was used as the HMD. In each situation, craving and anxiety were self-reported on a visual analog scale (VAS, from 0 to 10). The results showed differences between groups in the type of beverage chosen in the VR situations, whereby heavy drinkers chose alcoholic drinks more frequently. However, no statistically significant differences were found between groups in craving or anxiety levels reported on the VAS during VR exposure. Heavy-drinking students show a preference for alcoholic beverages in all VR situations compared with light drinkers, but do not experience different levels of craving or anxiety as assessed with VAS. If virtual environments are used to detect heavy drinking cases, behavioral parameters such as choosing between alcoholic or non-alcoholic cues seem more suitable than self-reports of craving or anxiety. Nevertheless, future studies are necessary to determine whether more objective measures of craving and anxiety (eye tracking or psychophysiological responses) perform better than self-reports in differentiating between heavy and light drinking.

**Keywords:** Virtual Reality, alcohol, craving, assessment

---

[*]Corresponding author: alexandraghita@ub.edu

## 1. Introduction

It has been extensively noted that excessive alcohol consumption has a serious impact on college students, particularly on their academic performance, general health and engagement in hazardous behaviors [1-3]. Repetitive drinking behaviors facilitate the development of motivational, rewarding features of alcohol-related stimuli [4], known as the *cue-reactivity paradigm*. This paradigm posits that exposure to substance-related cues induces changes in psychophysiological reactivity [5], behavioral approaches [6], emotional and cognitive responses [7] and self-reported cravings [8]. It has been hypothesized that craving for alcohol, defined as an impetuous desire to drink, is one of the underlying mechanisms in the maintenance of drinking-related behaviors [9]. Previous studies confirm that alcohol-related stimuli trigger greater urges to drink than neutral stimuli [1, 10, 11]. Hence, there is a greater likelihood of developing dependence over the years, due to the widespread availability of alcohol-related cues.

A growing body of literature on Virtual Reality (VR) has recently drawn attention, due to its applicability in the field of psychology. VR adds realism and a sense of presence to existing methods such as image/video or *in-vivo* cue exposure, by creating an immersive environment in which individuals can experience different scenarios in a similar way to real-life situations [12].VR techniques involve a dynamic human-computer interaction [13], which enhances the ecological validity of traditional paradigms. Several studies have demonstrated the effectiveness of VR as an instrument to trigger cravings in individuals who misuse alcohol [11, 14] and reduce the urge to drink in individuals with Alcohol Use Disorder (AUD) [15,16].

Similarly, a previous study [3] showed that binge drinking college students reported greater levels of alcohol craving following VR exposure to environments containing alcohol-related stimuli. Alcohol use and misuse in college is a serious worldwide concern with neuro-psycho-social implications for students [17]. Hence, there is an urgent need to conduct studies and implement new technologies that could help to detect problematic alcohol-related behaviors. In turn, this could lead to the development of further prevention methods, and a reduction in harmful behaviors among students.

The aim of this study was to explore empirically how well behavioral and self-reported measures of craving and anxiety differentiated between light and heavy drinking college students when exposed to a VR alcohol-related cue environment.

## 2. Method

### 2.1. Participants

Twenty-five college students ($M = 25.48$, $SD = 9.29$), 5 men and 20 women, participated in this study after their informed consent. On the basis of their alcohol consumption, participants were divided into two groups: light and heavy drinking college students. The cut-off score was ≤10 standard drink units (SDU/month) for light drinking college student and ≥11 SDU/month for heavy drinking college students. A Spanish SDU is a single consumption of 10g of ethanol corresponding to a standard measure of wine or beer and half a measure of liquors [18].

Light drinking college students ($N = 13$, AUDIT $M = 2.84$, S$D = 3.46$) consumed on average $M = 2.92$, $SD = 2.53$ SDU/month. Heavy drinking college students ($N = 12$, AUDIT $M = 7.25$, $SD = 4.22$) consumed on average $M = 23.5$, $SD = 9.84$ SDU/month.

Four participants reported a family AUD history. Exclusion criteria were participants with current psychopathology, severe vision problems, epilepsy or participants taking benzodiazepine medication.

## 2.2. Instruments

- *Alcohol Use Disorder Identification Test (AUDIT)* [19]. The Spanish version of AUDIT [20] is a 10-item scale that aims to explore alcohol use problems and risk consumption. Responses to each item are scored from 0 to 4 and the maximum score is 40.
- *Visual Analog Scale – Anxiety (VAS-A).* The VAS-A was a self-reported scale designed to assess anxiety levels from 0 to 10 when participants were exposed to a beverage, where 0 was "no anxiety" and 10 was "intense anxiety".
- *Visual Analog Scale – Craving (VAS-C).* The VAS-C was a self-reported scale designed to assess urges to drink on a scale from 0 to 10 when participants observed their beverages, where 0 was "no urge to drink" and 10 was "intense urge to drink".

## 2.3. Procedure

College students were recruited to participate in this study after their informed consent. Approval was obtained from the Ethics Committee of the University of Barcelona. Demographic information, psychopathology history, family alcoholism history and monthly and weekly alcohol consumption data were collected. Then, participants were asked to complete the AUDIT questionnaire. Subsequently, they were exposed to the VR environment (*Alco-VR*), which was comprised of four areas: restaurant, bar, bedroom and chill-out area, all of which contained alcohol-related stimuli (e.g. bottles of alcohol on the tables, commercials with alcohol content and glasses of alcohol). Different beverages (beer, wine, vodka, whisky, tequila, rum, gin, champagne, fresh juice, coffee, water and soda) could be chosen from a menu every time the experimenter asked participants to sit down (on a chair, a sofa, a bed or a stool). In each situation (restaurant, chill-out area, bar and bedroom), students were asked to explore the environment first and to choose either an alcoholic or non-alcoholic drink from a menu. Once they had selected a beverage, participants were asked to observe it for 10 seconds and then were asked to report their anxiety and craving levels on VAS-A and VAS-C. Oculus Rift Development Kit 2 and a joystick were used in the exposure protocol.

## 2.4. Statistical analysis

Repeated measures ANOVA with a Greenhouse-Geisser correction was used to determine whether there were statistically significant differences between light and heavy drinking students in terms of self-reported levels of craving and anxiety during exposure to the four virtual environments. Given the chi-square results, tests were run to explore the relationship between group and type of preferred beverages. A series of Pearson correlations were performed to test the relationships between craving and anxiety levels within the different settings of the VR environment. Data were analyzed using SPSS Statistics Version 23.0.

## 3. Results

### 3.1. Self-reported anxiety and craving responses among drinking college students

Neither the main effects nor the interactions were statistically significant. Our data showed no statistically significant differences in self-reported craving across all four settings of the VR environment ($F(2.031, 46.705) = .178$, $p > .05$, $\eta^2 = .05$). There were no statistically significant differences between light and heavy drinkers ($F(1, 23) = .48$, $p > .05$, $\eta^2 = .02$). Finally, there were no statistically significant differences in self-reported craving across all four VR settings between light and heavy drinking students ($F(2.031, 46.705) = 1.942$, $p > .05$, $\eta^2 = .22$).

Similarly, there were no statistically significant differences in self-reported anxiety across all four settings of the VR environment ($F(2.163, 49.744) = .342$, $p > .05$, $\eta^2 = .16$). There were no statistically significant differences between light and heavy drinkers ($F(1, 23) = .027$, $p > .05$, $\eta^2 = .001$). Finally, the results indicated no statistically significant differences in self-reported anxiety levels between light and heavy drinking students across all four VR settings ($F(2.163, 49.744) = 2.416$, $p > .05$, $\eta^2 = .18$).

**Table 1.***M* and *SD* of self-reported levels of anxiety and craving in heavy and lightdrinking students

|  | **Restaurant** | | **Bar** | | **Chill-out area** | | **Bedroom** | |
|---|---|---|---|---|---|---|---|---|
|  | *Craving* | *Anxiety* | *Craving* | *Anxiety* | *Craving* | *Anxiety* | *Craving* | *Anxiety* |
| *Heavy drinkers* | M= 3.83 SD= 2.91 | M= .83 SD= 1.46 | M= 4.25 SD= 3.01 | M= .58 SD= 1.16 | M= 4.75 SD= 3.52 | M= 1.08 SD= 1.73 | M= 4.58 SD= 3.52 | M= .92 SD= 1.73 |
| *Light drinkers* | M= 5.46 SD= 3.15 | M= .54 SD= .96 | M= 5.62 SD= 2.29 | M= 1.23 SD= 2.12 | M= 4.62 SD= 3.25 | M= .62 SD= .96 | M= 4.85 SD= 3.18 | M= .69 SD= 1.10 |

*M*, mean; *SD*, standard deviation

### 3.2. Types of preferred beverages among drinking college students

There was a significant difference between the type of beverage preferred by heavy and light drinking college students $\chi^2(1) = 9.64$, $p< .05$ within the VR restaurant setting. As observed in Figure 1, heavy drinking college students opted for alcoholic beverages, whereas light drinking college students preferred non-alcoholic beverages.
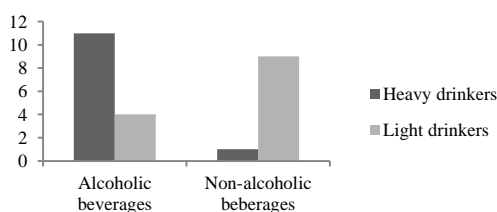


**Figure 1.** Types of preferred beverages within the VR restaurant environment

Similarly, there was a significant difference between the type of preferred alcoholic/non-alcoholic beverages of heavy and light drinking college students $\chi^2(1) =$

7.67, $p < .05$ within the bar setting. However, no significant associations between group and type of preferred beverages were found for the chill-out area $\chi^2(1) = .99$, $p = .32$ and the bedroom setting $\chi^2(1) = .32$, $p = .56$.

*3.3. Relationship between craving and anxiety levels within VR environments*

There was a significant relationship in the cravings reported on the VAS-C by light drinkers across all four VR settings (between restaurant setting and bar, $r = .89$, $p < .001$; restaurant and chill-out area, $r = .84$, $p < .001$; restaurant and bedroom, $r = .65$, $p < .05$; bar and bedroom, $r = .56$, $p < .05$; bar and chill-out area, $r = .61$, $p < .05$; bedroom and chill-out area, $r = .65$, $p < .05$). There was a significant relationship in cravings reported on the VAS-C by heavy drinkers across all four VR settings (between restaurant setting and bar, $r = .94$, $p < .001$; restaurant and chill-out area, $r = .84$, $p = .001$; restaurant and bedroom, $r = .63$, $p < .05$; bar and bedroom, $r = .71$, $p < .05$; bar and chill-out area, $r = .90$, $p < .001$; bedroom and chill-out area, $r = .93$, $p < .001$). Similarly, there was a significant relationship in anxiety reported on the VAS-A by light drinkers across all four VR settings (between restaurant and bar, $r = .86$, $p < .001$; restaurant and chill-out area, $r = .87$, $p < .001$; restaurant and bedroom, $r = .71$, $p < .05$; bar and chill-out area, $r = .66$, $p < .05$; bar and bedroom, $r = .77$, $p < .05$; bedroom and chill-out area, $r = .66$, $p < .05$). There was a significant relationship in anxiety reported on the VAS-A by heavy drinkers across all four VR settings (between restaurant and bar, $r = .96$, $p < .001$; restaurant and chill-out area, $r = .86$, $p < .001$; restaurant and bedroom, $r = .81$, $p = .001$; bar and chill-out area, $r = .74$, $p < .05$; bar and bedroom, $r = .75$, $p < .05$; bedroom and chill-out area, $r = .61$, $p < .05$).

## 4. Conclusions

The aim of this study was to determine which measures can best differentiate between light and heavy drinking college students using a four-setting VR environment.

The results of the study show a preference for alcoholic beverages in heavy drinking college students. Light drinking students were more likely to opt for non-alcoholic drinks within VR restaurant and bar settings. However, no statistical differences were found between light and heavy drinking college students in their scores on craving and anxiety self-reports. Hence, our data indicate that behavioral measures are more suitable for identifying differences between light and heavy drinkers than self-reported measures of craving and anxiety. It seems more effective to detect heavy drinking cases in college students through behavioral parameters such as choosing between alcoholic and non-alcoholic cues (beverages), rather than explicitly reporting craving and anxiety levels on a scale, as students may try to minimize their consumption behavior.

A key limitation of this study is the small sample. A larger sample may have revealed significant differences between heavy and light drinking cases. Nevertheless, future studies are necessary to determine whether measures of craving and anxiety, such as eye tracking or psychophysiological responses, perform better than self-reports in differentiating between heavy and light drinking cases.

## References

[1] M. J. Herrmann, H. G. Weijers, G.Wiesbeck, J.Böning & J. Fallgatter, Alcohol cue-reactivity in heavy and light social drinkers as revealed by event-related potentials, *Alcohol and Alcoholism* **36** (2001), 588–593.

[2] M. T. Schulte, D. Ramo, & S. A. Brown, Gender differences in factors influencing alcohol use and drinking progression among adolescents, *Clinical Psychology Review* **29** (2009), 535–547.

[3] J. J. Ryan, D. S. Kreiner, M. D. Chapman, & K. Stark-Wroblewski, Virtual reality cues for binge drinking in college students, *CyberPsychology & Behavior* **13** (2010), 159–162.

[4] R. Sinha, H. C. Fox, K. A. Hong, K. Bergquist, Z. Bhagwagar, and K. M. Siedlarz, Enhanced negative emotion and alcohol craving, and altered physiological responses following stress and cue exposure in alcohol dependent individuals, *Neuropsychopharmacology* **34** (2009), 1198–1208.

[5] J. Schacht, F. Anton, and H. Myrick, Functional neuroimaging studies of alcohol cue reactivity: A quantitative meta-analysis and systematic review, *Addiction Biology* **18** (2013), 121–133.

[6] M. Field, A. Kiernan, B. Eastwood, and R. Child, Rapid approach responses to alcohol cues in heavy drinkers, *Journal of Behavior Therapy and Experimental Psychiatry* **39** (2008), 209–218.

[7] T. M. Chaplin, K. Hong, K. Bergquist, and R. Sinha, Gender differences in response to emotional stress: an assessment across subjective, behavioral, and physiological domains and relations to alcohol craving, *Alcoholism: Clinical and Experimental Research* **32** (2008), 1242–1250.

[8] A. Hone-Blanchet, T. Wensing, and S. Fecteau, The use of virtual reality in craving assessment and cue-exposure therapy in substance use disorders, *Frontiers in Human Neuroscience* **8** (2014), 1–15.

[9] D. C. Drummond, Theories of drugs craving, ancient and modern, *Addiction* **96** (2001), 33–46.

[10] W. Ooteman, M. W. J. Koeter, R. Vserheul, G. M. Schippers, and W. van den Brink, Measuringcraving: an attempt to connect subjective craving with cue reactivity measuring craving, *Alcoholism: Clinical and Experimental Research* **30** (2006), 57–69.

[11] P. S. Bordnick, A. Traylor, H. L. Copp, K. M. Graap, B. Carter, M. Ferrer, and A. P. Walton, Assessing reactivity to virtual reality alcohol based cues, *Addictive Behaviors* **33** (2008), 743–756.

[12] P. S. Bordnick, B. L. Carter, and A. C. Traylor, what virtual reality research in addictions can tell us about the future of obesity assessment and treatment, *Journal of Diabetes Science and Technology* **5** (2011), 265–271.

[13] U. R. Acharya, Æ. K. P. Joseph, N. K. Æ. Choo, M. Lim, and Æ. J. S. Suri, Heart rate variability : a review, *Medical and Biological Engineering and Computing* **44** (2006), 1031–1051.

[14] J. S. Lee, K. Namkoong, J. Ku, S. Cho, J. Y. Park, Y. K. Choi, J. J. Kim, I. Y. Kim, S. I. Kim, and Y. C. Jung, Social pressure-induced craving in patients with alcohol dependence: Application of virtual reality to coping skill training, *Psychiatry Investigation* **5** (2008), 239–243.

[15] S. H. Lee, D. H. Han, S. Oh, I. K. Lyoo, Y. S. Lee, P. F. Renshaw, and S. E. Lukas, Quantitative electroencephalographic (qEEG) correlates of craving during virtual reality therapy in alcohol-dependent patients, *Pharmacology Biochemistry and Behavior* **91** (2009), 393–397.

[16] S. J. Hyun, S. J., Hyun, H. D., Churl, N., Hoon, L. S., & Won, Virtual reality therapy decreased metabolism of lentiform nucleus in patients with alcohol dependence: PET study, *European Neuropsychopharmacology* **23** (2013), 563–563.

[17] M. T. Fillmore and R. Jude, Defining 'Binge' Drinking as Five Drinks per Occasion or Drinking to a 0.08% BAC: Which is More Sensitive to Risk? *American Journal on Addictions* **20** (2011), 468–475.

[18] J. J. LlopisLlácer, A. Gual Solé, and A. Rodríguez-Martos Dauer, Registro del consumo de bebidas alcohólicas mediante la unidad de bebida estándar. Diferenciasgeográficas, *Adicciones* **12** (2000), 11–20.

[19] J. B. Saunders, O. G. Aasland, T. F. Babor, J. R. De La Fuente, and M. Grant, Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption--II, *Addiction* **88** (1993), 791–804.

[20] M. Contel Guillamón, A. Gual Solé, and J. Colom Farran, Test para la identificación de trastornos por uso de alcohol (AUDIT): Traducción y validación del AUDIT al catalán y castellano, *Adicciones* **11** (1999), 337–347.

# Exploring the relationship between the acceptability of a Flying phobia treatment delivered via the Internet and clinical outcomes

Soledad QUERO[a,b,*], Daniel CAMPOS[a], Adriana MIRA[a], Diana CASTILLA[a,b], Cristina BOTELLA[a,b] & Juana BRETÓN-LÓPEZ[a,b]

[a]*Universitat Jaume I (Castellón, Spain)*
[b]*CIBER de Fisiopatología de la Obesidad y Nutrición (CIBEROBN)*

**Abstract.** Acceptability (i.e. patients' expectation and satisfaction with the treatment) is claimed as an important and additional criterion besides efficacy. Nevertheless, the literature addressing this issue in the field of Internet-based treatments for specific phobias is scarce, and no studies for Flying Phobia (FP) are available. This study aims to explore the relationship between expectations and satisfaction with treatment and clinical variables in patients who have received an Internet-based treatment for FP (*NO-FEAR Airlines*). The sample included 46 participants from a randomized controlled trial. Clinical measures were: Fear of Flying Questionnaire-II, Fear of Flying scale, Fear and Avoidance Scales, Clinician Severity Scale, and Patient's Improvement Scale. Results showed significant correlations between expectations, satisfaction and the change on different clinical variables. Patients' expectations significantly correlated and predicted satisfaction with the treatment. Results also revealed that satisfaction with the treatment remained as a significant predictor of the change on all clinical variables. In sum, this study offers data on the relationship between acceptability measurements and clinical variables in patients receiving an Internet-based treatment for FP.

**Keywords.** Specific phobia, Flying Phobia, Acceptability, Computer-Assisted Exposure, Internet-based therapy

## 1.    Introduction

Internet-based treatments have shown to be effective and with numerous advantages in the treatment of mental health problems [1, 2]. Specifically for anxiety disorders, they obtained a large effect size in comparison with control groups (placebo treatment or waiting list) and equal or superior to face-to-face treatment [3, 4]. However, there are still challenges to face to improve the implementation of Internet-based interventions [5, 6]. One crucial aspect for research related to self-applied programs is acceptability. Although the efficacy of Internet-based interventions is important, their acceptability (i.e. patients' expectation and satisfaction with the treatment) is an additional criterion

---

* Corresponding Author: squero@psb.uji.es

likely to affect its implementation [7]. It is known that expectations influence the psychotherapy process and outcomes [8] and those positive expectations are also associated with better outcomes [9, 10]. On the other hand, satisfaction informs us about the feasibility of the intervention, helping to optimize the intervention efficacy [9, 11]. Therefore, the acceptability of the intervention can improve treatments effectiveness [12]. However, the research on these issues in the field of Internet-based treatments for specific phobias is scarce, and no studies for Flying Phobia (FP) are available.

This study aims to explore the relationship between expectations and satisfaction with treatment and clinical variables in patients who have received an Internet-based treatment for FP (*NO-FEAR Airlines*).

## 2.    Method

### 2.1.    Participants and design

The sample included 46 participants (32 women and 14 men) from a randomized controlled trial [13] who had completed *NO-FEAR Airlines*. The mean age was 37.59 years (SD = 11.13) ranging from 20 to 65 years.

### 2.2.    Measures

*2.2.1. Expectation and Satisfaction measures. Treatment Expectation-Satisfaction Scales* (adapted from [14]) assess the participants' expectations about the treatment they will receive and their satisfaction at the end. It includes a 6-item scale ranging from 0 ("*not at all*") to 10 ("*very much*") about: 1) how logical the treatment seemed, 2) to what extent it could satisfy the patient, 3) whether the patient would recommend the treatment to others, 4) whether it would be useful in treating other problems, 5) the treatment usefulness for the patient's problem and, 6) to what extent it could be aversive.

*2.2.2. Clinical variables*

*Fear of Flying Questionnaire-II (FFQ-II)* [15] is a 30-item self-report instrument that describes situations related to flying. Respondents rated their degree of discomfort associated with each item on a scale from 1 to 9 (1 = not at all, 9 = very much).

*Fear of Flying scale (FFS)* [16] is a 21-item self-report measure to assess fear associated with various air travel situations. Fear elicited by each situation was rated on a 5-point scale (0 = not at all, 4 = very much).

*Fear and Avoidance Scales* (adapted from [17]) are used to assess participants' fear and avoidance on a scale ranging from 0 ("No fear at all," / "I never avoid") to 10 ("Severe fear," / "I always avoid") related to the main target behavior: "flying".

*The Clinician Severity Scale* measures the severity of the patient's phobia on a scale from 0 ("symptom free") to 8 ("extremely severe") [18]. This scale is answered by the clinician.

*Patient's Improvement Scale* (adapted from [19]) assesses the level of improvement

achieved by the patient (compared to the baseline status) on a 7-point scale (1 "much worse" to 7 "much better"). The scale is answered by the patient.

### 2.3. Treatment

*NO-FEAR Airlines* is an Internet-based exposure treatment for FP. The program includes three therapeutic tools such as *psychoeducation*, *exposure* and *overlearning*. The *exposure* component is provided through multimedia exposure scenarios composed of images and real sound related to the flight process. A detailed description of *NO-FEAR Airlines* can be found elsewhere [13, 20].

