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German summary

Auf Grund der fortschreitenden Globalisierung und fortschrittlichen Massenproduktionsweisen, sieht sich die Weltbevölkerung mit einem wachsenden Problem von zurückgehenden Ressourcen und sozialen Konflikten konfrontiert. Auf politischer Ebene wird versucht, diese Herausforderung mithilfe von neuen Anreizen und Gesetzen zu bewältigen, welche meist auf Großunternehmen ausgerichtet sind. Allerdings wird an dieser Stelle mit dem nachhaltigen Gründer ein zentraler Akteur übersehen. Im Gegensatz zu größeren Unternehmen, welche meist inkrementelle Verbesserungen in Richtung Nachhaltigkeit vornehmen, können neu gegründete Startups in nachhaltigen Nischen mehr experimentelle und möglicherweise disruptive Ansätze wagen. Zudem besitzt der nachhaltige Gründer das Potenzial seine Lösungen zu skalieren, da er auf Gewinnerzielung abzielt und sich so von der Organisationsform der *Non-Governmental Organization* (NGO) abgrenzt. Nachhaltigkeit ist in diesem Kontext als gleichzeitige Erwirtschaftung von sozialen, ökologischen und ökonomischen Leistungen über den Verlauf der Zeit zu verstehen. Die vorliegende Dissertation nimmt sich der Person des nachhaltigen Gründers an und analysiert dessen Entscheidungsverhalten in drei Artikeln aus verschiedenen Perspektiven.

Kapitel zwei untersucht aus der Perspektive der psychologischen Forschung und auf Basis der *Theory of Planned Behavior* die Ursachen für die Intention ein nachhaltiger Gründer zu werden. Basierend auf der Literatur zu nachhaltigem Unternehmertum werden sechs Hypothesen entwickelt und mit Hilfe von Conjoint Analysen und Strukturgleichungsmodellierung überprüft. Es stellt sich heraus, dass positive Einstellungen gegenüber Unternehmertum und Nachhaltigkeit einen positiven Einfluss auf die nachhaltigen Gründungsintentionen haben. Es besteht zusätzlich ein verstärkender Moderationseffekt zwischen diesen beiden Einstellungen. Basierend darauf kann angenommen werden, dass im Vorfeld einer nachhaltigen Gründung ein Kupplungsprozess

der verschiedenen Identitäten des Individuums stattfindet. Soziale Normen im persönlichen Umfeld des potenziellen Gründers sind ebenfalls relevant für dessen entsprechenden Intentionen. Während unternehmerische Normen einen direkten positiven Effekt ausüben, ist der Einfluss von nachhaltigen Normen eher von passiver Natur. Obwohl kein signifikanter Pfad zwischen der erklärenden Variable *empfundene Kontrolle über Verhalten* und der abhängigen Variable identifiziert werden konnte, fand sich in der Literatur ein entgegengesetztes Verhältnis zwischen jeweils sozialen und ökologischen Intentionen und der empfundenen Kontrolle. Neben dem inhaltlichen Beitrag, wird in diesem Artikel die Methodik der Conjoint Analyse im Bereich des nachhaltigen Unternehmertums vorgestellt und angewandt.

Das Kapitel drei nähert sich der Thematik des nachhaltigen Unternehmers aus mikroökonomischer Sicht. Auf Basis eines Prinzipal-Agenten Modelles wird untersucht, welche Auswirkung Reputation in einem Zwei-Aufgaben Umfeld hat. Ziel ist es, unter der Annahme der Aufwandsabwägung eines Unternehmers zwischen nachhaltiger Zielverfolgung und Profitmaximierung die optimalen Aufwandslevels und Anreiz-strukturen zu bestimmen. Hierbei wird vorausgesetzt, dass nachhaltige Aktionen mit einem positiven Reputationseffekt behaftet sind und somit einen zusätzlichen Nutzen für den Unternehmer schaffen. Es zeigt sich ein Verdrängungseffekt von Anreizen für nachhaltige Bemühungen von den nachhaltigen Zielen zur Profitmaximierung. Dies bedeutet, dass der Unternehmer bei Zahlung von Anreizen für das reputationsbehaftete Ziel sich nicht mehr in der Lage sieht, seine intrinsische Motivation zu signalisieren. Daher verlagert er seinen Aufwand hin zu der rein ökonomischen Aufgabe. Basierend auf diesem Ergebnis wird die optimale Anreizstruktur für einen Gesellschaftsvertrag mit dem Unternehmer für beide Aufgaben bestimmt. Die erhaltenen, abstrakten Ergebnisse erweisen sich als zu komplex, um eine direkte Wirkungsweise der Anreize zu zeigen. Aus diesem Grund werden mehrere