### 2.4. Procedure

Participants completed a pre- and post-treatment assessment via telephone and online (through the *NO-FEAR Airlines* website) that included both clinical and acceptability measures (expectations and satisfaction). Regarding expectations assessment, participants answered these questions before the treatment and after receiving a brief explanation about the rationale of *NO-FEAR Airlines*. After the treatment, participants reported their satisfaction with the treatment answering the same questions. For detailed information about the recruitment and procedure of the RCT see the study protocol [13].

### 2.5.    Data analyses

Firstly, differences between pre- and post-treatment scores were calculated to estimate the change on each clinical variable. Secondly, Pearson correlations were conducted to explore relationships between expectations, satisfaction, and the change on clinical variables. Total scores and items from the Treatment Expectation-Satisfaction Scales were included for correlation analyses.

Finally, separate linear regression analyses were performed to examine whether patients' expectations and satisfaction with the treatment predicted the change on each clinical variable. An additional regression analysis was performed to test whether patients' expectations predicted the satisfaction with the treatment.

### 3.    Results

Results showed significant correlations between *patients' expectations* (total score) and the change in *Fear* ($r = .289$; $p < .05$) and *Avoidance* ($r = .306$; $p < .05$). *Satisfaction with the treatment* (total score) was significantly correlated with the change in all clinical variables: *FFQ-II* ($r = .358$; $p < .05$); *FFS* ($r = .555$; $p < .01$); *Fear* ($r = .690$; $p < .001$); *Avoidance* ($r = .640$; $p < .001$); *Severity* ($r = .751$; $p < .001$) and *Improvement* ($r = .792$; $p < .001$). Furthermore, significant correlations were found between *expectations* and *satisfaction* total scores ($r = .452$; $p < .01$).

Significant correlations between the different items in Treatment Expectation-Satisfaction Scales and the change in clinical variables are presented in Tables 1 and 2.

**Table 1.** Significant correlations between expectations and pre-post differences in clinical variables.

| | **Expectations** | | | | | |
| | Logic | Satisfaction | Recommendation to others | Utility to other problems | Utility to their problem | Aversiveness |
|---|---|---|---|---|---|---|
| FFS | - | - | - | - | - | -.347* |
| Fear (TB) | - | .405* | - | - | -.492** | -.492** |
| Avoidance (TB) | - | - | - | - | .360* | -.593** |
| Severity | - | - | - | - | - | -.470** |

Note: FFS, Fear of Flying Scale; TB, Target Behaviour (flying); Severity, Clinician Severity Scale. *p < .05; **p < .001.

**Table 2.** Significant correlations between satisfaction measures and pre-post differences in clinical variables.

| | **Satisfaction** | | | | | |
| | Logic | Satisfaction | Recommendation to others | Utility to other problems | Utility to their problem | Aversiveness |
|---|---|---|---|---|---|---|
| FFQ-II | - | .374* | - | - | .370* | - |
| FFS | - | .629** | .419* | - | .687** | - |
| Fear (TB) | - | .614** | .447** | .425* | .711** | -.389* |
| Avoidance (TB) | - | .551** | .466** | .446** | .629** | - |
| Severity | .373* | .626** | .573** | .458** | .743** | -.398* |
| Improvement | .445** | .771** | .594** | .431* | .851** | - |

Note: FFQ-II. *Fear of Flying Questionnaire-II* . FFS, Fear of Flying Scale; TB, Target Behaviour (flying); Severity, Clinician Severity Scale; Improvement, Patient's improvement Scale. *p < .05; **p < .001.

Regarding regression analyses, results revealed that *satisfaction with the treatment* (total score) remained as a significant predictor of the change on all clinical variables (Table 3). By contrast, *patients' expectations* (total score) was excluded from the model and it was not a significant predictor for any clinical variable. Finally, *patients' expectations* (total score) was a significant predictor of *satisfaction with the treatment* ($R^2$ = .204 ; β = .452; t = 2.821 ; *p* < .01).

**Table 3. Satisfaction with the treatment as a significant predictor of change in clinical variables.**

| DV | $R^2$ | β | t | *p* |
|---|---|---|---|---|
| FFQ-II | .128 | .358 | 2.098 | **.044** |
| FFS | .308 | .555 | 3.714 | **.001** |
| Fear (TB) | .477 | .690 | 5.314 | **.000** |
| Avoidance (TB) | .410 | .640 | 4.640 | **.000** |
| Severity | .573 | .825 | 5.269 | **.000** |
| Improvement | .631 | .823 | 6.616 | **.000** |

Note: DV; Dependent variable; FFQ-II. *Fear of Flying Questionnaire-II.* FFS, Fear of Flying Scale; TB, Target Behaviour (flying); Severity, Clinician Severity Scale; Improvement, Patient's improvement Scale. β. standardized beta coefficient.

## 4.    Discussion

This study offers data on the relationship between expectations and satisfaction measurements and clinical variables in patients receiving an Internet-based treatment for FP. The results showed that expectations (both the total score of the scale, as well as the different items separately) significantly correlated with the change on fear and avoidance outcomes as well as with patients' satisfaction. Moreover, patients' expectations were a

significant predictor of satisfaction with the treatment. Thus, positive expectations were associated with better outcomes. These results are in line with the literature [9, 10] and suggest the importance of considering patients' expectations of treatment, since it is a factor that explains part of the therapeutic efficacy as well as the patients' satisfaction with the treatment. Regarding satisfaction with the Internet-based intervention, the results also showed significant correlations with change on clinical variables. Furthermore, satisfaction appears as a significant predictor of change in clinical variables. This is an important result because it is known that satisfaction helps to optimize the intervention efficacy [9, 11] and the results in the present study proved that the same might happen with an Internet-based intervention program for FP.

Another relevant issue is the data referred to *aversiveness*. Our results suggest that the perceived *aversiveness* at pre-treatment (expectations) might be more related to the change on clinical variables than the *aversiveness* reported after the intervention (satisfaction). These finding might highlight the importance to consider the perceived aversiveness by patients before starting the intervention (i.e., to provide accurate information when they are informed about the treatment and to implement less aversive interventions, if necessary) in order to enhance the therapeutic process and outcomes.

In the light of these results it is worthy to take into account the necessity of developing not only interventions with effective treatment components, but also with aspects that improve the patients' expectations and satisfaction with the intervention, as this also influences the response to treatment. In the present study, the *exposure* component in the Internet-based intervention is provided through multimedia exposure scenarios composed of images and real sounds, related to the flight process aspects designed to improve patient expectations and satisfaction. According to authors, the use of these tools may provide a less frightening way to confront the fears compared to *in vivo* exposure resulting in better treatment acceptance (i.e., positive expectations and higher satisfaction with the treatment) and better outcomes [21]. In sum, our results are congruent with the data found in the literature. Thus, the acceptability of the intervention can improve treatments effectiveness [12]. However, as far as we know, this is the first study addressing this issue in the field of Internet-based treatment for FP. Research on Internet-based treatments acceptability in relation with efficacy variables might help to improve the treatment offered as well as its implementation, reaching more people in need. Future research is still needed.

## References

[1] G. Andersson. Internet-Delivered Psychological Treatments. Annual Review of Clinical Psychology **12** (2016), 157–179.

[2] M. Sijbrandij, I. Kunovski, & P. Cuijpers. Effectiveness of internet-delivered cognitive behavioral therapy for posttraumatic stress disorder: a systematic review and meta-analysis. *Depression and Anxiety* **33** (2016), 783–791.

[3] J.V. Olthuis, M.C. Watt, K. Bailey, J.A. Hayden, & S.H. Stewart. Therapist-supported Internet cognitive behavioural therapy for anxiety disorders in adults. *Cochrane Database of Systematic Reviews* (2016).

[4] W. Peñate, & A. Fumero. A meta-review of Internet computer-based psychological treatments for anxiety disorders. *Journal of Telemedicine and Telecare* **22** (2016), 3–11.

[5] G. Whitfield, & C. Williams. If the evidence is so good–why doesn't anyone use them? A national survey of the use of computerized cognitive behaviour therapy. *Behavioural and Cognitive Psychotherapy* **32** (2004), 57-65.

[6] E. Kaltenthaler, J. Brazier, E. De Nigris, I. Tumur, M. Ferriter, C. Beverley, … P. Sutcliffe. Computerised cognitive behaviour therapy for depression and anxiety update: a systematic review and economic evaluation. *Health Technology Assessment* **10** (2006).

[7] E.E.K. Wallin, S. Mattsson, & E.M.G. Olsson. The Preference for Internet-Based Psychological Interventions by Individuals Without Past or Current Use of Mental Health Treatment Delivered Online: A Survey Study With Mixed-Methods Analysis. *JMIR Mental Health* **3**(2016).

[8] R.P. Greenberg, M.J. Constantino, & N. Bruce. Are patient expectations still relevant for psychotherapy process and outcome? *Clinical Psychology Review* **26** (2006), 657–678.

[9] L.E. De Graaf, M.J.H., Huibers, H. Riper, S.A.H. Gerhards, & A. Arntz. Use and acceptability of unsupported online computerized cognitive behavioral therapy for depression and associations with clinical outcome. *Journal of Affective Disorders*, **116** (2009), 227–231.

[10] M.E.J.B. Goossens, J.W.S. Vlaeyen, A. Hidding, A. Kole-Snijders, & S.M.A.A. Evers. Treatment Expectancy Affects the Outcome of Cognitive-Behavioral Interventions in Chronic Pain. *The Clinical Journal of Pain* **21**(2005), 18–26.

[11] I.M. Marks, K. Cavanagh, & L.Gega. Computer-aided psychotherapy: Revolution or bubble? *British Journal of Psychiatry* **191** (2007), 417-473.

[12] L. Santana, & L.F. Fontenelle. A review of studies concerning treatment adherence of patients with anxiety disorders. *Patient Prefer Adherence* **5** 2011, 427-439.

[13] D. Campos, J. Bretón-López, C. Botella, A. Mira, D. Castilla, R. Baños, M. Tortella-Feliu, & S. Quero. An Internet-based treatment for flying phobia (NO-FEAR Airlines): study protocol for a randomized controlled trial. *BMC Psychiatry* **16** (2016).

[14] T.D. Borkovec, & S.D. Nau. Credibility of analogue therapy rationales. *Journal of Behavior Therapy and Experimental Psychiatry* **3** (1972), 257–260.

[15] X. Bornas, M. Tortella-Feliu, G. García de la Banda, M.A. Fullana, J. Llabrés. Validación factorial del cuestionario de miedo a volar (QPV) [The Factor Validity of the Fear of Flying Questionnaire]. *Análisis y Modificación de Conducta* **25** (1999), 885-907.

[16] Haug T, Berntzen D, Götestam K-G, Brenne L, Johnsen BH, Hugdahl K. A three-systems analysis of fear of flying: A comparison of a consonant vs a non-consonant treatment method. *Behaviour Research and Therapy* **25** (1987), 187–194.

[17] I.M. Marks, & A.M. Mathews. Case histories and shorter communication. *Behaviour Research and Therapy* **17** (1979), 263–267.

[18] P.A. DiNardo Brown TA, Barlow DH. *Anxiety Disorders Interview Schedule for DSM-IV: Life Time Version: Clien Interview Schedule*. Oxford University press, New York, 1994.

[19] W. Guy. *Clinical Global Impression Scale*. ECDEU Assessment Manual for Psychopharmacology, Department of Health, Education, and Welfare, Rockville, MD, US, 1976.

[20] S. Quero, D. Campos, A. Riera del Amo, J.M. Bretón-López, M. Tortella-Feliu, R. Baños, & C. Botella. NO-FEAR Airlines: a computer-aided self-help treatment for flying phobia. *Annual Review of Cybertherapy and Telemedicine* **219** (2015), 197-201.

[21] C. Botella, M.J. Gallego, A. García-Palacios, R. M. Baños, S. Quero, & M. Alcañiz. The acceptability of an Internet-based self-help treatment for fear of public speaking. *British Journal of Guidance & Counselling* **37** (2009),

# Does owning a "fatter" virtual body increase body anxiety in college students?

Marta FERRER-GARCIA[a*], Bruno PORRAS-GARCIA[a], Cristina GONZÁLEZ-IBAÑEZ[a], Mireia GRACIA-BLANES[a], Ferran VILALTA-ABELLA[a], Joana PLA-SANJUANELO[a], Giuseppe RIVA[b], Antonios DAKANALIS[c], José ACHOTEGUI-LOIZATE[a], Antoni TALARN-CAPARRÓS[a], Joan RIBAS-SABATE[d], Alexis ANDREU-GRACIA[e], Marina DÍAZ-MARSA[f], Miquel MONRÀS-ARNAU[g], Eduardo SERRANO-TRONCOSO[h], Janet TREASURE[i], and José GUTIÉRREZ-MALDONADO[a]

[a] *Department of Clinical Psychology and Psychobiology, Universitat de Barcelona, Barcelona, Spain*
[b] *Applied Technology for Neuro-Psychology Lab. Istituto Auxologico Italiano, Milan, Italy*
[c] *Department of Medicine and Surgery, University of Milano Bicocca, Milan, Italy*
[d] *Complejo Asistencial Benito Menni, Sant Boi de Llobregat, Spain*
[e] *Department of Psychiatry and Mental Health, Hospital General d'Igualada, Barcelona, Spain*
[f] *Unit of Eating Disorders, Hospital Clínico San Carlos de Madrid, Spain*
[g] *Department of Psychiatry, Hospital Clínic de Barcelona, Spain*
[h] *Department of Psychiatry, Hospital Sant Joan de Déu, Barcelona, Spain*
[i] *Department of Psychological Medicine, King's College London, UK*

**Abstract.** This study aimed to assess the ability of a virtual reality (VR)-based software to produce body anxiety responses in a non-clinical sample. 23 college students (5 male) were exposed to an immersive VR environment displayed with an HMD, where the illusion of ownership of a virtual body was induced by means of visuomotor synchronization. Each participant was exposed to three body sizes (from first-person perspective and from third-person perspective reflected in a mirror placed in the virtual environment): an avatar with the same body measurements as the participant, an avatar 20% larger than the participant, and another avatar 40% larger than the participant. BMI, drive for thinness (EDI 3-DT) and body dissatisfaction (EDI3-BD) were assessed before exposure, while body anxiety (PASTAS), fear of gaining weight (Visual analogue scale [VAS], from 0 to 100) and ownership illusion (VAS from 0 to 100) were assessed after exposure to each avatar. Students reported significantly higher levels of body anxiety and fear of gaining weight after owning a 40% larger virtual body than after owning a virtual body with their real measurements. When body dissatisfaction

---
[*] Corresponding Author: martaferrerg@ub.edu.

and drive for thinness was considered, only participants with higher scores in these scales showed a significant increment of body anxiety and fear of weight gain after exposure to the largest avatar. BMI had no effect on the results. This study provides evidence of the usefulness of virtual body ownership illusions to provoke weight and body related anxiety responses in individuals worried about their weight and body image and opens the door to its therapeutic use in patients with anorexia nervosa.

**Keywords.** virtual reality, body ownership illusion, visuomotor synchronization, body anxiety.

## 1.Introduction

Immersive virtual reality systems offer us the possibility to embody an avatar, which may have any feature we are interested in, within the virtual world. This fact has led to the emergence of several research lines that take advantage of embodiment techniques to assess emotional, cognitive and behavioural responses of individuals who own a virtual body with specific characteristics [1-3]. Embodiment techniques are based on the paradigm of rubber hand ownership illusion [4] and can be achieved by the synchronized stimulation of different sensory channels, for example, visuo-tactile (which is used in the rubber hand illusion), visuomotor and visuo-proprioceptive synchronization. Multisensory synchronization in virtual reality systems has been successfully used to provoke ownership illusion of a virtual body with a different size to that of the participant's real body size [5,6]. These studies showed that embodiment of a slimmer or a heavier virtual body induces both perceptual and cognitive changes in the way participants experience their own body, for example, diminishing or increasing body dissatisfaction. Given these findings, several authors have used such illusions to modulate perceived body size in patients with eating disorders (ED) and, thus, modify their disturbed body image [7,8].

Following this research line, we propose to take advantage of body ownership illusions in VR to expose patients with anorexia nervosa (AN) to their primary feared stimulus, i.e. the increase of weight. Patients with AN show high levels of anxiety and avoidance of food intake, associated with negative and rigid beliefs about the consequences of increasing weight. Avoidance behaviours prevent patients from realizing that normalization of weight does not lead to expected catastrophic consequences. All these features produce an extraordinary resistance to change, as one of the objectives of the intervention is precisely to increase weight. Therefore, the use of exposure therapy to one's own body, while progressively increasing weight, may be an effective method in order to reduce fear of gaining weight and, hence, to reduce rejection of food. As far as we know, there is only one case study in which imagery exposure was used with this aim, in a restrictive AN female patient who had shown resistance to the usual treatment [9]. Along five sessions, the patient had to imagine herself progressively increasing weight and facing the associated feared catastrophic consequences, such as criticism and social rejection. Authors reported that the patient increased weight during the intervention and maintained gain after one-month follow-up. Despite being a good option, imagery exposure has some important issues which may make the use of this procedure difficult in some patients, for example, difficulty in maintaining visualization long enough to reach the habituation or extinction of anxiety response, individual differences in the ability to visualize a situation, and risk of the most feared stimulus avoidance during visualization. Virtual reality, on the other hand, reduces the possibilities of avoidance behaviours and its efficacy is not conditioned by the

visualization abilities of the patients. Given that, VR exposure therapy could be an appropriate alternative.

The present study is part of a wider research, the final aim of which is to develop a VR-based application to reduce the fear that AN patients have of reaching a healthy weight and the consequent resistance to eating. A necessary first step in this research, was to assess the ability of VR-based software to induce body anxiety responses in participants. Specifically, we wanted to assess whether the embodiment in a fatter virtual body increases body anxiety and fear of gaining weight in college students, and to evaluate whether participants' BMI, body dissatisfaction, and drive for thinness, have an effect on results. It was expected that body anxiety and fear of gaining weight were higher after embodiment in a fatter virtual body than after embodiment in a virtual body of the participant's size. It was also expected that participants with higher BMI and higher levels of body dissatisfaction and drive for thinness showed more body anxiety and fear weight gain than participants with lower BMI, body dissatisfaction and drive for thinness.

## 2. Methods

23 college students (5 males and 18 female) participated in the study. Participants mean age was 24.91 (*SD*=4.78) and mean BMI was 22.18 (*SD*=4.41). After signing the informed consent, demographic data were collected and participants completed a test battery, which included the scales drive for thinness (EDI-DT) and body dissatisfaction (EDI-BD) of the Eating Disorders Inventory (EDI-2) [10]. Participants were also measured in order to calculate their BMI and to obtain the size of different body parts (shoulders, chest, waist, hips, thighs, and calves), needed to generate the avatar with the real measurements of the participant. Then, participants were exposed to an immersive VR environment displayed with an HMD (HTC-Vive), where the illusion of ownership of a virtual body was induced by means of visuomotor synchronization. The virtual situation consisted of a small room with light-coloured walls and a big mirror in front of an avatar with the same genre as the participant. Both assessment and exposure to VR were conducted individually. Visuomotor synchronization was performed from first-person perspective and from third-person perspective: first, participants were asked to look at the movement of their virtual arms from a first-person view, while moving their real arms at the same time (first perspective). After one minute, a mirror appeared on the wall in front the avatar and the participants were asked to look at the avatar reflected in the mirror while the virtual arms and the real arms of the participants moved synchronically for one minute (third perspective). All the movements were conducted following the instructions of the researcher.

Each participant was exposed to three body sizes: an avatar with the same body measurements as the participant, an avatar 20% larger than the participant, and another avatar 40% larger than the participant. After exposure to the avatar with the real body measurements and the avatar 40% larger, the participants left the VR system to answer several questionnaires, which included the Weight Subscale of the Physical Appearance State Anxiety Scale (PASTAS-W) [11] and two visual analogue scales (VAS, from 0 to 100) to assess fear of gaining weight (VAS-FGW) and ownership illusion (VAS-OI). On the other hand, after exposure to the avatar 20% larger, the participants did not leave the VR system but, instead, the researcher asked them to rate from 0 to 100 the fear of gaining weight and the feeling of ownership illusion while they remained exposed to the

black screen. Before finishing the experiment, participants were exposed again to the avatar with their real measurements and possible worry or discomfort related with body image was attended by the researcher.

## 2.1  Statistical Analyses

Two repeated measures analysis were conducted in order to assess the effect of variable size (real size, 20% larger size, and 40% larger size) on body anxiety (PASTAS-W) and fear of gaining weight (VAS-FGW) reported by participants during exposure to the virtual bodies. It is important to notice that, when analysing body anxiety, only two sizes were considered, as PASTAS-W was only administered after owning the real size virtual body and the 40% larger virtual body. In contrast, when analysing fear of gaining weight, all sizes (real size, 20% larger size, and 40% larger size) were considered, as VAS-FGW was administered three times (see procedure section). Several mixed between-within analyses of variance were also conducted in order to assess whether BMI, drive for thinness and body dissatisfaction influenced on body anxiety and fear of gaining weight experienced during embodiment in the different virtual bodies. To do these analyses, the sample was divided in two equal groups according BMI (high vs. low, percentile 50 = 21), EDI-BD (high vs. low, percentile 50 = 1), and EDI-DT (high vs. low, percentile 50 = 0). In those analyses where sphericity assumption were violated (Mauchly´s test $p<.05$), degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon$).

## 3.  Results

The strength of ownership illusion was high in all conditions: real size virtual body (*M*=66.09, *SD*= 3.64), 20% larger virtual body (*M*=61.74, *SD*= 4.01) and 40% larger virtual body (*M*=53.78, *SD*= 5.92).

Repeated measures analyses revealed a significant effect of virtual body size on body anxiety and fear of gaining weight (Table 2). Participants reported significant higher levels of body anxiety after owning the 40% larger virtual body than after owning the real size virtual body (Table 1). Likewise, participants reported more fear of weight gain after owning the 40% larger virtual body than after owning the 20% larger virtual body ($F(1,22)=18.104$, $p<.001$, $\eta^2=.451$) or the real size virtual body ($F(1,22)=18.383$ $p<.001$, $\eta^2=.455$). All the analyses showed very large effects.

**Table 1.** Mean body anxiety (PASTAS-W) and fear of gaining weight (VAS-FGW) through embodiment to a real size virtual body, a 20% larger virtual body and a 40% larger virtual in participants with low (*n*=12) and high (*n*=11) BMI, low (*n*=13) and high (*n*=10) drive for thinness and low (*n*=12) and high (*n*=11) body dissatisfaction.

| | Real size virtual body | | 20% larger virtual body | | 40% larger virtual body | |
|---|---|---|---|---|---|---|
| PASTAS-W | *M(SD)* | | *M(SD)* | | *M(SD)* | |
| | Low | high | Low | High | Low | High |
| BMI | 1.42(1.50) | 4.73(6.18) | - | - | 3.33(4.77) | 7.91(5.13 |
| EDI-DT | 1.25(1.36) | 5.30(6.27) | - | - | 1.85(1.82) | 10.30(8.08) |
| EDI-BD | 1.25(1.42) | 4.91(6.09) | - | - | 1.67(1.61) | 9.73(7.94) |
| Total (*N*=23) | 3(4.62) | | - | - | 5.52(6.85) | |
| VAS-FGW | | | | | | |
| BMI | 14.33(22.94) | 5.45(12.93) | 10.25(18.94) | 7.27(14.21) | 17.75(20.29) | 10(17.89) |
| EDI-DT | 10.77(22.53) | 9.20(14.17) | 8.46(18.64) | 9.30(14.31) | 9.23(18.01) | 20.30(19.69) |
| EDI-BD | 11.67(23.29) | 8.36(13.73) | 9.17(19.29) | 8.45(13.87) | 10(18.59) | 18.45(19.65) |
| Total (*N*=23) | 10.87(19.52) | | 9.57(17.70) | | 17.17(22.40) | |

*Note*: PASTAS-W (Body anxiety questionnaire), VAS-FGW (Fear of gaining weight), BMI (Body mass index), BD (Body dissatisfaction scale), DT (Drive for thinness scale), *M* (Mean), *SD* (Standard deviation).

Mixed within-between analyses of variance were also conducted in order to assess differences in body anxiety and fear of weight gain according BMI, body dissatisfaction, and drive for thinness were also assessed. As shown in table 2, the interaction between the virtual body size and the BMI of participants was not significant (small effect size). Participants with low (≤21) and high BMI (>21) showed similar levels of body anxiety and fear of gaining weight in all conditions. In contrast, interaction between drive for thinness and virtual body size and between body dissatisfaction and virtual body size were significant when assessing body anxiety. Thus, participants with low drive for thinness and body dissatisfaction showed similar levels of body anxiety in all the conditions, while participants with high drive for thinness and body dissatisfaction showed significantly higher levels of body anxiety after owning the 40% larger virtual body than after owning the real size virtual body. Likewise, interaction between virtual body size and drive for thinness was significant when assessing fear of weight gain. Whereas participants with low drive for thinness showed similar fear of gaining weight in all conditions, participants with high scores of drive for thinness reported significantly higher levels of fear of weight gain after owning the 40% larger virtual body than after owning the 20% larger virtual body or the real size virtual body. Finally, although interaction did not reach significance (*p*=.06), the same tendency was observed when assessing the effect of body dissatisfaction scores. Participants with high body dissatisfaction scores, but not participants with low scores, reported more fear of gaining weight after owning the 40% larger virtual body than in the other conditions. Again, all these analyses showed large or very large effects.

**Table 2.** Main effects and interactions of repeated measures analyses of variance and mixed analyses of variance for both body anxiety (PASTAS-W) and fear of gaining weight (VAS-FGW)

| | PASTAS-W | | | VAS-FGW | | |
|---|---|---|---|---|---|---|
| | *F* | *P* | $\eta^2$ | *F* | *p* | $\eta^2$ |
| Size | 7.187 | .014 | .246 | 16.952 | <.001 | .435 |
| Size x BMI | .440 | .514 | .021 | .788 | .411 | .036 |
| Size x DT | 11.038 | .017 | .243 | 4.103 | .039 | .163 |
| Size x BD | 6.938 | .016 | .248 | 3.437 | .061 | .141 |

*Note*: PASTAS-W (Body anxiety questionnaire), VAS-FGW (Fear of gaining weight), BMI (Body mass index), BD (Body dissatisfaction scale), DT (Drive for thinness scale).

## 4. Discussion and conclusions

The main objective of this study was to assess whether owning a fatter virtual body increased body anxiety and fear of gaining weight in college students. As expected, students reported higher levels of body anxiety and fear of weight gain after owning a fatter virtual body than after being exposed to an avatar with their real measurements. According to previous research [5-7], virtual body ownership illusion is able to produce changes in one's own body image. Most importantly, when body dissatisfaction and drive for thinness were considered, results made it evident that embodiment in a fatter virtual body only had a significant effect in those students with higher levels of body dissatisfaction and drive for thinness, that is, those who experience more food, weight and body image related concerns. It is therefore expected, that anxiety and fear responses after owning a larger virtual body would be even higher in AN patients. Likewise, although differences didn't reach significance, participants with higher BMI reported higher levels of body anxiety and fear of gaining weight after owning the largest virtual body. It must be noticed that only five participants were overweight (only one obese) in our sample. Possibly, in a wider sample, including more overweight participants, differences related with BMI would reach significance.

Despite limitations, such as the small sample size and the lack of a control condition (asynchronous visuomotor stimulation), this study provides evidence of the usefulness of virtual body ownership illusions to provoke weight and body related anxiety responses in individuals worried about their weight and body image. This finding constitutes a step forward towards the development of VR-based tools for body exposure therapy to reduce weight gain anxiety in AN patients and the consequent resistance to change that characterizes these patients. Besides exposing patients to an avatar representing their own body image and whose size increases progressively (according a pre-established hierarchy), another critical advantage of virtual reality is that it allows us to contextualize exposure in different virtual environments simulating real-life situations (home, restaurant, supermarket, etc.) where weight gain may have catastrophic consequences according patient's negative beliefs (social rejection, criticism, etc.) and, hence, makes generalization of changes easier beyond the therapist's office.

## References

[1]  D. Banakoua, R. Grotena, M. Slater, Illusory ownership of a virtual child body causes overestimation of object sizes and implicit attitude changes, *PNAS*, **110** (2013), 12846-12851.

[2]  N. Yee, J. Bailenson, The Proteus effect: The effect of transformed self-representation on behavior, *Human Communication Research* **33** (2007), 271–290.

[3]  L. Maister, M. Slater, M.V. Sánchez-Vives, M. Tsakiris, Changing bodies changes minds: owning another body affects social cognition, *Trends in Cognitive Sciences* **19** (2015), 6-12.

[4]  M. Botvinick, J. Cohen, Rubber hands 'feel' touch that eyes see, *Nature* **391** (1998), 756.

[5]  I.V. Piryankova, H.Y. Wong, S.A. Linkenauger, C. Stinson, M.R. Longo, H.H. Bülthoff, B.J. Mohler, Owning an overweight or underweight body: distinguishing the physical, experienced and virtual body, *PLoS ONE* **9** (2014), e103428.

[6]  C. Preston, H.H. Ehrsson, Illusory changes in body size modulate body satisfaction in a way that is related to non-clinical eating disorder psychopathology, *PLoS ONE* **9** (2014), e85773.

[7]  A. Keizer, A. van Elburg, R. Helms, C. Dijkerman, A virtual reality full body illusion improves body image disturbance in anorexia nervosa, *PLoS ONE* **11** (2016), e0163921.

[8]   S. Serino, E. Pedroli, A. Keizer, S. Triberti, A. Dakanalis, F. Pallavicini, A. Chirico, G. Riva, Virtual reality body swapping: a tool for modifying the allocentric memory of the body, *Cyberpsychology, Behavior, and Social Networking* **19** (2016), 127-133.

[9]  C.A. Levinson, J. Rapp, E.N. Riley, Addressing the fear of fat: extending imaginal exposure therapy for anxiety disorders to anorexia nervosa, *Eating and Weight Disorders* **19** (2014), 521-524.

[10] D.M. Garner, *Inventario de trastornos de la conducta alimentaria 2*, Tea Ediciones SA, Madrid, 1998.

[11] D.L. Reed, J.K. Thompson, M.T. Brannick, W.P. Sacco, Development and validation of the Physical Appearance State and Trait Anxiety Scale (PASTAS), *Journal of Anxiety Disorders* **5** (1991), 323-3

# Influence of Simulation Fidelity on Perceived Simulation Realism – An Exploratory Study on a Virtual Public Speaking Training Application

Mariia DUBIAGO[a,*], Sandra POESCHL[a], and Nicola DOERING[a]

[a]*Ilmenau University of Technology*

**Abstract.** Public speaking skills are essential for many professions. However, public speaking anxiety (PSA) is one of the most common phobias. PSA can be treated effectively by trainings in virtual environments. When trainees perceive the virtual environment as realistic (high simulation realism), training effectiveness is improved. This study investigated which specific simulation fidelity factors of a virtual public speaking training application predict perceived overall simulation realism of the application. A cross-sectional correlational study was conducted with $N = 40$ participants (63% male, 37% female, $M_{age} = 25.60$ years, $SD = 6.29$ years). Participants used a virtual reality training application. The virtual audience consisted of video recordings of real humans. Perceived overall realism of the application was the criterion. Three different simulation fidelity factors were employed as predictors (scene realism, audience behavior, and audience appearance; [1]). However, *audience appearance* was removed from analysis because reliability was insufficient (Cronbach's $\alpha = .524$). A linear regression revealed that the remaining factors *scene realism* and *audience behavior* significantly predicted perceived overall simulation realism ($F(2,37) = 3.44$, $p = .043$, $R^2 = .16$). Based on this result, developers should take fidelity factors into account when trying to achieve high overall simulation realism. The role of audience appearance remains unclear, though. Further research (e.g., experimental studies in order to determine causality) is necessary to better understand simulation realism and its determinants.

**Keywords.** Virtual reality, simulation fidelity, public speaking, training application

## 1. Introduction

To be able to hold a speech or presentation in front of an audience is an important and crucial skill both in private and professional life (at least in many occupations). However, the majority of the population lacks speaking skills [2] and tends to feel stressed before or during public talks. In fact, speaking in public is one of the most commonly reported phobias [3]. The leading psychological training method for *fear of public speaking* is

---

* Corresponding Author: mariia.dubiago@tu-ilmenau.de.

cognitive behavioral training, where people are systematically exposed to fear-triggering stimuli [4, 5]. As a result of this type of training, fear of public speaking can be reduced and public speaking skills can be significantly improved [6, 7]. For the training of public speaking skills, however, *real human audiences* are not always available for logistical reasons. Furthermore, a real human audience can be too intimidating for phobic trainees to even start the training. The main alternatives to real human audiences in public speaking trainings (presentation in front of a real audience, in-vivo exposition) are *imagined audiences* (imaginal exposure trainings) and *virtual audiences* (virtual reality exposure trainings). Wiederhold et al. [8] claim that virtual reality exposure trainings provide more opportunities in comparison to imaginal exposure trainings. Clients may not be able to realistically imagine the feared confrontation with an audience, whereas virtual reality technology can simulate the human audience and the public speaking situation quite convincingly. Therefore, virtual reality trainings lead to a higher level of elicited fear of public speaking than imaginal exposure training [8]. This is essential, since in order to change the anxiety structure, the feelings of fear must be activated during exposure [9]. Hence, virtual reality technology (VR) has been used in trainings to create a simulated controllable substitute for a real stimulus (here: the human audience). To conduct virtual reality exposure trainings for trainees with public speaking anxiety, a realistic virtual audience needs to be created. Virtual audiences can be defined as a collection of virtual agents (or avatars) that are placed in 3D environments and designed to simulate a public speaking situation [10, 11]. A number of studies [e.g., 7, 12] have demonstrated that virtual audiences can induce stress and can significantly reduce public speaking anxiety through frequent exposure to the feared situation.

Designing virtual audiences for a public speaking training application requires a deep understanding of how they are perceived by users and how the perceptions can be influenced by the virtual audiences' design (including behavior and appearance). *Simulation fidelity* or *simulation realism* is considered as an important factor in designing virtual reality trainings. It is defined as the degree of realism of the replication of real environments and objects in a virtual environment [13]. It was shown that higher simulation fidelity leads to a better transfer of gained skills and knowledge into real situations [14]. Thus, public speaking trainings aim at reproducing speaking situations with high fidelity, creating typical public speaking environments with virtual humans forming the virtual audience. Such virtual audiences aim at evoking nearly the same feelings in a public speaker as real audiences. However, evaluation studies are needed to investigate which characteristics of virtual audiences evoke those feelings.

Empirical research on the effects of virtual audience appearance and virtual audience behavior on the trainees' subjective perception of overall simulation fidelity of a virtual public speaking application is still rare. On the one hand, the few studies indicate that high simulation fidelity in general does not necessarily improve the users' experiences in virtual environments [for an overview see 17]. On the other hand, findings suggest that user experience in a virtual environment (and thereby possibly also perceived overall simulation fidelity) could result from a combined effect of specific simulation fidelity factors: High fidelity virtual agent behavior in combination with a low fidelity environment can lead to lower experience of presence than when the fidelity of the virtual agents' behavior and the fidelity of the environment are on a comparable level and therefore consistent [16].

Thus, the present study focused on finding out which specific fidelity factors of a virtual public speaking application predict the trainees' evaluations of the perceived overall simulation fidelity of the application.

## 2. Method

### 2.1. Sample

Participants ($N = 41$) from a German university, who gave informed consent, were recruited for the study via university mailing lists and personal contacts. Due to missing data for one participant, the final sample consisted of $N = 40$ subjects (63% male, 37% female, $M_{age} = 25.60$ years, $SD = 6.29$ years).

### 2.2. Procedure

Upon invitation to the study, participants were asked to prepare a five-minutes presentation on a self-selected subject without the use of any electronic devices. They were also asked not to merely read the whole presentation, but to speak freely instead. Through these restrictions, users were forced to look at the simulated audience. Participants were informed upon invitation that they are supposed to give a speech to a virtual audience. After arriving at the laboratory, subjects were briefed and gave a speech in the virtual public speaking training application. After the speech, participants filled in the German VR Simulation Realism Scale [1] and were debriefed.

### 2.3. Virtual Public Speaking Application

The study was conducted in a three-sided *CAVE*. The public speaking training simulation was created with the software RTT DeltaGen 12.2 and rear projection (passive stereoscopic projection, with a display resolution of 1400x1050). The virtual class room was designed to match an actual class room. Every virtual agent within the virtual audience was able to change his/her posture individually and to display different actions (e.g. nodding, itching, taking notes). Audience behavior was generated spontaneously and not prepared in advance or regulated by an operator on site. To create a natural-looking audience (Figure 1), each virtual agent had been created based on video recordings of a real person. The public speaking trainees perceived the virtual audience through 3D-glasses and from a first-person perspective (Figure 1). They could navigate in the virtual environment and were tracked by an ART head-tracking and flystick system. The duration of the public speaking simulation was approximately five to six minutes.

*M. Dubiago et al. / Influence of simulation fideli9ty on perceived simulation realism – An exploratory study on a virtual public speaking training application*

157

**Figure 1.** Screenshot of the virtual audience

## 2.4. Measures

*Simulation fidelity* was assessed using the German VR Simulation Realism Scale [1]. The questionnaire consists of 13 items that constitute the three sub-scales *scene fidelity* (five items, $\alpha = .733$; e.g., reflection, light and shades in virtual space), *audience behavior fidelity* (four items, $\alpha = .722$; e.g., postures and gestures of virtual humans), and *audience appearance fidelity* (four items, $\alpha = .524$; e.g., outfit of virtual humans). All fidelity evaluation items were based on a five-point Likert-scale ranging from 1 "highly disagree" to 5 "highly agree".

*Perceived overall simulation fidelity* was measured with the single item "How realistic is the application?" on a five-point scale ranging from 1 "not realistic at all" to 5 "very realistic".

## 2.5. Statistical Analyses

The reliability of the sub-scale *audience appearance fidelity* was low, so it was excluded from the statistical analyses. A linear regression was calculated to predict perceived overall simulation fidelity of the virtual audience by the remaining two fidelity factors *scene fidelity* and *audience behavior fidelity*. All analyses were performed with IBM SPSS Statistics 22.

## 3. Results

The regression model was statistically significant ($F(2,37) = 3.44$, $p = .043$, $R^2 = .16$, $1-\beta = 0.65$). Neither scene fidelity alone ($\beta = .29$, $t(39) = 1.74$, $p = .091$) nor audience behavior fidelity alone ($\beta = .18$, $t(19) = 1.09$, $p = .281$) significantly predicted perceived overall simulation fidelity of the public speaking application, but the combination of both fidelity factors did (see Table 1). This indicates that the combination of both aspects of simulation fidelity is important for the simulation fidelity subjectively perceived by the public speaking trainees. This relates back to Vinayagamoorthy et al. [16] who proposed that subjective user experience in a virtual reality application might be higher when single fidelity factors, which show a comparable level and therefore a certain level of consistency, are combined.

**Ta.ble 1.** Linear Multiple Regression of Scene Realism Fidelity and Audience Behavior Fidelity Predicting Perceived Overall Simulation Fidelity of a Public Speaking Application .

| Variables | $B$ | $SE\ B$ | $\beta$ | $T$ | $p$ | $1-\beta$ |
|---|---|---|---|---|---|---|
| Scene Realism Fidelity | 0.34 | 0.19 | .29 | 1.74 | .091 | 0.42 |
| Audience Behavior Fidelity | 0.22 | 0.21 | .18 | 1.09 | .281 | 0.20 |

Note. $N = 40$.  $R^2 = .16$, adjusted $R^2 = .11$, $p = .043$., $1-\beta = 0.65$.

## 4. Discussion

The purpose of this study was to contribute to a better understanding of perceived simulation fidelity in a virtual public speaking training, namely which simulation fidelity factors predict perceived overall simulation fidelity. Using the German VR Simulation Realism Scale, we examined three key fidelity factors that have the potential to influence perceived overall simulation fidelity. One of the factors could not be measured reliably, but the remaining two factors (scene realism fidelity and audience behavior fidelity) significantly predicted perceived overall simulation fidelity of the application. The result supports the findings of Vinayagamoorthy et al. [16]: possibly *combinations* of single simulation fidelity aspects with a similar level have an effect on perceived overall simulation fidelity of virtual reality applications.

However, the study has several limitations. The behavior of the virtual audience was limited in regard to real-time reactions to the trainee's behavior. Further studies should use more interactive virtual audiences (e.g., implementing questions and answers, reacting in a bored way if speakers present in a very monotonous way) in order to determine if interactivity influences perceived overall simulation fidelity of a public speaking application. Secondly, the virtual audience was created in a way that it looked casual while a formal-looking audience might have a different effect. Future research should examine audiences with different appearances. In addition, the application was designed for students; therefore, the virtual agents as well as the sample consisted of young students. Trainees from this sample, most likely, have prior experience of presenting in exactly such situations, namely in front of casually looking young people. Thus, they could have evaluated this application as very realistic. Hence, future audiences should be created and evaluated for a broader range of target groups (e.g., politicians). Finally, the study design does not allow for causal inferences. In order to better understand simulation realism and its determinants, further research using experimental designs is necessary.

In spite of the mentioned limitations, the study has a number of strengths. The virtual audience used in this study was quite unique. We used recordings of real people to create an audience with a highly realistic appearance, while most of the other existing applications use computer-generated virtual agents. At the same time, the audience was autonomous: the behavior was spontaneously generated and not prepared in advance or regulated by an operator on site. The combination of advanced technical equipment and an audience that looked highly realistic and behaved autonomously could have led to a generally high level of perceived simulation fidelity. Further, the study contributes towards a better understanding of perceived simulation realism in public speaking

applications. In practice, it is recommended for developers to take combinations of fidelity factors and their consistency (e.g., scene fidelity and audience behavior fidelity with a comparable level) into account when trying to achieve high overall simulation realism for virtual audiences.

## References

[1] S. Poeschl, N. Doering, The German VR simulation realism scale – psychometric construction for virtual reality applications with virtual humans. *In Annual Review of Cybertherapy and Telemedicine* **11** (2013), 33–37.

[2] J. Hart, J. Gratch, and S. Marsella, *How Virtual Reality Training Can Win Friends and In uence People*, chapter 21, Human Factors in Defence. Ashgate, 235-249, 2013.

[3] G. D. Bodie. A racing heart, rattling knees, and ruminative thoughts: Defining, explaining, and treating public speaking anxiety, *Communication Education*, **59**(1) (2010), 70-105.

[4] C. B. Pribyl, J. Keaten, M. Sakamoto, The effectiveness of a skill-based program in reducing public speaking anxiety, *Japanese Psychological Research* **43** (2001), 148-155.

[5] R. Heimberg, R. Becker, *Cognitive-Behavioral Group Therapy for Social Phobia: Basic Mechanisms and Clinical Strategies*, Guilford Publications, New York, 2002.

[6] S. R. Harris, R. L. Kemmerling, M. M. North. Brief virtual reality therapy for public speaking anxiety, *Cyberpsychology and Behavior*, **5** (2002), 543-550.

[7] D. Pertaub, M. Slater, C. Barker. An experiment on public speaking anxiety in response to three dierent types of virtual audience, *Presence: Teleoperators and virtual environments*, **11** (2002), 68-78.

[8] B. K. Wiederhold, D. P. Jang, R. G. Gevirtz, S. I. Kim, I. Y. Kim, M. D. Wiederhold. The treatment of fear of flying: a controlled study of imaginal and virtual reality graded exposure therapy, *IEEE Transactions on Information Technology in Biomedicine*, **6** (2002), 218-223.

[9] E. B. Foa, M. J. Kozak, Emotional processing of fear: Exposure to corrective information, *Psychological Bulletin*, **99** (1986), 20-35.

[10] M. Chollet, T. Wortwein, L.-P. Morency, A. Shapiro, S. *Scherer. Exploring Feedback Strategies to Improve Public Speaking: An Interactive Virtual Audience Framework*., Proceedings of UbiComp, Osaka, Japan, 2015.

[11] N. Kang, W.-P. Brinkman, M. B. van Riemsdijk, M. A. Neerincx. An expressive virtual audience with flexible behavioral styles, *Active Computing, IEEE Transactions on*, **4** (2013), 326-340.

[12] M. North, S. North, J. Coble, Virtual reality therapy: an effective treatment for the fear of public speaking, *The International Journal Of Virtual Reality,* **3** (1998), 1-6.

[13] C. Lee, G. A. Rincon, G. Meyer, T. Höllerer, D. A. Bowman, The effects of visual realism on search tasks in mixed reality simulation, Visualisation and Computer Graphics, *IEEE Transactions on Information Technology in Biomedicine*, **19** (2013), 547-556.