nummerische Beispiele als Veranschaulichung der Wirkungsweisen verschiedener Modellparameter auf die optimale Anreizausgestaltung aufgeführt. Die Beispiele dienen als Grundlage für Propositionen über die Wirkungsweisen der genannten Parameter.

Im vierten Kapitel dieser Arbeit ist nicht der nachhaltige Gründer das Untersuchungsobjekt, sondern die neurophysiologischen Ursachen von altruistischem, prosozialem und kooperativem Verhalten. In einer systematischen Literaturübersicht werden die Ergebnisse der neuroökonomischen Forschung im Zeitraum von 2011 bis 2016 in Bezug auf vier ökonomische Spiele dargestellt. Neben der Vorstellung des Diktator-, Ultimatum-, Vertrauens- und Public Good-Spiels und verbundenen, psychologischen Konzepten, werden im Vorfeld auch Ergebnisse über ausgesuchte Gehirnregionen aus dem Zeitraum vor der Untersuchungsperiode präsentiert. Dies dient als Grundlage für die darauf aufbauende deskriptive und inhaltliche Analyse der aktuelleren Ergebnisse.

Die Dissertation schließt mit einer Übersicht der Resultate der einzelnen Kapitel und weiterführenden Gedanken. Zusätzlich werden mögliche, zukünftige Forschungsfelder aufgezeigt und ein Aufruf an die Forschungsgemeinschaft für bessere Anreize für interdisziplinäre Arbeiten formuliert.

Table of contents

List of figures

List of tables

Abbreviations

ACC	-	Anterior cingulate cortex
AIC	-	Anterior insula cortex
APFC	-	Anterior prefrontal cortex
CBC	-	Choice-based conjoint
CE	-	Certainty equivalent
CFI	-	Comparative fit index
CSES	-	Core self-evaluation scale
CSR	-	Corporate social responsibility
DBD	-	Disruptive behavior disorder
DLPFC	-	Dorsolateral prefrontal cortex
DMPFC	-	Dorsomedial prefrontal cortex
EEG	-	Electroencephalography
ERP	-	Event-related potentials
(f)MRI	-	(functional) Magnetic resonance imaging
(f)MRT	-	(funktionelle) Magnetresonanztomographie
IF	-	Impact factor
LEN	-	Linear contracts, exponential utilities, normal distribution
MPFC	-	Medial prefrontal cortex
NAcc	-	Nucleus Accumbens
NGOs	-	Non-governmental organizations
OFC	-	Orbitofrontal cortex
OLS	-	Ordinary least squares
OPC	-	Oppicital cortex
PCC	-	Posterior cingulate cortex
PhD	-	Doctor of Philosophy
PIC	-	Posterior insula cortex
PLS	-	Partial least squares
PPC	-	Posterior parietal cortex
PRISMA	-	Preferred reporting items for systematic reviews and

		meta-analyses
PSED	-	Panel study of entrepreneurial dynamics
RMSEA	-	Root mean square error of approximation
RLH	-	Root likelihood
rTMS	-	Repetitive transcranial magnetic stimulation
SEM	-	Structural equation models / modelling
SJR	-	Scientific journal rankings
SMA	-	Supplementary motor area
SNIP	-	Source normalized impact per paper
SRMR	-	Standardized root mean square residual
STS	-	Superior temporal sulcus
tDCS	-	Transcranial direct-current stimulation
TPB	-	Theory of planned behavior
TPJ	-	Temporal parietal junction
VMPFC	-	Ventromedial prefrontal cortex
VLPFC	-	Ventrolateral prefrontal cortex

1 Introduction

In this initial chapter, the motivation for this dissertation is laid out, and an introduction for sustainable entrepreneurship is given. Subsequently, I present the methods that have been applied throughout the thesis and explain in detail the benefits and restrictions of choice-based conjoint analysis and of covariance-based structural equation modelling. At the end, I illustrate the structure of the thesis, define the research goals, and explain the perspectives on sustainable entrepreneurship that are covered by the articles included in this work.