[14] O.D. Kothgassner, A. Felnhofer, L. Beutl, H. Hlavacs, M. Lehenbauer, B. Stetina, A virtual training tool for giving talks, *Lecture Notes in Computer Science*, **7522** (2012), 53-66.

[15] M. Slater, D. Pertaub, A. Steed, Public speaking in virtual reality: facing an audience of avatars, IEEE *Computer Graphics and Application*s, **19** (1999), 6-9.

[16] V. Vinayagamoorthy, A. Brogni, M. Gillies, M. Slater, A. Steed, An investigation of presence response across variations in visual realism, *7th Annual International Presence Workshop*, 2004, 148-155.

[17] E. Nash, G. Edwards, J. Thompson, W. Barfield, A review of presence and performance in virtual environments, *International Journal Of Human-Computer Interaction* **12** (2000), 1-4

# SECTION VI

---

# WORK IN PROGRESS

It is important to emphasize the importance of developing technological strategies (such as artificial intelligence or augmented reality) that can provide either new enhanced experiences or technological systems also nurtured by artificial intelligence techniques developed by humans.

These new mixed ICT tools might evolve into experts in "helping others," with the objective of making our net-shared experience increasingly more competitive, creative, and capable in the task of helping others. Of course, this has significant ethical implications, which will also need to be explored at greater depth.

*Botella, Riva, Gaggioli,*
*Wiederhold,Alcaniz,*
*and Banos, 2012*

# Revenge Porn: Findings from the Harassment and Revenge Porn (HARP) Survey – Preliminary Results

Emma SHORT[a,*], Antony BROWN[a], Melanie PITCHFORD[a], James BARNES[a]
*[a]National Centre for Cyberstalking Research, University of Bedfordshire*

**Abstract.** Revenge porn, sometimes known as non-consensual pornography, has been defined as the distribution of intimate images without the individual's consent. This paper presents the results of the HARP (Harassment and Revenge Porn) survey pilot study which investigated the nature and impact of revenge porn. The study consisted of 64 participants aged 18–63 years, 59 of which were female. We surveyed a self-selecting sample of people who reported having experienced online revenge porn. Respondents provided demographic details and completed 32 questions on the nature and effects of the intimidation. The study's main aims were to examine the: (i) image production and distribution, (ii) psychological and physical effects, and (iii) support and help. Results showed that images are mostly generated voluntarily in a relationship and then distributed through multiple channels on social media and hosting websites. Most images were not altered, which lead some victim's to try and change their physical appearance. Many respondents had made life changes as a result of revenge porn, reporting changes to work and relationships as well as the feeling of being isolated from family and friends. Numerous participants had also experienced adverse changes in their general health and experienced anxiety and worry. Over half of the respondents were compelled to use self-harm behaviours to relieve negative feelings or thoughts. Only 10% reported the crime and of those many felt inadequately supported by the Police and also felt the service providers should provide more help to individuals who become a target for this kind of online abuse.

**Keywords.** revenge porn, non-consensual pornography, harassment, deviant online behaviors, cyberstalking

## 1. Introduction

The advance of modern technology in recent years has enabled public communication and access to a breadth of information that can reach both national and international audiences [1]. However, the integration of communication technologies that has occurred in our daily lives has also and infiltrated our intimate relationships [2] which has provided a new means of sexual exploitation [3]. One emergent social and legal phenomena involving technology is that of 'revenge porn', otherwise known as non-consensual pornography. This has been defined as the act of distributing intimate photography through different means without the individual's consent. This is largely motivated by the malicious intent to harm and humiliate the victim, who is often the perpetrator's previous romantic partner [4,5]. However, not all acts are committed for revenge, and can instead be committed as a means of extortion, intimidation or for the pleasure of causing annoyance in others [6]. The act of revenge porn seems to be increasingly employed by the offender as reprisal for a romantic relationship finishing, and is becoming more prominent with the growing popularity of sexting. Indeed, there are now an estimated 2,000 revenge porn web sites worldwide, and countless individuals have been repeatedly victimized through the availability of their intimate images on these

---

* Corresponding Author: emma.short@beds.ac.uk

platforms. Although it became a criminal offence in England and Wales in April 2015 [7], and courts can now prosecute individuals with guilty parties facing imprisonment for up to two years, little is known of the characteristics of those who commit acts of revenge porn or the psychological and physical effects on its victims.

Revenge porn or non-consensual pornography is the act of sharing or distributing sexually graphic or intimate, images and/or videos of another person onto online social networks such as Facebook or YouTube without their consent [4,5]. These images are generally produced in one of either two ways, either consensually (e.g. by the victim in a private relationship) or non-consensually (e.g. by surveillance or hacking) [5,8] Individuals of all ages, sexuality and gender, can be a victim of revenge porn but it is predominantly perpetrated against females [5,9,10], with female infidelity and display of sexuality penalised to an excessive amount [9].

The media in recent years has focused on the rise of revenge porn as a new phenomenon, but many would argue that it is just a reflection of a growing trend in the connection of technology with sexual and domestic violence and that revenge porn is arguably a digital extension of sexual violence [11]. The idea that stalking, intimate partner violence and sexual assault are all connected is not a new idea. Indeed, research has reliably shown that victims affected by these offences experience psychological and physiological symptoms including, depression, anxiety and symptoms of post-traumatic stress disorder [12]. They may also in some circumstances be at risk of physical harm such as physical assault or in danger of their lives [13]. Given the wide-ranging implications of revenge porn it is vital we understand the prevalence and nature of behaviours associated with this area of online abuse. The current study examined revenge porn and its association with particular psychological characteristics. Specifically, using the Harassment and Revenge Porn Survey (HARP) the aim of this research was to investigate the prevalence and impact of the use of non-consensual pornography as a means of harassment and to determine the psychological and social consequences of revenge pornography.

## 2. Methods.

The survey was conducted over 22 months between July 2015 and May 2017. During this period the responses of 66 participants were recorded with 59 of the 66 that declared their gender stating they were female. The survey was hosted on the website of the National Centre for Cyberstalking Research (NCCR) based at the University of Bedfordshire - people visiting the site were asked to complete the HARP survey. Links to the survey were also circulated through social media.

### 2.1 Ethics

The questionnaire web link initially brought respondents to a consent form assuring them of their anonymity and the confidentiality of any identifying information. It also provided details of National Stalking Helpline phone number and website and the Revenge Porn Helpline number and website. Respondents were advised that the questionnaire should be completed when at least one form of support was available to them. The proposal was approved by the University Ethics Committee.

### 2.2 HARP  Scale Construction

The HARP was devised in an iterative process of communication with the Suzy Lamplugh Trust and The Revenge Porn Helpline. The HARP survey was designed to capture demographic information, details of image capture and distribution, psychosocial effects of the experience and help seeking and support during and following the incidents. Respondents were given text boxes to respond to with qualitative information about their experience, as well as Likert scale type questions. Generalised anxiety disorder was assessed by the GAD-7 [14]. This scale consists of 7 items, each of which has a number value (0-3). Scores range from 0 to 21. A score of 10 or higher indicates the presence of significant anxiety. Scores over 15 are said to be severe. The measure has been described as a valid and efficient tool to screen for anxiety and to assess "its severity in clinical practice and research".

### 2.3 Demographics

Though the survey was anonymous, respondents were asked their age; 64 participants provided an age, though it should be noted the validity of the age submitted could not be verified. The age of participants in the survey ranged from 18 years old through to 63 years of age, and at both extremes had experienced incidences of being a victim of revenge porn. This wide spread of ages demonstrates that being a victim of revenge porn is not a problem that is peculiar to a particular age group. The median age of respondents to the survey was 31 years of age, with an SD of 9.70 years.

### 3. Results of HARP Survey

### 3.1 Image production and distribution

There exist many possible electronic means by which the perpetrator can post the images, including social networking sites, text messages and Internet forums. The most common place to publish images was on social network sites (37%) followed by mobile phone (27%) and general website domains such as youtube (25%). The number of images distributed varied between 1 and 331 with an average of 18 images. The growing use of electronic media, in various forms, meant that respondents also reported being victimised through multiple channels. Of the 66 respondents 57% received secondary abuse over the images with 52% of respondents reporting that family, friends and acquaintances viewed the images while 20 % thought the images were seen by strangers. Images were generally taken on a voluntary basis (56%) with 14% being forced or coerced into having their pictures taken and 24% of victims were unaware images were being taken. Of the people who were unaware of the images being taken almost half (44%), first became aware of their existence after they were published online. Of all the images published 79% were not altered in any way and were not subject to cropping or blurring.

When asked if the use of revenge pornography was a part of a wider pattern of harassment, 50% of respondent said it was, with many reporting it was perpetrated at the end of an abusive relationship with 17% believing it was motivated by the perpetrator having a righteous cause that demands action or punishment for previous behaviours. Extortion attempts were present in over half of the incidents with 56% of people reporting blackmail threats, 58% of which were from ex-partners while another 21% were from perpetrators where no identity could be established.

### 3.2 Psychological and physical effects of revenge porn

When asked about the effect the posting of revenge porn images had on their lives, 22% of respondents said their performance at work had been affected with a further 12% changing jobs and 5% being fired or demoted. Relationships with family and friends were also impacted with 38% indicating that it had damaged their relationship with family and friends and 22% of respondents giving up social activities and 40% felt extremely distant or cut off from people. Financial loss was also prevalent with 35% of people having either lost money or incurred expenses such as legal or therapy costs. Many had experienced adverse changes in their general health with 65% of people experiencing nervousness and anxiety for more than 50% of the time and 71% of people defined themselves as worrying too much over the same period. Half of all people felt afraid that something awful may happen and 59% engaged in self-harm behaviours that may have caused bleeding, bruising or pain to relieve negative feelings or thoughts, difficulties in relationships with others or to induce positive feelings.

Many of those who responded described their experience as stressful and 23% reported having extremely disturbing, repeated unwanted memories of the incident. This resulted in 69% having moderate to extreme feelings or acting in a way as if the experience would happen again, and 32% getting extremely upset or having extremely physical reactions (30%) when reminded of the experience. Of those who reported the experience as stressful 35% said they avoided memories, thoughts or feelings related to their experiences and 40% had extreme sleep disturbances.

### 3.3 Help and Support

When asked what they did to stop the attacks only 10% reported their case to the police and 4% contacted a helpline. Changing their social media presence or their phone number was an action taken by 33% of respondents, while 10% contacted or engaged in a conversation with the perpetrator to ask them to stop the abuse. Only 14% of people contacted the administrators of the websites, chat rooms or social media companies where the images were present. A further 8% of people changed their appearance so they would not be recognised. People received support mainly from family and friends (61%), but many comments from the questionnaire highlighted that the events had caused excessive embarrassment or feelings of shame which inhibited help seeking or contact with the police. Many too commented that they felt there was a lack of help and support in providing advice that can stop the on-going harassment and remarked that service providers needed to investigate claims immediately and be more helpful on removing the images.

### 4. Discussion

This pilot project involved the development of the HARP survey that sought to examine the nature and impact of revenge porn, to provide new in-sights into the field and possibly make proposals to address the problem. One of the aims of this study was to ascertain the impact and nature of the communications technology-mediated posting of images performed by one party and directed at another. This may be interpreted as intrusive, threatening, or otherwise unwelcome by the individual and also to identify the impact of the experience on the person whose images had been posted. This study may

be a first step towards that goal by collecting data that has provided significant insights into how people are being harassed online, what effects it has on them and the ways in which they deal with it. Further, this study gives an initial picture of what revenge porn is and what it means to victims in the UK. The data collected by the HARP survey shows that perpetrators can use various sites to invade numerous aspects of their victim's lives which produces adverse changes in their general health and leaves them feeling stressed, anxious and in many cases turning to self-harm behaviours that cause bleeding, bruising or pain to relieve negative feelings. The data shows that victims feel cut off from people and many give up their daily activities which in turn can lead to more severe psychological impacts. The fears created by revenge porn are varied and extreme, changing for the individual effected. However, the findings show that incidents of revenge porn affect multiple aspects of people's lives, from their work situation to their relationships with others. In addition, many changed their internet usage and social media behavior. Respondents reported changing/losing jobs, isolating themselves by giving up social activities, and having difficulty in their personal relationships. One clear message from the data collected is that many of the victims of revenge porn are frustrated with the lack of help and support they feel is available, and due to the level of embarrassment and shame many do not seek external advice from police and helplines. The key sources they want to be able to act are the Police and Service Providers, both in terms of providing actions that can stop the distribution of their images and also in providing support to those affected in dealing with its effects. This adds to the growing debate of whether legislative change is required to allow the police and encourage service providers to provide the help people need in cases of cyber revenge porn and if so, exactly what changes those should be.

### References

[1]  R.Taylor, E. Fritsch and J. Liederbach, Digital crime and digital terrorism (3rd Edition). Pearson Inc., New Jersey, US, 2015.

[2]  B. Klettke, D.J. Hallford and D.J. Mellor, Sexting prevalence and correlates: A systematic literature review. *Clinical Psychology Review*, **34**(1) (2014), 44–53.

[3]  L. D. Roberts, Cyber-Victimization. In: R. Luppicini & R. Adell (Eds.), *Handbook of Research on Technoethics*. Hershey, PA: IGI Publishing, 2008.

[4]  A. Burris, Hell Hath No Fury Like a Woman Porned: Revenge Porn and The Need for a Federal Nonconsensual Pornography Statute, Online, 2014. [Cited 2017 May 10] Available from http://www.floridalawreview.com/wp-content/uploads/11-Burris.pdf

[5]  D. K. Citron and M. A. Franks, Criminalizing revenge porn. *Wake Forest Law Review*, **49** (2014), 345–391.

[6]  N. Henry and A. Powell, Sexual violence in the digital age: The Scope and Limits of Criminal Law. *Social & Legal Studies*, **25**(4) (2016), 397–418.

[7]  Criminal Justice and Courts Bill. 2015. [Cited 2017 May 10] Available from http://services.parliament.uk/bills/2014-15/criminaljusticeandcourts.html

[8]  S. R. Stroud and J. Henson, What exactly is revenge porn or nonconsensual pornography? In: A.C. Scheinbaum (Ed.), *Online Consumer Behavior: The Dark Side of Social Media*. Routledge, (2016). [Cited 2017 May 10] Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id = 2828740

[9]  E. Poole, Fighting back against non-consensual pornography. *University of San Francisco Law Review*. University of San Francisco School of Law, **49** (2015), 181–214.

[10]  M. Salter and T. Crofts, Responding to revenge porn: Challenging online legal impunity. In: L. Comella &S. Tarrant (Eds.), *New Views on Pornography: Sexuality, Politics, and the Law*. Online, 2015. [Cited 2017 May 10] Available from http://UWSAU.eblib.com.au/patron/FullRecord.aspx?p = 1930115

[11]  N. Henry and A. Powell, Beyond the 'sext': Technology-facilitated sexual violence and harassment against adult women. *Australian & New Zealand Journal of Criminology*, **48**(1) (2014), 104–118

[12] C. Maple, E. Short, A. Brown, Cyberstalking in the United Kingdom: An Analysis of the ECHO Pilot Survey. NCCR, Online, 2011. [Cited 2017 May 10] Available from: http://uobrep.openrepository.com/uobrep/bitstream/10547/270578/1/ECHO_Pilot_Final.pdf

[13] J. Monckton-Smith, Exploring the relationship between stalking and Homicide. Suzy Lamplugh Trust, Online, (2017). [Cited 2017 May 10] Available from https://www.suzylamplugh.org/Handlers/Download.ashx?IDMF=1a6cf4d9-0df5-42be-8b02-4bdbd75fa264

[14] R. L. Spitzer, K. Kroenke, J. B. Williams and B. Lowe, A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Intern. Med.*, **166**(10) (2006), 1092-1097.

# Towards a Mobile Application for Monitoring and Reporting Mobile Victimisation among South African High School Students

Shallen LUSINGA[a,*] and Michael KYOBE[a]

[a] *University of Cape Town, Cape Town, South Africa*

**Abstract.** To understand mobile victimisation, Lusinga and Kyobe (2017) developed a typology (Mobile Victimisation Typology (MVT)). This typology is based on (a) the frequency of mobile phone use, (b) the advancement of the mobile phone, and (c) the attachment to the mobile phone. With this typology, one can identify, describe, compare, explain and predict mobile victimisation of students. Adopting pragmatism as the ontological and epistemological stance, the current study describes the process of automating this typology and explains the usefulness of such an application to the potential victims of mobile bullying.

**Keywords.** Mobile Application; Mobile Victimisation; Typology; High school; Mobile bullying; Pragmatism; Design Science.

## 1. Introduction

Kowalski et al. [1] define mobile bullying as a form of cyberbullying through using mobile phones. In existing studies on cyberbullying, there has been limited examination of the nature of mobile bullying, and, subsequently, mobile victimisation [2-3]. Ngo and Paternoster [3] have suggested that there is a definite need for empirical research on victims to investigate a variety of factors contributing to victimisation. Badenhorst [4] also suggests that in the South African context, mobile bullying and the resulting mobile victimisation have not been extensively examined. In addition to these challenges, few of the interventions made by schools and the Department of Education in South Africa have been effective in minimising victimisation in some schools [5]. Notar et al. [6] also highlight that while research or efforts to intervene generally exist, evidence suggests that many of these interventions (i.e., practitioner-delivered, program-based, paper-based, or technological) have not worked effectively: none meet all the requirements to counter cybervictimisation [6].

Research from other disciplines suggests that digital interventions (DIs) can effectively address health and psychological challenges. For instance, in the health industry, evidence has shown that digital self-intervention can offer patients self-care information and education and can help to manage and support behaviours towards better health [7]. This method of intervention may also be done remotely using technological media such as the Internet, mobile applications, and text messaging services. Bradbury

---

[*] Corresponding Author, LSNSHA002@myuct.ac.za

et al. [7] highlight DIs as being more beneficial than (i) paper-based interventions, which require the production, printing and distribution of costly hard-copy material and (ii) practice-based interventions which limit access or availability of practitioners and sometimes are costly. They also argue that DIs complement practitioner-delivered interventions, increase access to healthcare interventions and can reach large numbers of people [7].

Not many digital or mobile tools have been developed to address the mobile victimisation problem and it is suggested that to combat cybervictimisation, advantage can be taken of explicit interventions in the form of new technical developments [8]. With the mobile phone currently becoming the dominant means of bullying, this study discusses a way in which to develop a mobile-based tool that may be used as an intervention method. The tool will be useful as a means of self-intervening by monitoring and reporting the mobile victimisation of high school students in South Africa. The research objectives for this study are therefore to develop a digital tool, based on a victimisation typology, that will monitor and report mobile victimisation among South African high school students, and to describe and explain the methodology and approaches that were adopted in developing such a tool.

## 2. Literature Review

### 2.1. Victimisation, Peer Victimisation and Mobile Victimisation

Victimisation is the process of a person becoming a victim of a crime [9]. Victimisation has also been studied as an act that stems from bullying. This means that those who are bullied are victims of bullying as they would have been victimised through the bullying process. As a result, victimisation can be said to be a result of the activity of bullying. To understand cybervictimisation, however, it is important to discuss peer victimisation in the physical sense (conventional bullying). Peer victimisation can take various forms including direct bullying behaviours (such as teasing or physical aggression) as well as more indirect behaviours (such as group exclusion or malicious gossip) [10]. Peer victimisation in the cyber environment is, however, a special case that occurs through the use of electronic devices and is called cybervictimisation [11]. Mobile victimisation may, therefore, be considered a special case of peer victimisation as mobile phones may be one of the electronic devices used in peer victimisation to exercise bullying behaviours.

### 2.2. Understanding and Intervening Mobile Victimisation

Using major theories of victimisation that are often highlighted in the literature related to victimisation and reviewing the major typologies of victimisation, Lusinga and Kyobe [12] developed a Mobile Victimisation Typology (MVT) to aid in the understanding and intervening of mobile victimisation. The MVT can assist in identifying, describing, comparing and predicting mobile victimisation. However, evidence from literature suggests that paper- or program-based interventions have not been especially effective in addressing cybervictimisation in developing countries, including South Africa [5, 6, 13]. Calls have therefore been made for digital solutions.

### *2.2.1. Digital Applications used to address Suicide and Cyberbullying*

There have been suggestions that bullying and suicide parallel one another [14]. Therefore, research in suicide may inform research in bullying. To intervene suicide, Westerlund et al. [15] believe it is necessary both to inform people about the suicidal process and to develop new digital applications that identify suicidal individuals by the way they communicate. Shand et al. [16] and Guille et al. [17] have, for example, used cognitive behavioural therapy as the basis for developing web-based applications and mobile phone applications respectively. These digital interventions have proven to reduce the negative impacts on individuals in stressful positions.

With regards to cyberbullying, the main digital innovations that exist fall into two groups, i.e., *detecting* and *intervening in* cyberbullying [18]. Detecting cyberbullying involves the use of machine learning to better understand and therefore detect cyberbullying behaviours [18]. Intervention technologies urge victims to seek emotional support, discover how others have dealt with similar situations, give suggestions for appropriate responses and discourage them from retaliating [18].

In their study, Gasser et al. [13] found that while important individual contributions exist, such as those mentioned above, this field (digital child safety) is emerging in the developing world. They suggest that special contextual considerations be taken regarding the design and use of these tools. Gasser et al. [13] also assert that there is a need for more research in this field to use more pragmatic approaches.

### *2.3. Gaps Identified*

The key gaps identified are that (i) there has been limited examination and understanding of the nature of mobile bullying and mobile victimisation [2; 19], (ii) although interventions exist to counteract cyberbullying, most are not comprehensive enough given the complexity of mobile victimisation [6], and (iii) theoretical work is needed to inform the development of digital interventions [16-17]. This study therefore adopted the MVT to aid our understanding of mobile victimisation, and to inform the development of a digital intervention to mobile victimisation.

### 3. Research Methodology

### *3.1. Research Philosophy: Ontology, Epistemology and Methodology*

Giacobbi et al. [20] describe pragmatism as a means of providing practical solutions to contemporary problems and not about answering questions about absolute truth. Pragmatists believe in multiple realities and that no one theory is closer to the truth than the other [21]. Thus, they focus on what is of interest and value to the researcher [21]. This study took pragmatism as its ontological stance because there needs to be a practical solution (a digital intervention) to the problem of mobile victimisation. Given the nature of this research, it is necessary to build this intervention with knowledge that already exists so that in its conception, it is acceptable to those for whom it is built. It is also necessary that in the process of developing a digital intervention, the opinions of the stakeholders are considered. In addition, the research question posed in the current study,

i.e., "*How can a digital tool monitor and report mobile victimisation of South African high school students?*" requires the adoption of both objectivist and subjectivist considerations. An objectivism stance would be adopted since there is a causal relationship between the effectiveness of a digital intervention and its ability to monitor and report mobile victimisation. The subjectivism stance is also necessary as students' opinions are needed for an effective solution.

Pragmatism as epistemology considers knowledge to be "a combination of facts, words/meanings and figures that solve problems ... combining inductive and deductive thinking, measuring, observing and developing new meanings" [22, p. 67]. Therefore, knowledge is obtained through both objective measurement and social construction [22]. Deductive thinking in this study occurred through using literature to understand mobile victimisation, its causes, and the relationships that exist within itself and its parts. Inductive thinking then becomes key when the opinions of those for whom the digital intervention was developed are integrated in the development of the intervention.

Since the current study considers both objective and subjective world views, the researchers considered mixed methodology as the most appropriate method since data that is both quantitative and qualitative will be necessary to capture both world views.

### 3.2. Research Strategy

This study adopted Design Science (DS) as the research strategy because it enables information systems researchers to generate new knowledge through the development of innovative artefacts and the evaluation of these artefacts [23]. This fits well with the aims of the present study. The design science research (DSR) process model proposed by Vaishnavi and Kuechler [23] was used in this study and gives five steps in conducting design science research (awareness of the problem, suggestion, development, evaluation and conclusion) [23]. These are described below:

*Awareness of problem*: This step involves bringing into focus an interesting issue within research or practice that needs to be addressed. This awareness may be informed by the industry or the discipline itself. At this step, the proposal for the research is produced [23]. The researchers took an objective approach to develop the research problem through conducting a review of existing literature to identify issues within the field of interest, i.e., mobile victimisation and its interventions.

*Suggestion*: This is a step where creative solutions to the problem are proposed in the form of a tentative design. The tentative design offers new, creative ways of solving the problem [23]. Therefore, for this study, developing an intervention tool that addresses the mobile victimisation of high schools is considered an innovative means by which mobile victimisation is understood and intervened. In this step, the design for a mobile application was conceptualised. This too was informed by literature.

*Development*: This stage converts the tentative design into that artefact, paying more attention to the actual design process than the construction of the artefact [23]. The design process involved drawing up ideas on how to automate the Mobile Victimisation Typology (MVT). The most suitable way was to use a survey to capture the MVT and a reporting form to capture instances of mobile victimisation. These are discussed below. The mobile application prototype was then developed using online software on *appypie.com* which helps users to develop apps for different mobile platforms. This software allows one to compile different templates of the application for a prototype as they were readily available. This step was subjective because the development of the prototype was based on the suggestions of field experts in both software development

and mobile bullying, so that time spent developing the application was reduced. Time spent developing an artefact is considered a limitation of design science [24]. In addition, to reduce time spent, the tool will be tested in areas where mobile victimisation is prevalent so that the effectiveness of the tool is assessed in a short amount of time. Only at a later stage will the users of the tool have input.

Currently, the proposed mobile application has the About, How To, Mobile Victimisation Survey and Reporting Form pages. The About page informs students about mobile bullying, mobile victimisation and their consequences. The How To page explains how to use the mobile application and describes two steps. The first step is to take a survey based on the MVT. The survey was developed using questions adapted from other studies and issues identified within the body of literature of mobile bullying and victimisation. The intention of this survey is (i) to capture mobile victimisation and its contributing factors quantitatively as highlighted by Lusinga and Kyobe [12]; and (ii) to test the MVT within this study. The second step and main function of the application is to report mobile victimisation on the Reporting page. On this page, students can report their mobile victimisation by adding details about when and how it occurred. The data collected from the forms will be analysed by the researchers.

The DSR process model is an iterative process, of which the proposed prototype is the first artefact of this process. What follows is the *evaluation stage*, where the artefact is evaluated and the results obtained are compared to the initial requirements made in the proposal phase [23]. If any differences between the two are noted, they are explained or corrected [23]. Within this study, the proposed mobile application will be tested and evaluated among high school students. This allows the researchers to know about the students' experience with the tool and whether it was effective in monitoring and reporting mobile victimisation. In addition, the researchers would seek to know if the tool is gathering sufficient and relevant information that would improve the MVT. From the data gathered, if changes are necessary, the prototype will be redesigned to fit the needs of the students as well as the aims of this research – in which case, a new iteration would begin. This step is therefore subjective as the students would be informing the creation and development of knowledge and the mobile application.

*Conclusion*: In this phase, the results of the research are consolidated and written up [23]. The information and knowledge obtained through this research process may then inform the field of mobile victimisation.

## 4. Conclusion and Contributions

The aim of this paper is to describe how a digital application based on a Mobile Victimisation Typology (MVT) may be developed and implemented to improve the identification, description, comparison and explanation of mobile victimisation. It also shows how pragmatism can be used as both an ontological and epistemological consideration to guide the development of the digital interventions. In addition, it shows the usefulness of adopting the design science strategy in this process. Given the fact that there are not many digital interventions for mobile victimisation [6], this study contributes in this direction by describing approaches to be used in this development. This is of great importance as literature has shown that while interventions on cyberbullying exist, these have not worked effectively and fail to meet all the requirements to counter cybervictimisation in general [6].

Having used pragmatism as the philosophical consideration for this study and design science as its strategy, there will be further development of the MVT based on deeper interactions with students and the analysis of their opinions. Also, since students from schools in crime-ridden areas will be sampled for this study, the limitation of time in the development of the application will be reduced. The objectives of the MVT solution will therefore be further refined to ensure that not only a practical problem is solved but also that the MVT will make a theoretical contribution to the development of broader solutions for applications in the fight against mobile victimisation.

## References

[1]  R. Kowalski, S. Limber, and P. Agatston, *Cyber bullying: Bullying in the digital age,* Blackwell, UK, 2008.
[2]  P. Smith, J. Mahdavi, M. Carvalho, and N. Tippett, An investigation into cyberbullying, its forms, awareness and impact, and the relationship between age and gender in cyberbullying. *Research Brief No. RBX03-06. London: DfES*, (2006).
[3]  F. Ngo, and R. Paternoster, Cybercrime victimization: An examination of individual and situational level factors, *International Journal of Cyber Criminology*, **5** (2011), 773-793.
[4]  C. Badenhorst, Legal responses to cyber bullying and sexting in South Africa. *Centre for Justice and Crime Prevention*, **10** (2011), 1-20.
[5]  B. Creecy, Gauteng education MEC Barbara Creecy's opening address at the colloquium on bullying at Turffontein Racecourse 21 August 2012. Retrieved 25 April 2016 from http://www.education.gpg.gov.za/Media/Statements/Documents/Media%20Statement%20-%20MEC%20address%20at%20colloquium%2021%20August%202012.pdf
[6]  C.E. Notar, S. Padgett, and J. Roden, Cyberbullying: Resources for Intervention and Prevention, *Universal Journal of Educational Research*, **1** (2013), 133-145.
[7]  K. Bradbury, S. Watts, E. Arden-Close, L. Yardley, and G. Lewith, Developing digital interventions: A methodological guide. *Evidence-Based Complementary and Alternative Medicine*, **2014** (2014), 1-7
[8]  R. Slonje, P.K. Smith, and A. Frisén, The nature of cyberbullying, and strategies for prevention. *Computers in Human Behavior*, **29** (2013), 26-32.
[9]  Canadian Resource Centre for Victims of Crime. The Impact of Victimization. Retrieved 18 August 2014 from http://www.crcvc.ca/docs/victimization.pdf
[10]  N. Crick, J. Casas, and H. Ku, Relational and physical forms of peer victimization in preschool. *Developmental psychology*, **35** (1999), 376-385.
[11]  Dempsey, M. Sulkowski, R. Nichols, and E. Storch, Differences between peer victimization in cyber and physical settings and associated psychosocial adjustment in early adolescence. *Psychology in the Schools,* **46** (2009), 962-972.
[12]  S. Lusinga, and M. Kyobe, Testing a Typology of Mobile Phone Victimisation Using Cluster Analysis. *The Electronic Journal of Information Systems in Developing Countries*, **78** (2017), 1-21.
[13]  U. Gasser, C.M. Maclay, and J.G. Palfrey, Working towards a deeper understanding of digital safety for children and young people in developing nations. *Berkman Center Research Publication*, **7** (2010), 10.
[14]  S. Bauman, R.B. Toomey, and J.L. Walker, Associations among bullying, cyberbullying, and suicide in high school students. *Journal of Adolescence*, **36** (2013), 341-350.
[15]  M. Westerlund, G. Hadlaczky, and D. Wasserman, Case study of posts before and after a suicide on a Swedish internet forum. *The British Journal of Psychiatry*, **207** (2015), 476-482.
[16]  F. L. Shand, R. Ridani, J. Tighe, and H. Christensen, The effectiveness of a suicide prevention app for indigenous Australian youths: study protocol for a randomized controlled trial. *Trials*, **14** (2013), 396.
[17]  C. Guille, Z. Zhao, J. Krystal, B. Nichols, K. Brady, and S. Sen, Web-Based Cognitive Behavioral Therapy Intervention for the Prevention of Suicidal Ideation in Medical Interns:  A Randomized Clinical Trial. *JAMA Psychiatry*, **72** (2015), 1192-1198.
[18]  H. Lieberman, K. Dinakar, and B. Jones, Let's Gang Up on Cyberbullying. *Computer*, **44** (2011), 93-96.
[19]  J. Lipton, Combating cyber-victimization. *Berkeley Tech. LJ*, **26** (2011), 1103-1156.
[20]  P.R. Giacobbi Jr, A. Poczwardowski, and P.F Hager, A pragmatic research philosophy for applied sport psychology. *The sport psychologist,*, 2005
[21]  S.F. Pratt, Pragmatism as Ontology, Not (Just) Epistemology: Exploring the Full Horizon of Pragmatism as an Approach to IR Theory. *International Studies Review*, **2016** (2016), viv003.
[22]  S. Grimstad, Business driven environmental action in agricultural based tourism micro-clusters in Norway and Australia. *The University of Newcastle's Digital Repository*, 2013.

*S. Luisinga et al. / Towards a Mobiule Application for Monitoring and Reporting Mobile Victimisation among south African high School Students*

173

[23] V. Vaishnavi, and W. Kuechler, Design research in information systems, 2004.

[24] N.L. Ball, Design Science II: The impact of design science on e-commerce research and practice. *Communications of the Association for Information Systems*, **7** (2001), 2.

# Automation of Community-Based HIV and STI Testing Service

Richard BOYLE[*,a]

[a]1HIV Ireland

**Abstract.** HIV Ireland, Ireland's largest and longest established HIV charity, opened a free 'drop-in' HIV and STI testing service in January 2012 after a six month pilot service. This service remains the only 'community-based' service in Ireland, as all free HIV and STI services are statutory and located in major hospitals. The service and its setting were designed to be low threshold, welcoming and informal.

Client registration, testing day management, and results dissemination used to be a manual process and it was challenging to collect complete and useful data from the testing population. Furthermore, recorded observations from staff indicated that clients had particular worries around potential waiting times and the dissemination of results.

In response to this, HIV Ireland, sponsored by GlaxoSmithKline (GSK), introduced a number of technologies to streamline the process, making the testing service more efficient and user friendly while collecting useful and anonymous data about the testing population. This is the only system of its kind in Ireland.

Technologies used included a cloud-based testing day system utilising gamification techniques, automated text messages and a unique W-Fi registration system to streamline the process. Clients and nurses alike welcomed the system and testing day capacity increased by approximately 30%. Management and key stakeholders were provided with detailed statistics about the testing populations, which in turn informed future educational campaign design.

HIV Ireland constantly collects user feedback with a view to improving the system and developing a best practice model for community based testing services, potentially evolving a national and international service network using this system.

**Keywords.** Gamification, Automation, HIV Testing, SMS, Wi-Fi, Community, Public Health, Edugames, Stigma, Health, Healthtech

## 1. Introduction

The European Centre for Disease Control (ECDC) estimates that 17% of individuals living with HIV in EU countries are not aware of their HIV positive status [1] and that 48% of those being diagnosed with HIV are being diagnosed late with a very compromised immune system [2].

It is well accepted that community testing settings are the primary gateway to HIV prevention, care and treatment and that they are attractive to at-risk and difficult to reach populations [3]. In addition to benefiting the health of the individuals, HIV testing also has a role to play in terms of public health. Individuals who test HIV positive and who then adhere to their HIV medication regimens typically develop an undetectable HIV 'viral load', making transmission of the virus by these individuals extremely unlikely.

Knowing this, Ireland's largest and oldest HIV and AIDS charity *HIV Ireland* introduced a free, low-threshold drop-in HIV and STI testing service at their premises

---

[*] Corresponding Author: richard.boyle@hivireland.ie

on Eccles Street, Dublin in January 2012. Coupled with an informal approach to sexual health testing, this community based testing service proved very popular amongst at-risk and difficult to reach communities such as migrant communities and the drug using community and among others who did not wish to present in hospital environments for a variety of reasons. Within six months of mainstreaming the service, queues regularly formed outside the premises on testing days. The HIV Ireland testing service remains highly busy and delivers exceptional HIV detection rates[†] [4].

## 2. Description of HIV Ireland HIV and STI Testing Service

Given that HIV Ireland is a support and training organisation and not a medical environment, clinical services for the testing are contracted from St. James's Hospital, Ireland's largest hospital. Two nurses are contracted for each testing day, which takes place the 2nd and 4th Wednesday of each month between 1:30pm and 4:00pm. Two staff members assist with orientating the clients and each testing session is overseen by a duty-manager.

Doors open promptly at 1:00pm on each testing day, but typically a queue forms before this time outside the main door, with clients arriving up to 2 hours early to ensure a testing slot.

Clients are given a numbered ticket at the door and shown to a waiting room, where they complete an anonymous registration form. They are offered tea, coffee, fruit and snacks, and papers and magazines as well as a guide to the testing service which outlines how the service works. When a client's number is called, he/she is shown to a testing room where the nurse takes blood samples to test for HIV, Hepatitis, and Syphilis and also provides the client with self-swabs which clients undertake in a private toilet and then return to the nurse. These swabs are tested for Gonorrhoea and Chlamydia.

Once the swabs are delivered to the nurse, the client is free to leave and typically receives his or her test results in around 7-14 days. HIV Ireland provides support for those that test positive for HIV or another STI.

## 3. Technologies Used

### 3.1. Registration via Wi-Fi

Cisco "Meraki" Wi-Fi units were installed in the building to provide dedicated SSID's which automatically provide the anonymous testing registration form. Put simply, this means that clients "View Wireless Networks" on their phone settings, and simply click on the "Register for Testing" label to be brought directly to the registration

---

[†] Detection rates in HIV Ireland's testing service in 2016 were 1 HIV detection in every 80 people tested. Studies have indicated that HIV testing is cost-effective when 1 previously undiagnosed HIV infection is detected in every 1,000 individuals tested. See for example: Sanders GD, Bayoumi AM, Sundaram V, Bilir SP, Neukermans CP, Rydzak CE, et al. *Cost-effectiveness of screening for HIV in the era of highly active antiretroviral therapy.* New England Journal of Medicine 352(6): 570-585. 2005.

form. A number of tablet devices are available from staff in the event that clients don't have, or don't wish to use, their own smart phone. (See Figure 1).
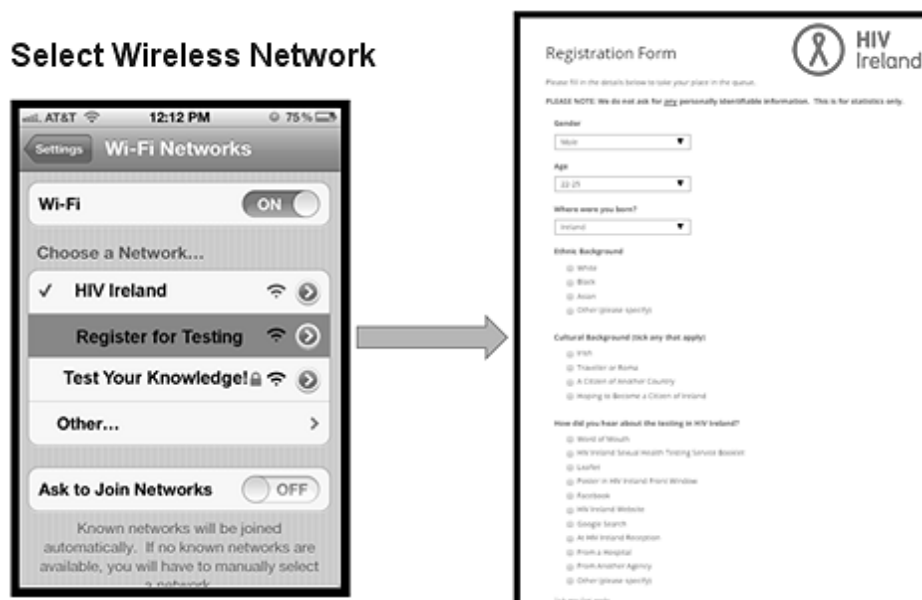


**Figure 1**: Wi-Fi delivery of registration form.

The registration form contains 16 questions relating to the background and lifestyle of the client. Note that no personally identifiable information is requested and this point is emphasised on printed materials around the waiting room. All questions must be completed before the form can be submitted, ensuring complete datasets.

This electronic registration method replaced a paper-based registration form, which required manual transcribing to a computer after each testing day and yielded high levels of uncompleted data.

At the end of the registration form, clients enter the unique number on the back of their ticket as a simple mechanism to avoid multiple registrations or registrations from individuals who are not presenting for testing, ensuring accurate registration data.

### 3.2. Waiting List Screen

One large monitor is located in a highly visible position in the waiting room displaying which ticket number has been called and highlighting any clients who have not yet successfully registered, again ensuring a complete registration dataset.

An estimated waiting time is also displayed, enabling clients to leave the building if they choose while they are waiting. (See Figure 2 – Queue with estimated waiting times).

This queue is available live over the internet at hivtesting.ie/q so that clients can monitor it from their own phones thus ensuring that they arrive back in time for their test.
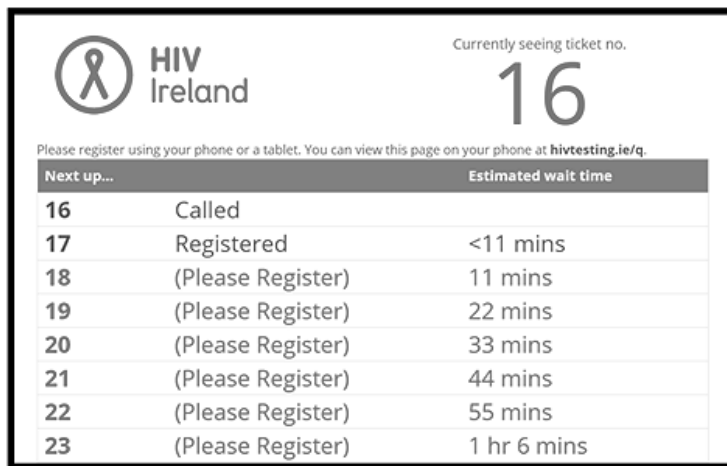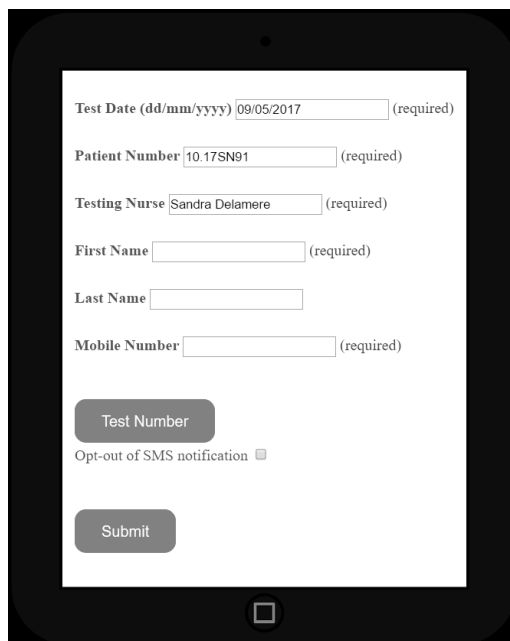
**Figure 2**: Waiting Room Screen.

### 3.3. Nurses' Tablets

Each nurse is provided with a tablet device which automatically cues up her/his next patient by simply clicking a 'Next' button. All default information (such as hospital patient number) is auto-completed for them. The only details nurses have to enter are a name and mobile phone number provided by the patient. (See Figure 3 for screenshot of nurses' tablet).

### 3.4. Mobile Number Live Checking

With a single click of a button, the nurse can instantly test the mobile number provided by sending a test SMS to the patient's mobile phone on the spot. This step virtually eliminates incidences of being unable to contact clients due to incorrect mobile numbers recorded, which is critical given that the mobile phone is the primary mechanism by which the test results are delivered. (See "Test Number" button on Figure 3).

**Figure 3**: Nurses' Tablet.

*3.5. SMS Delivery of Negative Test Results*

Before this technology was introduced, clients were only contacted if there was a positive result for an infection; they had been told "If you don't hear from us within 2 weeks, your results are clear." From the clients' point of view, this proved to be a very long and anxious wait and so the introduction of negative test results being delivered via SMS to the client's phone was hugely welcomed and it also eliminated a high volume of calls from people enquiring as to whether their results had come in yet.

*3.6. Exit Poll*

A simple "happy or not" style exit poll containing 4 faces with differing degrees of satisfaction is presented on a screen on the way out of the building. Clients rate their satisfaction with their testing day experience and also have the opportunity to provide anonymous feedback into an electronic suggestion box. This feedback mechanism is in keeping with HIV Ireland's mission of constantly improving the service based on client feedback with a view to developing a best practice model for community based testing services.

*3.7. Management Reporting*

Service management and key funding stakeholders are provided with detailed breakdowns and easy to read live graphs of registration data, providing valuable insights into the backgrounds and behaviours of the testing populations presenting. This in turn enables the development of future educational campaigns based on insights gleaned.

*3.8. Gamification of HIV Information*

After registration has been completed, clients have the option to take a graphical quiz on their phones while they are awaiting their test, utilising the same simple Wi-Fi delivery mechanism as used to provide the registration form on clients' own phones or in-house tablets.