1.1 Motivation for research

In spite of increases in economic wealth and continued enhancements in the quality of life, which had their roots in globalization and the development of mass production methods over the past decades, these trends have also had an immensely negative impact on social and ecological factors (Larsen and Ballesteros, 2014; World Commission on Environment and Development., 1987). The consequences have been far-reaching, have affected several areas of the world's ecological systems, and have posed a threat to human social systems. Sheperd and Patzelt (2011) have listed a sample of cases where the severe exploitation of natural resources has had a negative effect on human society in the long run. They have identified certain procedures that negatively affect the supply for basic human needs: such as extensive mining activities, which have altered surfaces and thus rendered them unusable for agricultural purposes, and overfishing, which has diminished the fish population. While the two aforementioned cases clearly lead to scarcity in food resources, the reduction of marine biospheres and the resulting reduced water purification capacity has also limited the already insufficient drinking water supplies of the world. The current rate of usage of the

world's resources is not sustainable. In the last four decades, the consumption patterns of humanity have changed dramatically, and they are now a far stronger driver of overconsumption than population growth (Toth and Szigeti, 2015). The resource extraction per capita in North America was around 68 kilograms per day in 2000; Europe and Latin America used approximately 40 kilograms per day per individual (Giljum et al., 2009). According to Toth and Szigeti (2015), in 2008 the level of consumption exceeded the capacity of resources the world can supply by 52 percent. Bearing in mind that resource extraction in Asia in the year 2000 was 14 kilograms per day per capita (Giljum et al., 2009) and is likely to approach the levels of other industrial countries, one can see that consumption patterns and overconsumption constitute a tremendous challenge. While most political leaders have agreed upon the imperative of sustainable development in their countries, the pledges to induce the necessary changes in production and consumption patterns have often remained at the level of rhetoric (Jeffrey, 2005).

York and Venkataraman (2010) have identified four particular incentives that have been presented by the scientific literature to tackle environmental issues. These are: regulatory actions (laws and subsidies), stakeholder actions (including non-governmental organizations and individual activists striving for preservation of natural resources), corporate social responsibility (the concept of responsibility of economic actors for social or environmental problems caused by them), and competitive advantages (innovation opportunities originating from social and environmental issues resulting in cost reductions or profit growth). Besides the macro-economic perspective of governmental guidance for market systems, the micro-economic view that analyzes the potential of private actors to address sustainability challenges has garnered considerable attention from the scientific community (Kuckertz and Wagner, 2010). In most scholarly contributions, the role of large-sized corporations and their development towards more sustainable behavior has been the

main aspect of exploration. In many cases, these firms have been thrust towards more environmental practices by the aforementioned regulations or stakeholder actions. The extent to which corporations have actively pushed in this direction to obtain competitive advantages over their competitors has been rather small (Esty and Winston, 2009; York and Venkataraman, 2010). In addition, the movements of these players have been incremental in the majority of circumstances and have not set free the potential of innovative concepts that have a radical impact on sustainability issues (Cohen and Winn, 2007). Yet the role of those market participants who are known to pursue risky opportunities, namely entrepreneurs, has only come to attention recently (York and Venkataraman, 2010).

Researchers have called for the entrepreneur to sit at the steering wheel so as to able not only to sustain ecosystems, global climate, flora and fauna, water supply, and diversity of species but also to develop education, wealth, public health, and the general well-being of humanity (Cohen and Winn, 2007; Dean and McMullen, 2007; Hall et al., 2010; Kuckertz and Wagner, 2010; Shepherd and Patzelt, 2011). The reasoning behind this is that entrepreneurial ventures are more likely than other economic players to develop disruptive innovations that have the ability to reach the aforementioned goals (Kuckertz and Wagner,