Quiz questions cover various aspects of HIV including transmission methods, available treatment, myths, and little known facts. Quiz questions are self-correcting, providing the clients with key messages. The quiz answers provided by the clients are also stored - again, no personally identifiable information is requested – and these answers can be cross-referenced to the registration data to give even more detailed information on what different populations may know or think. Quiz questions can gauge attitudes and beliefs around HIV in addition to factual information and be cross tabbed to age, gender, sexual preference, and country of origin, for example.

## 4. Conclusions

HIV Ireland's community-based low threshold HIV and STI testing service is proving to be an effective way of increasing testing among traditionally difficult to reach and at-risk populations, which in turn is yielding high HIV detection rates.

The automation of the HIV and STI testing service at HIV Ireland has significantly streamlined the service, enabling approximately 30%[*] more clients to be tested on each testing day and receiving a universal welcome from service users due to its user-friendliness and convenience.

In addition to this, the detailed and complete data being gathered about the populations presenting to this service for testing is providing a valuable tool for management, key stakeholders, and designers of future educational campaigns.

HIV Ireland's policy of constantly refining all aspects of its testing service based on client feedback, assisted by the technological mechanisms described above, plays a part in developing a best practice model for community-based low threshold HIV and STI testing services.

## References

[1] European Centre for Disease Prevention and Control. *The status of the HIV response in the European Union/European Economic Area, 2016.* Stockholm. ECDC, 2017.
[2] European Centre for Disease Prevention and Control. *HIV Surveillance in Europe Report, 2015.* Stockholm. ECDC, 2016.
[3] European Centre for Disease Prevention and Control. *HIV testing: Increasing uptake and effectiveness in the EU.* Stockholm. ECDC, 2010.
[4] G. D. Sanders, A M. Bayoumi, V. Sundaram, S.P. Bilir, C.P. Neukermans, C.E. Rydzak, et al. Cost-effectiveness of screening for HIV in the era of highly active antiretroviral therapy. *New England Journal of Medicine* **352** (6) (2005), 570-585.

---

[*] Total number of tests completed at HIV Ireland on testing days averaged 25 people before the system was introduced and 33 after it was introduced.

# SECTION VII

## BRIEF COMMUNICATION

# Chronic pain treatment through Virtual Reality

Danilo GUARINO[a,*], Filippo LA PAGLIA[a], Marco DAINO[a], Valerio MAIORCA[a],
Salvatore ZICHICHI[a], Filippo GUCCIONE [a], Ambra PINTABONA[b],
Mark D WIEDERHOLD[c], Giuseppe RIVA[d, e], Brenda K WIEDERHOLD [f],
and Daniele LA BARBERA[a]

[a] *Department of Experimental Biomedicine and Clinical Neuroscience, University of Palermo, Italy*
[b] *Centro Psicofisico e Fisiokinesi, srl, Palermo*
[c] *Virtual Reality Medical Center, San Diego, CA*
[d] *Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan ,Italy*
[e] *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*
[f] *Interactive Media Institute, Virtual Reality Medical Institute, San Diego, CA*

**Abstract.** Chronic pain is a notable issue of public healthcare, causing enormous direct and indirect costs, and a reduction of the quality of life in the affected patients. In this study, we have used Virtual Reality (VR) as a method to reduce stress, anxiety and pain in patients affected by chronic pain. We examined two cohorts of patients: an experimental group and a control group. The patients in the experimental group were administered eight VR sessions, each of those lasted thirty minutes, while the control group had a standard therapy. The results are encouraging: they demonstrate the efficacy of VR treatment and the safety of the method.

**Keywords.** Chronic pain, palliative care, virtual reality, analgesia.

## 1. Introduction

The definition of pain was given by the IASP (International Association for the Study of Pain) in 1979. According to this definition, the pain is described as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" [1]. Said definition puts emphasis not only on the objective component of the pain, but also on the subjective part. Being an unpleasant experience, there is also an emotional charge that accompanies the pain [2]. Therefore, pain therapy not only aims to restore of the damaged tissue, but also to re-establish the psychological equilibrium of the patient. Furthermore, depression, anxiety, denial and muscle weakness are often associated with chronic pain [3]. In particular, the relation between pain and depression is not a mere cause-effect interaction, but the two factors are capable of influencing each other, such that depression can amplify the perception of pain and vice versa. The economic and social costs linked to chronic pain are enormous, since this has been identified as one of the main causes of loss of function and productivity in several countries.

---

[*] Corresponding author: dguarino@live.it

Pharmacological intervention is the main therapy for the patients. This is able to reduce the inflammation and the levels of pain perceived, but also brings important side effects. Furthermore, when tolerance occurs, it's necessary to increase the amount of drug administered to maintain the desired level of analgesia.

## 2. Methods

A group of 11 patients, composed of 8 women and 3 men was recruited in sanitary structures and divided in two groups: an experimental group and a control group

**Table 1**: Population characteristics

|  | **Experimental group** | **Control group** |
|---|---|---|
|  | *n* = 6 | *n* = 5 |
| Age (Mean ± SD) | 54.8 ± 12.6 | 57.4 ± 8.64 |
| (range) | 38 ± 70 | 44 ± 70 |
| Gender (M, F) | 3.3 | 0.5 |

Subjects in the experimental group were administered eight VR treatment sessions of thirty minutes each, two times per week. The VR scenarios used were "Enchanted Forest", "Castle" and "Cliff", developed at The Virtual Reality Medical Center, San Diego, CA. The worlds help evoke relaxation and deep breathing [4]. The control group adhered to the classical therapy, consisting of pharmacological intervention and thermotherapy, magnetotherapy, and ultrasonic treatment.

VR scenarios were run in a PC, and the environments were visualized on a monitor, configuring a non-immersive VR experience. The movements through the environments were managed with the help of a joypad and the sound was reproduced by a pair of headphones.

## 3. Results

**Table 1.** Results at Wilcoxon test

| Test-retest | Experimental (n=6) | Control (n=5) |
|---|---|---|
| McGill | z= -2.201, p= 0.028* | z= -0.447, p= 0,655 |
| BPI Severity | z= -2.207, p= 0.027* | z= -1.826, p= 0.068 |
| BPI Interference | z= -2.201, p= 0.028* | z= -1.633, p= 0.102 |
| STAI Y-1 | z= -0.943, p= 0.345 | z= -1.604, p= 0.109 |
| STAI Y-2 | z= -1,572, p= 0.116 | z= -1.841, p= 0.066 |
| BDI | z= -1,261, p= 0.207 | z= -1.604, p= 0.109 |
| VAS | z= -2,032, p= 0.042* | z= -1.461, p= 0.144 |
| SUDS | z= -1,732, p= 0.083 | z= -1.414, p= 0.157 |

*Significant $p < 0.05$

The results of the tests show the efficacy of the two therapies (the VR treatment and the classic therapy). In the experimental group there is a significant reduction in the scores obtained in the McGill Pain Questionnaire, Brief Pain Inventory severity and interference and in the Visual Analog Scale. A tendency to significance is shown in the Subjective Units of Distress Scale. In the control group there is not a meaningful reduction of the scores, except for a tendency to significance in the Brief Pain Inventory severity.

## 4. Discussion

In the experimental group, the reduction in the McGill, BPI severity and interference and STAI scores indicates that the therapy is efficient and powerful. The results obtained suggest that there has been a decrease in the pain experienced by the subjects, in the interference with daily activities. Instead, the subjects in the control group had a meaningful reduction of the scoring only in the BPI severity test. This shows that the subject had a reduction of the intensity of the pain experienced, even if the amount of this reduction is not as high as the one obtained in the experimental group. The VR treatment has showed to be an excellent tool to induce analgesia. Both therapies lasted four weeks, showing that in the same quantity of time, the VR therapy is more efficient to induce analgesia than the classical therapy.

## 5. Conclusions

VR treatment is still to be considered the future of low and mild pain syndromes, since the more studies are carried out, the more the advantages of said technique continue to show. The absence of use of pharmacological analgesics, and the minimal invasiveness of the procedure are capable of encouraging the patients to start the therapy, and helping to reach a certain level of analgesia in just one month.

It should be acknowledged that these results were obtained with a non-immersive VR technology, in which the VR environments were displayed on laptop computer instead of a head mounted display. The implementation of a head mounted display could give a greater sense of immersion in the VR, distracting the patients more efficiently and thus strengthening the effects of the therapy.

At least, the results are encouraging, but still the number of patients has to be increased.

## References

[1] H. Merskey, N. Bogduk, *Classification of chronic pain. Description of chronic pain symptoms and definitions of pain terms. Second edition. IASP Task Force on Taxonomy*, IASP Press, Seattle, 1994.

[2] J.S. Carpenter, D. Brockopp, Comparison of patients' ratings and examination of nurses' responses to pain intensity rating scales, *Cancer Nurs*, **4** (1995), 292-8.

[3] G. Magni, M. Marchetti, C. Moreschi, H. Merskey, S.R. Luchini, Chronic musculoskeletal pain and depressive symptoms in the National Health and Nutrition Examination. Epidemiologic follow-up study, *Pain*, **53** (1993), 163-8.

[4]  B. Wiederhold, Virtual reality as a distraction technique in chronic pain patients, *Cyberpsychol Behav Soc Netw*, **17** (2014), 346-52.

# Triggering and measuring social inhibitory response in humans immersed in interactions with virtual humans

Godson AHAMBA[a,*] David ROBERTS[a] and Peter EACHUS[a]
[a] *University of Salford, Manchester.*

**Abstract.** The aim of the proposed study is to determine if a virtual human can evoke a measurable inhibitory response to anti-social stimuli within the prefrontal cortex. Justification, protocol and demonstrator are described here. The work follows a previous study demonstrating that neural inhibitory responses can be measured within an immersive virtual reality display. We have adopted the approach of combining functional Near Infrared Spectroscopy (fNIRS) and virtual reality head-mounted display. Haemodynamic changes will be measured in healthy participants and subsequently, subjects with mental deficits, as both engage in interactions that seek to evoke a response that would normally be inhibited. Disinhibition is an aspect of social response exaggerated by several deficits of mind, including dementia, autism and Tourette's syndrome. This research could improve tools for understanding, diagnosis and treatment of such condition.

**Keywords.** Virtual Reality, Virtual Humans, Neuroimaging, Social Interaction.

## 1. Introduction

As a crucial part of our daily activity in life, we engage in social interaction with people [1]. However, in the course of social interaction, exhibition of anti-social behaviour is common [2]. The degree to which these antisocial behaviours are exhibited during interaction is often influenced by such factors as the influence of alcohol, temperaments and mental well-being of interacting parties [3]. Mental health studies suggest that anti-social behaviour is more likely to be exhibited (disinhibited) by people with cognitive impairments or mental deficits [4].

We are interested in the neural inhibitory response that would normally stop antisocial behavior arising from social cues perceived as evocative. Our experiment attempts to provide such cues and measure the response. Such an experiment relies on naturalistic conversation, preferably including a non-verbal element. However, the likelihood of fatigue for human confederates, the cost of recruiting trained confederates, repeatability and controllability of experiments, and ensuring safety of confederates, suggest adoption of virtual human confederates. Virtual Reality (VR) brings the advantage of carrying out our experiments in a controlled environment and immersive VR makes interactions with virtual humans more natural and compelling. To measure the response, we employ neural imaging, specifically measuring changes to blood oxidization in the prefrontal cortex (PFC).

---

* Corresponding Author: G.Ahamba@edu.salford.ac.uk

To date we have developed the protocol, and experimental environment, gained ethical approval and have begun recruiting.

## 2. Literature Review

We identify useful cues around our focus from existing studies. To achieve this, we consider studies that have focused on triggering responses to stimuli, measuring these stimuli as well as the technologies and paradigms adopted by these studies.

### 2.1. Virtual Reality (VR)

Psotka [5] argues that communication with virtual characters is more naturalistic and thus convincing in immersive virtual reality. In line with this argument, this study shall adopt immersive Virtual Reality (VR). Existing VR Technologies include the Head Mounted Displays (HMD) and CAVE Automatic Virtual Environments (CAVE) [6]. We are primarily interested in HMDs because of their wide availability and general low cost.

### 2.2. Virtual Humans (VH) and Social Interaction

Within this study, we focus primarily on virtual humans (VHs). A good number of studies have attempted replicating social interaction in virtual space using virtual humans and avatars [7]. Whilst several studies have attempted to show that VHs are perceived the same way as real humans, the empirical evidences provided by these studies are often inconsistent. Hence the conflict in opinions around perception of VHs [7].

The current study attempts to distinguish between perception of VHs and the neural response invoked by them. We attempt to provide empirical evidence to these neural responses. VR studies around the social domain have focused mostly on perception of confederates and therapies for public speaking and phobia for crowds. We have found none that targets inhibition to anti-social stimuli during social interaction or monitors neural responses during these interactions. This study therefore attempts to fill this gap.

### 2.3. Neuroimaging

The choice of neuro-imaging tools has often been guided by research interest and availability of technology or funds. The current study is concerned with inhibition during social interaction and we expect the medial prefrontal cortex (MPFC) to be implicated during interaction and their associated inhibition [8]. Therefore, we adopt a neuro-imaging tool that is effective in measuring PFC activity.

We note that some paradigms such as the Hayling, Stroop and Simon tasks have been used in attempts to measure inhibition in the past [8-11]. Honan et al [13] however, argue that the inhibition evaluated by these measures may differ from inhibition within the social domain.

## 3. Methodology

We seek to utilize our findings from this review to develop a system that seeks to correlate inhibition as evaluated by a classic paradigm for evaluating inhibition (the Hayling task) with neural responses from immersive interaction with friendly and evocative virtual humans.

### 3.4 Proposed Experiment

The proposed experiment shall be a virtual simulation of a room with virtual humans. Our participants shall be immersed in this simulation through an HMD. A friendly virtual confederate within the scene shall calmly disagree with the participant's opinion, while another virtual confederate (not initially part of the conversation) interrupts the discussion also in disagreement (but in a confrontational manner), thereby potentially triggering inhibitory response in the participant.

This study is yet to be carried out. However, ethical approval has been obtained and piloting is about to commence. The VR simulation will be tuned in piloting.

## 4. Potential Impact

The findings from this study will be potentially useful in behavioural therapies especially for people with a history of anti-social behavior or possible mild cognitive impairments or psychological disorders that make anti-social behavior more likely.

## References

[1] W.C. So, M.K.Y Wong, and K.Y. Lam. *social and communication skills Predict imitation abilities in children with autism*. Frontiers in Education. Vol. 1. Frontiers, 2016.

[2] M. Bruijnes, J. Linssen, R. op den Akker, M. Theune, S. Wapperom, C. Broekema, & D. Heylen. *Social behaviour in police interviews: relating data to theories*. In Conflict and Multimodal Communication. Springer International Publishing (2015), 317-347.

[3] R. A. Baer. *Mindfulness-based treatment approaches: Clinician's guide to evidence base and applications*, Academic Press, 2015.

[4] M. F. Green, W. P. Horan and J. Lee. Social cognition in schizophrenia. *Nature Reviews Neuroscience*, 2015.

[5] J. Psotka. Immersive training systems: Virtual reality and education and training. *Instructional science* **23** (1995), 5-6, 405-431.

[6] R. Pausch, D. Proffitt, and G. Williams. *Quantifying immersion in virtual reality*. Paper presented at the Proceedings of the 24th annual conference on Computer graphics and interactive techniques, 1997.

[7] L. Schilbach. The neuroscience of mimicry during social interactions. *Emotional Mimicry in Social Context* (2016), 72.

[8] C. D. Frith. The social brain? *Philosophical Transactions of the Royal Society of London B: Biological Sciences* **362(1480)** (2007), 671-678.

[9] J. R.Stroop. Studies of interference in serial verbal reactions. *Journal of experimental psychology,* **18(6)** (1935), 643.

[10] B. Hommel. Inverting the Simon effect by intention. *Psychological Research* **55**(1993), 270-279, 1993.

[11] A. E. Pinkham, M. Griffin, R. Baron, N. Sasson, and R. C. Gur. The face in the crowd effect: anger superiority when using real faces and multiple identities. *Emotion,* **10(1)** (2010), 141.

[12] C. Honan, M. Skye, A. Fisher, and K. Osborne-Crowley. *Social disinhibition: Piloting a new clinical measure in traumatic brain injury (TBI) individuals.* Paper presented at the INS/ASSBI 5th Pacific Rim Conference, 2015.

# Video games as learning tools at school: parents' attitude

Claudia CARISSOLI[a,*], Daniela VILLANI[a], Melissa CAPUTO[a] and Stefano TRIBERTI[a]

[a]*Department of Psychology, Università Cattolica del Sacro Cuore, Milano*

**Abstract.** Interest in video games for educational purposes is continuously increasing. According to the Technology Acceptance Model, attitude toward a technology is an important factor to its adoption. Up to now, a few studies have investigated the attitude of students and teachers towards video games as learning tools, but almost none have addressed parents' perspectives. This study investigates parents' attitudes towards video games at school. Participants show a mildly favourable opinion about video games at school, but some doubts still emerge about video games usefulness. More, experience in using video games influences parents' attitude: specifically, gamers consider video games more useful at school and show a clear preference of school adopting them than non-gamers.

## 1. Introduction

Video games (VGs) represent a very widespread activity among young people: they are more and more considered an important part of our culture as a whole [1]. The interest towards the use of VGs for educational purposes is continuously increasing. Video games seem to be able to promote a students' positive attitude toward learning and school [2–4]. They offer the opportunities to apply knowledge in practice and they facilitate a "trial and error" learning process, improving problem-solving and critical thinking skills [5,6]. The availability of a technology represents a necessary but not sufficient condition to guarantee its effective use. According to the Technology Acceptance Model (TAM), to encourage the behavioral intention and actual use of video games, it is fundamental that all key stakeholders have a positive attitude toward these tools, finding them useful and easy to use [7]. Applied to school, this means that for an efficient adoption of video games as educational instruments, all stakeholders, such as students, teachers, school managers and parents, must be involved and having a positive approach [8]. At the moment, just a few studies have investigated the attitude of students and teachers towards VGs as learning tools [9,10], but almost none addressed parents' perspectives. This study is a preliminary investigation into the attitude towards video games at school in a sample of Italian parents.

---

[*] Corresponding Author: claudia.carissoli@unicatt.it

## 2. Methods

### 2.1. Participants

Participants were recruited by contacting elementary and lower secondary school managers via general advertisement on social media and through fliers distributed during events. Fifty-three participants completed an online survey after signing an informed consent. The recruitment criteria were: (a) being older than 18 years old, (b) being parent of a child attending primary (6-10 years old) or lower secondary school (11-13 years old) (c) having a digital device and internet (d) being able to read and understand Italian.

### 2.2. Procedure and Measure

The online survey was constructed using Qualtrics, a web-based tool. Completion of the questionnaire took approximately 20 minutes. The survey consists of several sections investigating the following aspects: (1) demographic data; (2) parents' familiarity with new technologies and VGs; (3) parents' attitude towards Internet (Attitudes Towards the Internet Scale - ATIS Scale) [11], measured by 7-point Likert based subscales: General Internet Usage; Negative Internet Attitudes; (4) parents' PC self-efficacy [12]; (5) parental attitude towards video games as learning tools at school that includes usefulness, ease of use, preference for video games (these scales have been adapted from [9]).

## 3. Results

20 fathers and 33 mothers completed the online survey. Participants' age ranged from 30 to 50 years old. Respondents' children are attending mainly primary school (83%) and are predominantly males (66%). Respondents use Internet daily, own more than one digital device (e.g. PCs, smartphones and tablets) and feel quite competent in using PC (computer self-efficacy M = 3.64, SD = 1.18). Participants consider Internet quite useful and they usually surf (M=4.82, SD=.81). Nevertheless, they pointed out some distrust towards its use (negative attitude M=4.41 SD=1.09). More than half of respondents (55%) usually play VGs and they are moderately favorable towards the use of VGs at school (M=3.24; SD=1.05). Parents think that VGs are easy-to-use for their children (M=3.59; SD=.83), but are not fully persuaded about VGs usefulness (M=2.99; SD=.39). Data show positive correlations between the parents' PC self-efficacy and their positive attitude towards VGs at school (Self Efficacy & VG usefulness at school r=.433; p<.05; Self Efficacy & VG preference: r=.366; p<.05). Furthermore, performing a comparison between video gamers and not video-gamers we find that: parents who use VGs consider the introduction of VGs at school more useful than parents who do not use VGs (Usefulness: Gamers M=3.31, sd=.80, Not Gamers M=2.60, SD= .96, F=8.467 p<.05, $\eta^2$=.14); both parents who use VGs and who do not use VGs consider VGs easy to use at school (Ease of use: Gamers M=3.56, sd=.92; Not Gamers M=3.63, SD=.072, F=.088 p=.77, $\eta^2$=.02); parents who use VGs would prefer more a school adopting VGs than parents who do not use VGs (Preference for video games: Gamers M= 3.74, sd= .94, Not Gamers M= 2.61, sd= .81, F=21.215 p<.05, $\eta^2$=.30).

## 4. Discussion and Conclusions

Participants are typical Internet users, quite confident in their computer abilities and conscious about the Internet risks**.** They appear moderately in favor of VGs at school and moderately favor of schools open to adopt them. They are convinced that their children would not encounter problems with VGs even in school contexts, but doubts still remain about their usefulness. Data show a positive relation between parents' computer self-efficacy and the positive attitude towards VGs as learning tools; in addition, previous experience with VG playing seems to facilitate an open-mindedness approach versus the consideration of VGs as educational tools. Schools are increasingly testing game-based learning approaches to motivate and involve student in learning and VGs, serious or commercial ones, represent a useful resource. These results, albeit preliminary, point out the importance of parents' attitudes towards technology and of sharing educational decisions with them, to make clear the role that VGs can have at school and the learning opportunities that these tools can offer to children.