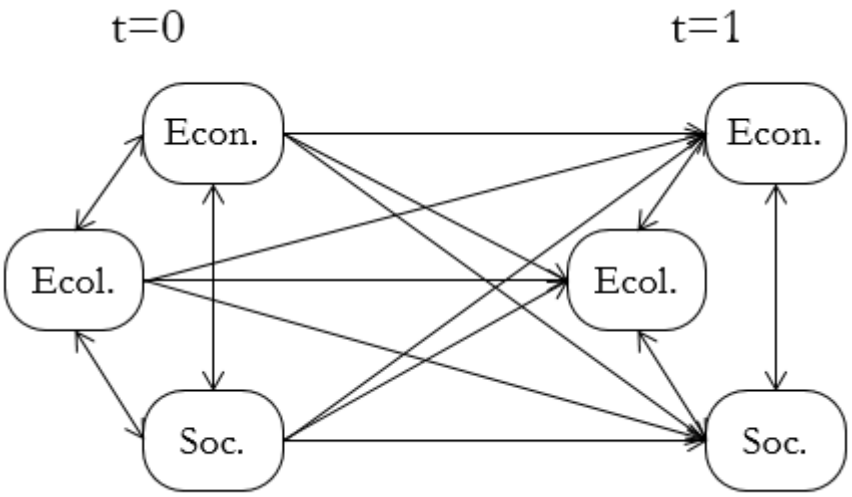

Figure 1 The concept of sustainability, including four dimensions

2010). In comparison to non-governmental organizations, entrepreneurs can create economic gains for economies, investors, and themselves that create the possibility to scale their solutions up to the point where they are able to change human behavior. To be called "sustainable", entrepreneurship needs to consider all, sometimes contradictory, directions in value creation to provide benefits for an entrepreneur and the systems influenced by a venture (Cohen and Winn, 2007; Parrish and Foxon, 2008; Wheeler et al., 2005). An often cited concept in regard to sustainable development is the so-called *triple bottom line* (Elkington, 1997; Slaper and Hall, 2011) that encompasses a benefit creation in economic, ecological, and social senses. The idea of sustainability contained in this dissertation is depicted in **Figure 1**. Besides the *triple bottom line*, time is added as an additional dimension that describes the entanglements between the three components of sustainability. While the dimensions influence each other at a given point in time, they also have an impact on the future manifestations of all three dimensions. The aim of this work is to shed light on the interaction between entrepreneurial action and sustainable development. In the following section, the methods applied to achieve this aim are explained in detail.

1.2 Applied research methods

1.2.1 Choice-based conjoint analysis

Conjoint analysis enables the researcher to retrieve information on decision-making processes in a so-called *decompositional* manner (Shepherd and Zacharakis, 1997). The individual is presented with a set of stimuli that represent an already composed object with certain attributes. The researcher then has three options for gathering the respondent's preferences: rating each stimulus on a predefined scale, ranking all stimuli in a preferred order, or choosing the most preferred stimulus out of a subset of stimuli. Each of these options has advantages and disadvantages (Green et al., 2001; Green and Srinivasan, 1990).

The option with the highest rate for obtaining information is the rating-based method as one can determine incremental differences in the preferences of the individual. Moreover, it also has the advantage of a concise survey layout. However, the cognitive effort for the respondent is the highest for this method, and the evaluation is relatively distant from reality. Usually, an individual evaluates a restricted set of choice options in comparison to each other, and each item has to be rated specifically in comparison to all potential others. A ranking-based measurement of preferences yields the second highest rate of information but has an unrealistic underlying model of utilities since it makes the assumption of equal distance in utility between choice options. Even though some of this evaluation process' complexity is removed in comparison to the rating-based method, the cognitive stress is still high. The final measurement approach, choice-based analysis, is the closest to reality. A subset of stimuli is presented to the individual, who has to choose which option seems most desirable. This is similar to real-life choice-based situations a given person is already accustomed with. The downside of this approach is the relatively limited amount of information retrieved from each choice. To enable the backward induction of the utility function of the individual, a relatively high number of choice sets needs to be evaluated, which, in consequence, leads to a long questionnaire. Based on the ratings or choices, the researcher can estimate the importance of the attributes that describe the stimuli presented and can attach utility ratings to individual manifestations of the attributes.

1.2.2 Covariance-based structural equation modelling

Structural equation modeling (SEM) employs a set of statistical procedures to reveal the underlying causal relationships between variables. Variables can either be observed or latent, and they can be correlated with each other. In comparison to multivariate regression analysis, these capabilities improve the ability to analyze complex causal systems (Markus, 2012). Structural equation modeling comprises two sub-models: the path model and the

measurement model. The path model determines the relational coherences between the observed and latent variables included in a system. The measurement model describes the composition of the independent and dependent variables, which can be composed of either single-item measures (observed) or multi-item measures (latent). To determine the items' loading factors that constitute the latent constructs, factor analysis is utilized (Gefen et al., 2000).