## References

[1]   J. Kirriemuir, and A. McFarlane, *Literature Review in Games and learning*, Futurelab Series. (2004).
[2]   L.A. Annetta, Video Games in Education: Why They Should Be Used and How They Are Being Used, *Theory into practice,* **47** (2008) 229–239.
[3]   K. Durkin, and B. Barber, Not so doomed: Computer game play and positive adolescent development, *Journal of Applied Developmental Psychology*. **23** (2002) 373–392.
[4]   F. Ke, A case study of computer gaming for math: Engaged learning from gameplay? *Computers and Education*. **51** (2008) 1609–1620.
[5]   P.J.C. Adachi, and T. Willoughby, More Than Just Fun and Games: The Longitudinal Relationships Between Strategic Video Games, Self-Reported Problem Solving Skills, and Academic Grades, *Journal of Youth and Adolescence*. **42** (2013) 1041–1052.
[6]   P.J.C. Adachi, and T. Willoughby, Do Video Games Promote Positive Youth Development?, *Journal of Adolescent Research*. **28** (2013) 155–165.
[7]   T. Teo, Factors influencing teachers' intention to use technology: Model development and test, *Computers & Education*. **57** (2011) 2432–2440.
[8]   T.M. Pendergrass, K. Hieftje, C.A. Crusto, E. Montanaro, and L.E. Fiellin, If We Build It, Will They Come? A Qualitative Study of Key Stakeholder Opinions on the Implementation of a Videogame Intervention for Risk Reduction in Adolescents, *Journal of Adolescent Health*. **58** (2016) S88–S89.
[9]   J. Bourgonjon, M. Valcke, R. Soetaert, and T. Schellens, Students' perceptions about the use of video games in the classroom, *Computers & Education*. **54** (2010) 1145–1156.
[10]  J. Bourgonjon, F. De Grove, C. De Smet, J. Van Looy, R. Soetaert, and M. Valcke, Acceptance of game-based learning by secondary school teachers, *Computers and Education*. **67** (2013) 21-35.
[11]  B.J. Morse, N.L. Gullekson, S.A. Morris, and P.M. Popovich, The development of a general Internet attitudes scale, *Computers in Human Behavior*. **27** (2011) 480-489.
[12]  I. Vekiri, and A. Chronaki, Gender issues in technology use: Perceived social support, computer self-efficacy and value beliefs, and computer use beyond school, *Computers and Education*. **51** (2008) 1392-1404.

# Acceptability of positive technologies by patients with eating disorders: Results from a Randomized Control Trial

Ángel ENRIQUE[a*], Juana M. BRETÓN-LÓPEZ[a,b], Guadalupe MOLINARI[a],
Soledad QUERO[a,b] & Cristina BOTELLA[a,b]

[a]Universitat Jaume I, Castellón, Spain
[b]CIBER de Fisiopatología de la Obesidad y Nutrición (CIBEROBN), Madrid, Spain

**Abstract.** The present study is aimed to analyze acceptability ratings of positive technologies reported by patients with eating disorders. 54 patients were enrolled in a randomized control trial with two experimental conditions. In the intervention group (n=29), participants performed the best possible self exercise, through positive technologies, for one month. Likewise, participants in the control group (n=25) had to write about their daily activities also through technology. Acceptability levels were rated at the end of the one-month training. Results showed that participants of both conditions reported appropriate levels of satisfaction with the exercises and the technologies and they also perceived the exercises as useful. These results suggest that positive technologies can serve as a supporting tool delivering interventions aimed to improve positive emotions and well-being in clinical samples.

**Keywords.** Positive Technology, Best Possible Self, Eating Disorders, Well-being

## 1. Introduction

Eating disorders (EDs), are difficult conditions to be treated and patients often remain ill for many years [1]. In this sense, it has been suggested that interventions addressed to improve well-being in patients with such diagnoses can be useful as a way to buffer against the harmful effects caused by these conditions [2]. However, few studies have explored the efficacy of positive psychological interventions (PPIs) in ED samples. More specifically, given that these patients have difficulties imagining a better personal future, interventions aimed to promote optimistic thinking in this population can be of considerable benefit [2].In this regard, one PPI that has been found useful at improving optimistic thinking is the best possible self (BPS) exercise [3].

Positive Technology (PT) has been defined as the scientific approach of technology for improving the quality of our personal experience as a way to enhance our well-being [4]. PT applications have shown appropriate levels of acceptability by users and they are effective in improving well-being and reducing depressive symptoms in general and clinical samples [4]. The present study aims to evaluate the acceptability levels of positive technologies rated by patients with eating disorders. These patients were part of

---

* Corresponding Author: aenrique@uji.es

a randomized control trial that examined the efficacy of the BPS exercise for improving positive functioning measures (for a complete description see [5]).

## 2. Method

### 2.1. Participants

All the participants had a diagnosis of ED established by clinical psychologists. Mean age was 27 (SD = 8.6) and 96.3% of the sample were female. Regarding the level of education 55.6% of the sample had a university degree, 40.7% high school and 3.7% elementary school.

### 2.2. Positive Technology Applications

Book of Life. It seems like a personal diary composed of different chapters, each one addressed to write about significant life areas. Each chapter aims to promote specific strengths and all of them allow the user to include multimedia content such as images, music and videos, to complement the developed narrative.
TEO (Emotional-Online Therapy). It is a web-platform where a clinician can develop and organize therapeutic contents based on multimedia materials to be delivered to patients.

### 2.3. Procedure

54 participants were randomly allocated to: a) BPS condition (n=29) consisting on thinking and writing about a future in which all has gone in the best possible way; b) control condition (n=25) where participants were asked to report the activities, thoughts and feelings experienced at the past 24 hours. The experiment lasted for a period of one month. In the first session, participants completed the assigned exercise for 20 minutes. In the BPS condition, they performed the exercise through the Book of Life system, being able to add multimedia content to the essay. In the control condition, participants completed the task through a PowerPoint file. Finally, all the content developed by the patients of the BPS condition was uploaded to TEO and they were given a user name and password to practice the exercise at home. In the case of the control condition, participants were sent the PowerPoint file by email. Participants were encouraged to practice the exercise in home five minutes per day for one month. After that time, patients attended a final session where a credibility/expectancy questionnaire was administered to assess the experience of the patients with the technologies.

### 2.4. Measures

Credibility/ Expectancy Questionnaire [6]. This instrument was used to assess acceptability ratings with the technologies. Participants rated their degree of satisfaction and perceived utility on a 10-point Likert scale.

## 3. Results

Participants of both conditions reported adequate levels of satisfaction with the exercises (M= 6.70, SD = 2.54 for the BPS condition, M = 6.70, SD=1.72 for the DA condition) and they found them useful (M= 7.00, SD = 2.63 for the BPS condition, M = 6.70, SD=1.82 for the DA condition). Regarding the positive technologies used to perform the exercises, Figure 2 depicts the levels of satisfaction and usefulness for each one. Participants of the BPS condition reported to feel satisfied with both the technologies they used (Book of Life and TEO) and they found them useful. In the case of control condition, participants reported similar levels of satisfaction and usefulness with the PowerPoint file.
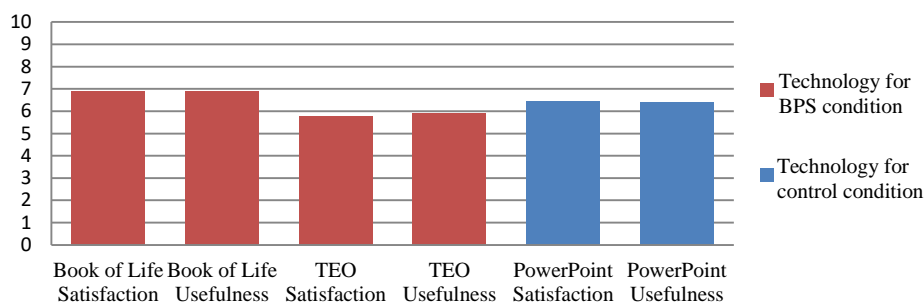


**Figure 1.** Acceptability levels for the different Positive Technologies reported by participants

## 4. Conclusions

The results regarding the satisfaction and usefulness levels of the exercises and the positive technologies indicate that participants felt satisfied and found them useful, which is in line with the results found in other studies with positive technologies [4]. The design of therapeutic procedures that are well rated by patients with ED is important in order to promote adherence to the treatment, given that conventional treatments of these conditions are often not aligned with patients' aims, resulting in high drop-out [7]. In addition, the Book of Life and TEO have shown to be flexible tools that can serve for the implementation of PPIs in clinical samples. Future studies could analyze the levels of acceptability and efficacy of other PPIs through these positive technologies and compare the results with a condition without technologies, in order to explore the specific contributions of these tools.

## References

[1]  A. M. Wood,  S. & Joseph,. The absence of positive psychological (eudemonic) well-being as a risk factor for depression: a ten year cohort study. *Journal of affective disorders* **122(3)** (2010), 213-217.

[2]  H. Malson, B. Lin, S. Clarke, J. Treasure, G. Anderson, M. Kohn.  Un/imaginable future selves: A discourse analysis of in-patients' talk about recovery from an «eating disorder». *European Eating Disorders Review* **19(1)** (2011), 25-36.

[3]  J. M. Malouff, & N. S. Schutte. Can psychological interventions increase optimism? A meta-analysis. *The Journal of Positive Psychology* (2016), 1-11.

[4] V. Guillén, C. Botella, M. R. & Baños. Psicología clínica positiva y tecnologías positivas. *Papeles del Psicólogo* (2017), 19-25.

[5] A. Enrique, J. Bretón-López, G. Molinari, P. Roca, & C. Botella Efficacy of a positive psychological intervention in patients with eating disorders: a Randomized Control Trial, (submitted).

[6] T. D. Borkovec, & S. D. Nau, Credibility of analogue therapy rationales. *Journal of Behavior Therapy and Experimental Psychiatry* **3(4)** (1972), 257-260.

[7] S. Wonderlich, J. E. Mitchell, R. D. Crosby, T. C. Myers, K. Kadlec  K. LaHaise,, ... & M. Jorgensen. Minimizing and treating chronicity in the eating disorders: a clinical overview. *International Journal of Eating Disorders* **45(4)** (2012), 467-475.

# "Positive Bike" – An Immersive Biking Experience for Combined Physical and Cognitive Training of Elderly Patients

Andrea GAGGIOLI [a,b,*] Luca GRECI [c], Sara ARLATI [c,d],
Marco STRAMBA-BADIALE[e], Elisa PEDROLI [a], Desirée COLOMBO [a],
Silvia SERINO [a,b], Pietro CIPRESSO [a], Giuseppe RIVA [a,b]

[a]*Applied Technology for Neuro-*Psychology *Lab, I.R.C.C.S. Istituto Auxologico Italiano, Milan, Italy*
[b] *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*
[c] *Institute of Industrial Technologies and Automation, Consiglio Nazionale delle Ricerche, Milan, Italy*
[d]*Department of Electronics, Information and Bioengineering, Politecnico di Milano, Milan, Italy*
[e] *Department of Geriatrics and Cardiovascular Medicine, I.R.C.C.S. Istituto Auxologico Italiano, Milan, Italy*

**Abstract.** Previous evidence shows that combined cognitive and physical exercises (dual-task intervention, (I-DT)) potentiates cognitive performance more than either type of single training alone (Lauenroth et al., 2015). Here, we describe the rationale, the design and the implementation of the "Positive Bike", a fully-immersive virtual reality biking experience for implementing I-DT training protocols in older patients. The system consists of a cycle-ergometer positioned within a Cave Automatic Virtual Environment (CAVE). The system also features a cloud-based platform which allows the therapist to configure the exercise parameters (i.e, duration and load). Using the Positive Bike, the patient can take a virtual ride by physically pedalling at variable paces within a simulated scenario (i.e., a park). During the virtual ride, the patient can be presented with different interactive cognitive exercises (attentional, memory etc). In one of such exercises, for example, the patient has to recognize different animals appearing on the route sides and press a button if such animal has a name beginning with a specific letter. Potential applications of Positive Bike in geriatric wellness and rehabilitation are discussed.

**Keywords.** Positive technology, neuro-rehabilitation, dual-task, virtual reality, CAVE

## 1. Introduction

Previous evidence shows that combined cognitive and physical exercises (dual-task intervention, I-DT) potentiates cognitive performance more than either type of single

---

* Corresponding Author:  andrea.gaggioli@auxologico.it

training alone (Lauenroth et al., 2015). The "Positive Bike" is a fully-immersive virtual reality biking experience for implementing I-DT training protocols in older patients.

In every-day life, many activities make use of dual-task (cognitive and physical) ability. Frail older individuals, who are characterized by general vulnerability and a decreased resistance to stressors, may show difficulties in dual-task activities (i.e., walking and talking) and this could lead to an increase risk for falls [2].

## 2. System architecture

The system is constituted by a cycle-ergometer (EuroBike 320, Lumed, Opera, MI, Italy), a pushing button anchored on the cycle-ergometer handlebars, a pulse-oximeter, a blood pressure meter, an Arduino2 board, an Xbox controller. The virtual environment is displayed in a Cave Automatic Virtual Environment (CAVE) via a series of stereoscopic projectors. Interaction with the VE occurs via the Xbox controller and a wand that is recognized by the tracking system integrated in the CAVE and can be used like the 3D equivalent of the PC mouse. The VE has been designed and implemented using Unity3D, and displayed in the CAVE using MiddleVR (http://www.middlevr.com/middlevr-for-unity/), a Unity plug-in that allows multi-screens / multi-computers synchronization for higher-resolution VR systems. A graphical user interface allows the therapist either to create a new user or to load the information of a preexisting user and set the parameters of the scenario (i.e., task difficulty level). The patient's profile data as well as session data are stored in a XML file for further analysis.

The VR scenario consists of a large park populated with plants and animals. The dual task includes an attentional task and a motor task. The attentional task consists of selecting those (and only those) animals, appearing on the side of the route, starting with a target letter (i.e., if the letter "b" pops out, the patient will select all animals starting with "b", like bear, bison etc.). Another version of the attentional task requires the patient to determine whether the color of street furniture corresponds to the target one. To perform the selection, the patient presses a physical button mounted on the cycle-ergometer's handlebars. If the choice is correct, the target is highlighted in green; if wrong, the target's color turns red. For each one of these two tasks four difficulty levels have been set, as specified in Table 1.

**Table 1.** Stimuli used in the dual task within the virtual cycling scenario

| Level nr. | Frequency of the stimuli appearance [s] | # target | Target animals' names first letter | Pieces of furniture's target colors | Cycle-ergometer workload [W] |
|---|---|---|---|---|---|
| 1 | 20 | 5 | G | Red | 20 |
| 2 | 15 | 5 | T | Blue | 30 |
| 3 | 15 | 5 | C | Green | 40 |
| 4 | 15 | 5 | S | Yellow | 50 |

The motor task consists in pedaling at a target speed (predefined by the therapist). The user's cycling speed is constantly monitored during the task; if the patient's speed is slower or faster than the target velocity, an audio warning feedback is provided.



**Figure 1.** A screenshot taken from the virtual park route. An animal has appeared on the route side.

The cycling velocity data is used also to synchronize the visual flow in the VE: the virtual bike proceeds in the park along the predefined path according to the real cycle-ergometer rounds-per-minute parameter. During the whole exercise, users' vital parameters are continuously monitored. Patient's heart rate is measured through a pulse-oximeter that can be worn on a fingertip or on the ear lobe; arterial blood pressure is measured by a blood pressure meter every two minutes. Both sensor devices, as well as the push button, communicate with the VR application via Arduino.

## 3. Conclusion

The Positive Bike is currently being tested in a pilot trial to determine the usability and clinical feasibility of the system, as well as potential adverse effects (i.e. motion sickness). In the next phase of the research, the Positive Bike will be tested with a sample of frail older individuals to improve functional status and wellbeing.

## 4. Acknowledgment

## References

[1] A. Lauenroth, A. E. Ioannidis, and B. Teichmann, Influence of combined physical and cognitive training on cognition: a systematic review. *BMC Geriatrics*. **16** (2016) p. 141.

[2] S. Vermeiren, R. Vella-Azzopardi, D. Beckwée, A. K. Habbig, A. Scafoglieri, B. Jansen, ... and Gerontopole Brussels Study group, Frailty and the Prediction of Negative Health Outcomes: A Meta-Analysis. *Journal of the American Medical Directors Association*. **17**(12) (2016): p. 1163.e1-1163.e17.

# Exploring the impact of hand movement delays and hand appearance on myoelectric prosthesis embodiment using Immersive Virtual Reality

Andrew HODRIEN[a,*], Adam GALPIN[a], David ROBERTS[a], and Laurence KENNEY[a]

[a]*University of Salford*

**Abstract.** Prosthesis embodiment, the feeling of a prosthesis being part of the user, is reported by some prosthesis users. Myoelectric prostheses are electrically powered which produce a delay with fixed and variable components. The latter introduces uncertainty over hand behaviour, likely influencing embodiment. Embodiment may also be influenced by hand appearance. An Immersive Virtual Reality experimental study is currently in preparation. It involves anatomically-intact participants to systematically measure the impact of movement delays and appearance on embodiment of a virtual prosthesis. This includes a head-mounted display and motion tracking of a myoelectric prosthesis, with various virtual appearances and hand-movement delays.

**Keywords.** embodiment, myoelectric prosthesis, virtual reality, virtual hand illusion

## 1. Introduction

One definition of *embodiment* is the sense of a person's body which includes *body ownership* and *agency* [1]. That is, the feeling of ownership over one's body and being the agent of your actions, respectively. *Prosthesis embodiment* (PE) involves feeling the prosthesis being 'part of' the user, becoming more than a mechanical object, having a psychological investment into the self [2]. Unlike tool embodiment, this goes beyond a change in *body schema*, extending the body's configuration in space [3], by being incorporated into the *body image*, the thoughts and feelings towards the body [4].

Broadly, users have described their prosthesis as either feeling part of them, or as a tool but not experienced as part of their body [e.g., 2; 4; 5]. One type of upper-limb prosthetics, myoelectric prostheses, are electrically powered and controlled via electrodes measuring electromyographic (EMG) signals from muscle within the user's remaining limb. The difficulty in controlling such prostheses and their appearance have been noted by users as reasons for prosthesis rejection [6; 7], and may influence PE.

---

* Corresponding Author: A.D.Hodrien@edu.salford.ac.uk

Myoelectric prostheses are electrically powered which produce a fixed delay with fixed and variable components. The fixed delay is electromechanical. The variable delay comes from reliability of electrodes picking up the EMG signal. The latter introducing uncertainty over how the hand will behave. Thus, the predicted response of the prosthesis can be disrupted and is likely to influence embodiment as such predictions are important for the feeling of agency and body ownership [8]. This is highlighted by a version of the *Rubber Hand Illusion* (RHI), a well-established body ownership technique in psychology, where a participant moves their hand and sees a rubber hand move. Synchronised movements (as with tactile stimuli traditionally used in the RHI) can lead to ownership and agency over the rubber hand [e.g., 8] and has been replicated using virtual hands [e.g., 9].

Similar to Kalckert and Hersson [8], the delay between intended and actual movement may be one of the factors influencing whether PE occurs. Prosthetic appearance may also be a factor as it has been found to be important for a user's experience of their prosthesis [5; 10]. Supporting this, a virtual hand ownership study found that moving a human looking virtual hand produced stronger feelings of ownership than an abstract looking hand [11]. There may be an interaction between delay and appearance on embodiment. As encouraging PE has been proposed as a goal of rehabilitation [4], designers of prostheses need to understand the impact of factors on embodiment. An Immersive Virtual Reality (IVR) study is currently in preparation to systematically measure the impact of movement delays and appearance on ownership and agency of a prosthetic hand, measured via questionnaire and physiological response to a threat to the virtual hand.

## 2. Method

### 2.1. Design

A mixed design including both repeated measures and independent groups components will be used. The independent groups component involves temporal synchrony ('synchronous', 'asynchronous specific', 'asynchronous random') groups. In the synchronous group, virtual hands will move in synchrony with actual hand movements to the optimal ability of the technology, the asynchronous specific group will involve a specific delay (to be determined), and the asynchronous random group will involve a random delay between a set range of times (to be determined). The repeated measures component involves virtual prosthesis appearance (to be determined).

### 2.2. Participants

Anatomically-intact students and staff will be recruited from University of Salford.

### 2.3. Materials

1) A myoelectric prosthetic hand which opens and closes via EMG signals from electrodes measuring arm muscle flexes (see Figure 1). 2) IVR head-mounted display (HMD, e.g., *Oculus Rift* or *HTC VIVE*, see Figure 2) – for displaying a virtual

environment via first-person perspective tracking. 3) *Leap Motion* (see Figure 2) - for hand movement tracking and displaying virtually. This will be pointing downwards in a similar setup as used by [11] (see Figure 2). 4) *Galvanic skin response* (skin electrical activity) will be measured in response to a virtual threat. 5) A virtual hand ownership and agency questionnaire adapted from [8] to subjectively measure embodiment.



**Figure 1.** Myoelectric prosthetic hand.          **Figure 2.** Oculus Rift and Leap Motion from [11].

## 2.4. Procedure

Participants will be assigned to one of the temporal synchrony groups. During experiments participants will rest their arm on their leg below a table with their hand positioned below the prosthetic hand on the table. With the HMD they will have a first-person perspective looking down at a virtual prosthesis. Participants will open and close the prosthetic hand numerous times via the EMG electrodes, whilst observing the virtual hand. At the end, a virtual threat will be applied to the hand. Physiological measurement will be taken and participant behaviour filmed. After questionnaire completion the experiment will be repeated with an alternative hand appearance.

## References

[1]    M. R. Longo, F. Schüür, M. P. Kammers, M. Tsakiris, and P. Haggard, What is embodiment? A psychometric approach. *Cognition*, **107(3)** (2008), 978-998.
[2]    M. MacLachlan, *Embodiment: Clinical, critical and cultural perspectives on health and illness*, Open University Press, McGraw-Hill Education, Maidenhead, UK, 2004.
[3]    A. Mayer, K. Kudar, K. Bretz, and J. Tihanyi, Body schema and body awareness of amputees. *Prosthetics and orthotics international*, **32(3)** (2008), 363-382.
[4]    C. D. Murray. An interpretative phenomenological analysis of the embodiment of artificial limbs. *Disability & Rehabilitation*, **26(16)** (2004), 963-973.
[5]    U. Wijk, and I. Carlsson. Forearm amputees' views of prosthesis use and sensory feedback. *Journal of Hand Therapy*, **28(3)** (2015), 269-278.
[6]    E. Biddiss, and T. Chau. Upper-limb prosthetics: critical factors in device abandonment. *American journal of physical medicine & rehabilitation*, **86(12)** (2007), 977-987.
[7]    E. A. Biddiss, and T. T. Chau. Upper limb prosthesis use and abandonment: a survey of the last 25 years. *Prosthetics and orthotics international*, **31(3)** (2007), 236-257.
[8]    A. Kalckert, and H. H. Ehrsson. Moving a rubber hand that feels like your own: a dissociation of ownership and agency. *Frontiers in human neuroscience*, **6** (2012), 40.
[9]    M. V. Sanchez-Vives, B. Spanlang, A. Frisoli, M. Bergamasco, and M. Slater. Virtual hand illusion induced by visuomotor correlations. *PloS one*, **5(4)** (2010), e10381.
[10]  S. Ritchie, S. Wiggins, and A. Sanford. Perceptions of cosmesis and function in adults with upper limb prostheses: A systematic literature review. *Prosthetics and orthotics international*, **35(4)** (2011), 332-341.

[11]  F. Argelaguet, L. Hoyet, M. Trico, and A. Lécuyer. The role of interaction in virtual embodiment: Effects of the virtual hand representation. *Virtual Reality (VR), 2016 IEEE* (2016), 3-10.

# Longer the Game, Better the Sleep: Intense Video Game Playing is Associated to Better Sleep Quality and Better Daytime Functioning

Sara PERACCHIA [a,*], Stefano TRIBERTI [b], Giuseppe CURCIO [a]

[a] *Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy*
[b] *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*

**Abstract.** Sleep is a behavioural and physiological state that contributes to physical and mental health in children and adolescents. It is believed that sleep is beneficial not only for energy conservation, neuronal recuperation, and brain plasticity, which are linked to daytime brain functioning and body homeostasis, but also for growth and cognitive and psychological development. Few investigations have assessed the effects of exposure to video games on sleep. Two contrasting hypotheses can be stated; on the one hand, video games intense use may cause sleep deprivation and therefore negatively impact on overall sleep quality and daytime functioning (Hp1); on the other hand, video gaming may promote a better sleep, as other demanding and intense activities do according to literature (e.g., sports) (Hp2). The purpose of this study was to examine sleep quality and sleep-related variables in a group of hard (HG) and casual gamers (CG); the sample has been created selecting 300 participants from a bigger sample, balanced by extremely low or high video gaming, according to the Assessment of Internet and Computer Game Addiction Scale (AICA-S). Partially supporting Hp2, the HG group reported significantly better subjective sleep quality, habitual sleep efficiency and daytime positive functioning compared to CG. Taking into account the potential biases affecting measures of sleep quality based on self-report, the results are interpreted according to the possible relation between the intensity of daily activities and overall sleep quality.

**Keywords.** video game, computer game, sleep, sleep quality, video gaming, adolescence

## 1. Introduction

Today people is more and more interested and worried about possible effects of repeated and continuous exposure to video games (VG) on human life and well-being, mainly due to the enormous spreading of VG in everyday life. Such a great success of VGs industry, together with the fact that VG playing became one of the most popular recreational activities.

---

[*] Corresponding Author: sara.peracchia@graduate.univaq.it

Although also a number of positive effects of VG playing on cognitive abilities, emotions and social behaviour have been reported, a huge part of the literature is still focused on negative outcomes [1].

From a behavioural point of view, it should be taken into consideration that playing VGs may also influence sleep quality, because video gaming is often a night-time activity. Playing during the first hours of night brings to a relevant sacrifice of time of sleep. Insufficient sleep, delayed sleep-wake behaviour and sleep disturbances are common among youth and adolescents and the causes are multiple [2]. Nonetheless, until now just a few investigations explored the effects of VG exposure on sleep in general and on self-reported quantitative aspects of sleep such as quality, quantity, latency of sleep onset, nocturnal awakenings, etc.

The aim of the present study was to examine sleep quality and sleep-related variables in a group of hard (HG) and casual gamers (CG). Two contrasting hypotheses can be stated; on the one hand, VG intense use may cause sleep deprivation and therefore negatively impact on overall sleep quality and daytime functioning (Hp1), and, on the other hand (Hp2), video gaming may promote a better sleep, as other demanding and intense activities actually do (e.g., sports).

## 2. Methods

A sample of 1614 Italian adolescents (899 females; mean age 14.83±1.01 years) completed a survey in which habits of videogaming and sleep quality by means of Pittsburgh Sleep Quality Index (PSQI) [3,4] were analyzed. The Pittsburgh Sleep Quality Index (PSQI) is a self-report questionnaire used to measure the quality and patterns of sleep. It differentiates "poor" from "good" sleep quality by measuring 7 different components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month. The sample involved in the present study has been created selecting 300 participants (186 females; mean age 14.76±1.08 years) balanced by extremely low or high video gaming, according to the Assessment of Internet and Computer Game Addiction Scale (AICA-S) [5]. From this selection we created two groups of 150 participants each: the *"Hard Gamers"* (HG) group (who used to play almost all days for 4-6 hours) and the *"Casual Gamers"* (CG) group (who played occasionally less than 1 hour). The two groups were compared with respect to sleep quality.

## 3. Results

As showed by Table 1, CG group reported a significantly poorer subjective sleep quality ($p= 0.04$), poorer habitual sleep efficiency ($p= 0.04$) and greater daytime dysfunction (p= 0.02). The general sleep quality also tended to be worse in CG compared to HG group, without reaching the statistical significance ($p= 0.08$).

**Table 1.** Sleep quality components in CG ang HG  (*p=0.04; **p=0.02

|  | F (g.l.) | *P* | Eta squared | Hard Gamers (m, SD) | Casual Gamers (m, SD) |
| --- | --- | --- | --- | --- | --- |
| *Sleep quality* | 4,38 (1,298) | 0.04 | 0.02 | 1,04 (0,95) | 0,84 (0,67) |
| *Sleep efficiency* | 4,27 (1,298) | 0.04 | 0.02 | 0,65 (1,07) | 0,43 (0,75) |
| *Daytime dysfunction* | 5,58 (1,298) | 0.02 | 0.04 | 0,92 (0,76) | 1,13 (0,81) |

## 4. Discussion and Conclusions

Contrary to some previous literature evidences, being a hard gamer seems to induce a better sleep quality. Partially supporting Hp2, the HG group reported significantly better subjective sleep quality, habitual sleep efficiency and daytime positive functioning compared to CG. This effect is more dependent by amount of hours per day dedicated to videogaming rather than the number of days dedicated to such a playful activity. Taking into account the potential biases affecting measures of sleep quality based on self-report, the results are interpreted according to the possible relation between the intensity of daily activities and overall sleep quality. This could be due to greater physiological activation that occurs during video gaming in HG group, which could make deeper subsequent sleep and a better quality of self-perceived sleep.

Further research is needed, possibly involving objective measures of sleep quality, to understand the possible influences of video game playing on sleep and sleep-related well-being variables.

## References

[1] D.A. Gentile and W. Stone, Violent video game effects on children and adolescents. A review of the literature, Minerva Pediatrica **57(6)** (2005), 337-58.
[2] L. Hale and S. Guan, Screen time and sleep among school-aged children and adolescents: A systematic literature review, *Sleep Medicine Reviews* **21** (2014), 50-8.
[3] D.J. Buysse, C.F. Reynolds, T.H. Monk, S.R. Berman and D.J. Kupfer, The Pittsburgh Sleep Quality Index (PSQI): A new strument for psychiatric research and practice, *Psychiatry Research* **28(2)** (1989), 193-213.
[4] G. Curcio, D. Tempesta, S. Scarlata, C. Marzano, F. Moroni, P.M. Rossini, M. Ferrara and L. De Gennaro, Validity of the Italian version of the Pittsburgh Sleep Quality Index (PSQI), *Neurological Sciences* **34(4)** (2013), 511-519.
[5] K. Wölfing, K.W. Müller and M. Beutel, Reliability and Validation of the Assessment of Internet and Computer Game Addiction Scale (AICA-S), *Psychotherapie Psychosomatik Medizinische Psycho*logie **61(5)** (2011), 216-24.

# Web-based, self-help intervention for Adjustment Disorders: acceptance and usability.

Iryna RACHYLA[a*], Soledad QUERO[a,b], Marian PÉREZ-ARA[a], Mar MOLÉS[a], Daniel CAMPOS[a] and Adriana MIRA[a]

[a] *Universitat Jaume I*
[b] *CIBER de Fisiopatología de la Obesidad y Nutrición (CIBEROBN)*

**Abstract.** Despite having proved their efficacy, Internet-based interventions (IBI) have not yet been implemented in health care settings. The acceptability of these interventions may be one key barrier. The present work aims to assess the acceptability and usability of a Web-based self-help intervention (TAO) for Adjustment disorders (AD) among 7 patients with AD and 15 clinicians. The intervention was well accepted and described as user-friendly by both samples. Furthermore, results of this work suggest that certain aspects should be considered during the development of IBI in order to promote adherence and achieve the desired changes. To our knowledge, this is the first work to explore specific features of an IBI that might impact users' satisfaction and adherence.

**Keywords.** internet-based self-help interventions, acceptance, usability, adherence, adjustment disorders

## 1. Introduction

Research has proven that Internet-based interventions (IBI) are not only an effective way to disseminate psychological interventions [1], but they also provide advantages over traditional face-to-face therapy [2]. However, the low acceptability of IBI may be one of the reasons for the lack of implementation of these interventions in clinical settings [3]. The present work assesses the acceptability and usability of a Web-based self-help intervention (TAO) for Adjustment disorders (AD) among patients and clinicians. AD is one of the most prevalent psychological disorders [4], which causes great suffering, including suicidal thoughts and behaviors [5]. It is essential to develop evidence-based, well-accepted interventions, able to reach everyone who needs them.

---
* Corresponding Author: rachyla@uji.es

## 2. Methods

### 2.1. Participants

Seven patients with AD [6] and fifteen clinicians (12 clinical psychologists and 3 master students) voluntarily agreed to participate in the study and signed the informed consent form. The mean age of the patients (4 men and 3 women) was 30.57 years (SD=11.18). The mean age of the clinicians was 31.27 (SD=4.43). None of them were familiarized with TAO. However, five of the participants had wide experience in the development and use of internet-based interventions.

### 2.2. Measure

A survey to examine users' opinion on TAO was specifically designed for this pilot study. The survey was structured in three parts, each of them focusing on different aspects of the online-based intervention. In the first part, 10-point Lickert scales were used to assess different characteristics and audiovisual resources included in TAO. Open answer questions were used in order to collect qualitative data. The second part included *System Usability Scale* [7] to explore the user-friendliness of TAO. Finally, the third part explored the users' attitude and opinion towards an internet-based, self-help intervention like TAO.

### 2.3. TAO: Adjustment Disorders Online

TAO is a self-applied online treatment program for AD structured in 7 modules which includes different multimedia resources: texts, videos, illustrations, and interactive exercises. It is a computerized version of a CBT protocol including the following therapeutic components: psychoeducation, techniques to manage negative emotions, exposure, problem solving techniques, acceptance and elaboration of the stressful event, positive psychology strategies, and relapse prevention. The system presents a simple interface which facilitates its use even to people who are not skilled in computers.

### 2.4. Procedure

Participants had approximately an hour to freely explore module 3 of the TAO program. Afterwards, they completed the survey described above.

## 3. Results

Opinions on TAO module and the overall internet-based intervention for AD are shown in Tables 1 and 2, respectively. The intervention was well-received by both samples.

**Table 1.** Means and standard deviations of participants' opinion on TAO module.

|  |  | Patients | Clinicians |
|---|---|---|---|
| Usefulness of the program content | To help patients with AD | 7.43 (1.40) | 9.20 (1.01) |
|  | To treat other psychological disorders | 7.71 (1.25) | 8.47 (1.69) |
| Characteristics of the program content | Logical | 8.57 (0.79) | 9.47 (0.52) |
|  | Boring and/or difficult | 2.86 (2.55) | 2.33 (2.50) |
|  | Pleasant and/or interesting | 7.86 (1.07) | 7.53 (1.51) |
|  | Clear and/or understandable | 8.14 (1.57) | 8.93 (0.80) |
|  | Need for professional assistance | 2.00 (1.30) | 3.93 (3.08) |
| Overall program rating | Module 3 of TAO program | 8.00 (0.82) | 8.67 (0.72) |
|  | Multimedia contents | 8.29 (1.38) | 8.13 (0.99) |
| Usefulness of the included audiovisual resources | Texts | 8.14 (1.46) | 8.33 (1.11) |
|  | Images | 8.14 (1.07) | 8.33 (1.40) |
|  | Illustrations | 7.71 (1.25) | 8.47 (1.30) |
|  | Videos | 5.57 (1.40) | 8.93 (1.03) |

**Table 2.** Means and standard deviations of participants' opinion on TAO.

|  | Patients | Clinicians |
|---|---|---|
| Helpful | 7.86 (1.86) | 8.53 (0.99) |
| Useful | 8.00 (2.00) | 8.13 (2.10) |
| Would use | 7.71 (1.98) | 8.13 (1.51) |
| Would recommend | - | 8.80 (1.32) |

The usability of the system was scored with 88.93/100 (SD=5.37) by patients and 91.67/100 (SD=6.03) by clinicians. Finally, all participants highlighted the inclusion of videos, clear and well-structured contents, simple terminology, and availability of examples as strengths of the intervention. Interactivity and the amount of written information were identified as aspects that could be improved.

## 4. Discussion

TAO was well accepted and described as user-friendly by both patients and clinicians. Different features of TAO were detected as adherence enhancers. Inclusion of relevant therapeutic contents does not seem to be enough to achieve the desired clinical changes. Therefore, certain aspects should be considered during the development of IBI.

To our knowledge, this is the first work to explore specific features of an IBI that might impact on the users' satisfaction and adherence. Further study is needed in this field in order to be able to fully leverage the potential of IBI as a therapeutic tool.

## References

[1] G. Andrews, P. Cuijpers, M.G. Craske, P. McEvoy, and N. Titov, Computer therapy for the anxiety and depressive disorders is effective, acceptable and practical health care: a meta-analysis, *Plos One* **5** (2010).

[2] R.M. Baños, V. Guillén, A. García-Palacios, S. Quero, and C. Botella, Las nuevas tecnologías en el tratamiento de los trastornos de ansiedad, *Informació psicològica* **102** (2011), 28-46.

[3] P. Musiat, P. Goldstone, and N. Tarrier, Understanding the acceptability of e-mental health - attitudes and expectations towards computerised self-help treatments for mental health problems, *BMC Psychiatry* **14** (2014).

[4] S.C. Evans, G.M. Reed, M.C. Roberts, P. Esparza, P. Ritchie, and M. Maj, Psychologists' perspectives on the diagnostic classification of mental disorders: Results from the WHO-IUPsyS Global Survey, *International Journal of Psychology* **48** (2013), 177-193.

[5] P. Casey, F. Jabbar, E. O'Leary, and A. M. Doherty, Suicidal behaviours in adjustment disorder and depressive episode, *Journal of Affective Disorders* **174** (2015), 441-446.

[6] American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders: DSM-V*, American Psychiatric Association, Washington, 2013.

[7] J. Brooke, *System Usability Scale (SUS): A Quick-and-Dirty Method of System Evaluation User Information*, Digital Equipment Co Ltd., Reading, 1986.

# The Effect of Immersion and Presence in a Virtual Reality Public Speaking Task

Luke WILSDON[a]* and Chris FULLWOOD[a]
*Institute of Psychology, University of Wolverhampton*

**Abstract.** Three virtual environments (with varying immersive features) of a small teaching classroom were tested to determine whether higher graphical fidelity (immersion) improved public speaking anxiety (PSA) after participating in a mock public speaking task. The UWIST Mood Adjective Checklist (UMACL) and Personal Report of Public Speaking Anxiety (PRPSA) were completed before and after the task and from the perspective that participants were about to engage in a real life public speech. The iGroup Presence Questionnaire (IPQ) was also completed. Perceived presence significantly differed between low, medium and high immersion conditions. PSA did not improve after participating in the task and increased immersion did not reduce PSA. Participants in all conditions however experienced a positive mood shift after participating in the public speaking task.

**Keywords.** Virtual Reality, Immersion, Presence, Public speaking, objective elements

## 1. Introduction

Public Speaking Anxiety (PSA) is a sign of affective dysregulation, stemming from individuals assigning overactive anxiety responses to innocuous stimuli [1]. Although historically treatment of PSA has relied on therapist involvement, technological advancements allow sufferers to seek support at their own convenience. In recent years, there has been a massive growth in Internet-based treatments for various health conditions that is indicative of our rapidly changing technological times. Delivering therapy via the Internet presents numerous advantages, including placing fewer demands on therapists and overcoming geographical barriers [2]. One technology which has only recently become consumer-accessible is Virtual Reality (VR).

Key factors which impact the user experience of VR are immersion and presence. Immersion occurs when part or all of a person's perception is directed towards objects, environments or people created by a human technology and perception is diverted from the real world. Immersion is considered to be objective and measurable, which suggests that it can be manipulated [3]. This begs the question: what is the objective level of immersion necessary to produce a therapeutically useful result? Presence is the "subjective psychological response to a VR system" [4] and can be thought of as the experience of perceiving a reality mediated by technology while failing to accurately acknowledge the role of the technology.

The current study aimed to develop three virtual environments of a teaching classroom with emotionally-neutral audience members, whilst manipulating immersion features. The environments were designed to alleviate mild PSA using the CBT concept of exposure therapy. It was predicted that: H1) Participants will experience greater reduction in PSA in higher immersive VR environments, H2) participants will experience a greater sense of presence in VR environments with higher immersion.

---
\* Corresponding Author: L.Wilsdon@wlv.ac.uk

### 2.1. Method & Materials

An opportunity sample of University of Wolverhampton students were recruited with ten participants in each condition (9 male, 31 female) and aged 19-47 (M = 25.5, SD = 8.65). PSA was measured using the PRPSA [5], a measure of mood was obtained using the UMACL [6] and presence was measured using the IPQ [7].

### 2.2. Procedure

Participants first completed the PRPSA and UMACL. They then participated in a 5-minute mock public speaking task about their experiences of their first week at University to a virtual audience while wearing Tepoinn 3D glasses. The virtual environment was delivered using the Samsung Galaxy S7 Edge Smartphone. After completing the task participants completed the IGP, PRPSA and UMACL. The real-life (control) condition followed the same procedure but instead participants stood and delivered the speech to the researcher.

### 2.3. Environment construction

Technical aspects to maximise immersion were considered and manipulated across the three VR conditions [8]. Resolution, pixel density and average frames per second were maintained across the three environments. Baked global illumination and ambient occlusion lighting methods were implemented in only the high immersion condition and the corresponding light maps had a value of 35x1024x1024. Eight light probes were utilised in the high condition with a Texels per unit value of 300. No light probes or units were included in the low or medium condition. The SetPass calls for low, medium and high were 1, 28 and 104 respectively. The triangles present in low, medium and high conditions were 35.2k, 79.1k and 79.1k respectively.

### 3.1. Results

A one-way between groups ANOVA was conducted to compare the effect of the three VR conditions (low/medium/high) on spatial presence, involvement, realness and general presence (IPQ measures). There were significant effects of spatial presence (F (2, 27) = 9.68, $p<0.01$), realness (F (2, 27) = 8.80, $p<0.01$) and general presence (F (2, 27) = 4.08, $p< 0.05$), but not involvement. A post-hoc comparison using the Bonferroni correction indicated that the mean score for spatial presence in the low condition (M = 11.3, SD = 6.18) differed from medium (M = 20.8, SD = 4.87) and high conditions (M = 20.6, SD = 5.42) at $p<0.01$ for both comparisons. The mean score for realness in the low condition (M = 7.7, SD 3.27) differed from the high condition (M = 14, SD = 2.26) at $p<0.01$. The mean score of general presence in the low condition (M = 2.8, SD = 1.99) differed to the medium condition (M = 4.6, SD = 1.35) at $p<0.05$.

A one-way mixed ANOVA examined the effects of condition (low/medium/high immersion and face-to-face control) on PSA (measured using PRPSA) before and after the task. There was no significant within-groups main effect of PSA before and after the task, no significant interaction between condition and PSA before and after the task and no significant between-groups effect of condition.

A one-way mixed ANOVA was conducted on the three subscales of UMACL (hedonic tone, energetic arousal, tense arousal). There was a significant within-groups main effect of hedonic tone before and after (F (1,36) = 5.05, $p< 0.05$) with hedonic tone increasing in all conditions. The mean values before were (9.5, 10.5, 10.5, 9) and the mean values after were (10.4, 11.1, 11.8, 10.2) for "control, low, medium and high" conditions respectively. There was no significant interaction between condition and time of measurement (before/after) for Hedonic Tone. There were no main effects or interactions for all other scales of the UMACL (energetic arousal and tense arousal).

### 4.1. Discussion

Spatial presence was significantly higher in the medium and high conditions compared to the low condition. The low condition was built with limited technical features and a very unrealistic look, to determine what level of immersion would be too weak to produce presence. These findings support the importance of future research to focus on elements of presence and how to maximize the user experience. The medium condition was built as an attempt to load onto spatial presence, along with a progressive increase in technical elements; the room was block-colored with no textures but colored as to highlight the differences in space. The medium environment achieved a significantly higher result for spatial and general presence than the low condition. The high environment was built with the goal of producing the most texturally real-to-life environment with the inclusion of more sophisticated technical elements given the time and computing power constraints present in the current study. The results did not reflect these ambitions however, with realness in the medium and high conditions being numerically different but not significantly. Hedonic tone increased significantly in all conditions indicating that participants felt a more pleasant mood after completing the task which is encouraging for the efficacy of this approach. Manipulating objective elements produced a subjective psychological response change; however further longitudinal research with increased exposure to the public speaking task is needed to determine whether this response change can influence PSA.

**References**

[1]   T. Jr, Clevenger, A definition of stage fright. *Communication Studies*, **7**(1) (1955), 26-30
[2]   E. Hedman, B. Ljótsson, V. Kaldo, H. Hesser, S. Alaoui El, M. Kraepelien, and G. Andersson, Effectiveness of internet-based cognitive behavior therapy for depression in routine psychiatric care. *Journal of Affective Disorders,* **155** (2014), 49-58.
[3]   M. Slater, A note on presence terminology. *Presence Connect,* **3**(3) (2003), 1-5.
[4]   M. Slater, Measuring presence: A response to the Witmer and Singer presence questionnaire. *Presence: Teleoperators and Virtual Environments,* **8**(5) (1999), 560-565.
[5]   J. C. McCroskey, Measures of communication-bound anxiety. *Speech Monographs*, **37** (1970), 269-277.
[6]   G. Matthews, D. M. Jones, and A. G. Chamberlain, Refining the measurement of mood: The UWIST mood adjective checklist. *British Journal of Psychology*, **81**(1) (1990), 17-42.
[7]   T. Schubert, F. Friedmann, and H. Regenbrecht, The experience of presence: Factor analytic insights. *Presence: Teleoperators and Virtual Environments,* **10**(3) (2001), 266-281.
[8]   M. V. Sanchez-Vives, and M. Slater, From presence to consciousness through virtual reality. *Nature Reviews Neuroscience,* **6**(4) (2005), 332-339.

# Subject Index

# Author Index