The two major approaches in SEM are partial least squares (PLS) and covariance-based analysis. For the first step, a decision needs to be made as to which method is most suitable for the estimation of the model at hand. While PLS is targeted at the optimal level of prediction of the dependent variables, which is comparable to a multivariate linear regression model, covariance analysis aims for the best possible replication of the empirical variance-covariance matrix (Markus, 2012). In addition, covariance analysis encompasses the factor analysis of the latent variables and the analysis of the path estimates, that describe the relationships between the model variables, simultaneously and considers all parameters included in the model. The main differences between the two approaches are threefold. The method of partial least squares enables the application of formative and reflective measurement models, whereas covariance analysis only allows reflective modeling. Formative models follow the supposition that the observed items determine the manifestation of the latent variable, and the opposite is true for reflective models. Here, the latent construct is an underlying cause for the manifestations of the measured items (Gefen et al., 2000). To illustrate this coherence more clearly, one may ask two simple questions. Does the elimination of one indicator item change the conception of the latent construct (for formative models this is true, for reflective ones it is not)? Does a change in one of the indicator items affect the manifestation of the other items (there are no changes in a formative model, but the items in reflective models are linked to each other through the

underlying idea of the latent construct)? The ways in which reflective models are estimated differ for covariate analysis and PLS. On the one hand, covariate analysis follows the approach of factor analysis, which is coherent with the underlying principle that the latent variable is the basis of reflective modeling; on the other hand, PLS employs principal components analysis to determine the items' loadings on the latent construct, which is closer to the idea of formative models.

A main distinction between these two estimation methods is the decomposition of variances into factor variance and error variance. Principal components analysis does not make a distinction between these two variance types. Consequently, the estimation of the path model in the PLS structural equation model is biased. In contrast, the factor analysis approach permits the differentiation of these two variance types and determines the path of coefficients solely on the basis of factor variance. Second, the aforementioned simultaneous estimation of measurement and the path model in covariate analysis makes it possible to optimize the model parameters to a global optimum. Partial least squares, in comparison, estimates each model subsequently: it initially identifies the optimal factor loadings of the latent variables and then estimates the path coefficients on the basis of the latent constructs calculated. As a result, each estimation step is optimized locally, and the comprehensive involvement of all aspects is not given. Third, founded on the different approaches of simultaneous and subsequent estimation, the goodness-of-fit criteria differ between the two models. For PLS, the main target is the minimization of prediction errors in each step of the optimization, and the fit criteria measure the accomplishment of this goal; the application of goodness-of-fit indicators in the case of covariate analysis allows for holistic assessment of the validity of the model. Due to this property, a comparison between models is possible. Something that PLS does not afford (Gefen et al., 2000).

1.2.3 Principal agent modelling

An often-applied methodology to analyze the relationships and behavior in cooperation settings between economic parties is principal agent modelling. The basic setup consists of a principal, who devolves a task onto an agent, who then is rewarded by means of a previously agreed-upon contract and executes a certain task for the principal. Eisenhardt (1989) has listed two issues that researchers try to resolve with the contract optimization. On the one hand, the interests of the principal and the agent are divergent and need to be aligned to come to an optimal solution for both parties; on the other hand, the effort exerted by the agent is not observable for the principal, thus making it difficult to directly reward the agent's actions. Additionally, both parties may differ in terms of risk aversion, which will result in discrepancies in the best behavior of the agent. In the above-mentioned so-called LEN model, several assumptions are made about the players included in the model, the contract, and the variables.

In this setup, ***L****inear contracts* are available; this means that the principal can pay a fixed sum and/or a variable income based on a selected signal. The players in the model do have ***E****xponential utilities*; this results in a constant absolute risk aversion. And random variables are ***N****ormally distributed* (Kräkel, 2010). The typical objective of such studies is to minimize the difference between the so-called *first-best solution* and *second-best solution*. The *first-best solution* consists of choices that optimize the outcome of the added-up benefits of all parties involved. In many cases, the result of optimal welfare can only be reached through the assumption of complete information, no hidden actions, and no uncertainty. This first-best solutions is then compared to the *second-best solution*, the choices made by the parties involved when facing hidden information, hidden actions, and uncertainty, to improve regulatory settings that guide the incentive schemes (Bolton and Dewatripont, 2005).

1.2.4 PRISMA systematic literature review

The **P**referred **R**eporting **I**tems for **S**ystematic Reviews and **M**eta-**A**nalyses (PRISMA) is a guideline that contains a 27-item checklist and a four-phase flow diagram to enable researchers to conduct consistent and comprehensive literature reviews (Liberati et al., 2009). It was mainly compiled in the context of medical studies but provides valuable guidance for other research areas. By utilizing the PRISMA reporting scheme, one aims at ensuring the traceability and replicability of the searching procedure and the reporting of results. Besides that, the application should rule out a selection bias of included studies or, at least, should enable the reader to reconstruct such a bias (Moher et al., 2009). The PRISMA Statement consists of two documents. The flow diagram gives an overview of four different phases (identification, screening, eligibility, and inclusion) of the search and selection processes. The checklist indicates several items that should be included in the article to ensure thoroughness in the reporting of results. The list entails some items that are specifically designed to cover the requirements of meta-analyses and that, therefore, are negligible when conducting a literature review.

1.3 Thesis structure and main research goals

The aim of this dissertation is to reassess the salutary potential of sustainable ventures and to determine the role that the individual and personal characteristics play in the process of not only becoming self-employed but also pursuing goals that are based on the realms of sustainability. The approach applied in this work is similar to the abovementioned *triple bottom line*. On the analytical as well as the methodological level, I employ three different perspectives on the issue.

The remainder of this work is structured as follows. The dissertation consists of three independent studies. In Chapter Two, a psychological perspective is utilized to identify the

antecedents of sustainable venturing intentions on the basis of the theory of planned behavior. I build on a literature overview of the research stream to develop six hypotheses and subsequently test them with conjoint analysis and SEM. Chapter Three is dedicated to the development of a two-task LEN model and, therefore, approaches sustainable entrepreneurship from a behavioral-economic perspective. I combine two fundamental microeconomic studies to analyze the incentive structures between the general society and an individual entrepreneur. The entrepreneur faces two tasks: an economic profit creation and the pursuit of sustainable goals, of which the latter does have a positive reputational effect. Starting from a model that implements the two tasks and the reputational utility, I derive the optimal levels of effort for each task for the entrepreneur and the optimal incentives for each task for society. Additionally, numerical examples are presented to illustrate the influence of several factors included in the model on the optimal effort levels and incentives. In Chapter Four, the most abstract level of analysis is applied. The object of investigation in this study are the neurophysiological roots of prosocial and cooperative behavior in a selected set of economic games. In a systematic literature review guided by the PRISMA scheme, the results of the neuro-economic literature on this topic are comprehensively presented. The review includes a descriptive and content-related analysis of selected brain regions that play an important role in the decision-making processes of social exchange situations. Chapter Five summarizes the results of all presented papers, and concluding thoughts are provided for future research directions that could be enrichened by the findings of this work.

2 The role of attitudes, norms, and control: A conjoint analysis of sustainable entrepreneurship

Abstract

The entrepreneur has been presented as a potential solver of the issues endangering the sustainable development of humankind. We examine the choices of potential entrepreneurs when aligning their prospective ventures with their personal attitudes and social norms. Inspired by Ajzen's theory of planned behavior and drawing on a choice-based conjoint analysis with 4,155 data points, we identify predictors for this intention by utilizing structural equation modelling. We find that entrepreneurial and sustainability-related attitudes as well as entrepreneurial norms are critical to the decision to pursue a sustainable venture. The link between attitudes and intentions is amplified by a positive moderation effect.

2.1 Introduction

The interweaving between the realms of economic advancements and the protection of social as well as ecological assets is a complex system which needs to be kept in balance to ascertain the sustainable development of humankind (Brundtland, 1987). The term *sustainability* stands for all kinds of behavior that are aimed at resolving current issues that result from the interaction of the aforementioned realms (Kuckertz and Wagner, 2010). On the organizational level, hybridity constitutes a fitting concept for this duality since it couples values and missions regarding differing aspects of sustainability (Doherty et al., 2014). On the individual level, identity coupling represents a similar notion (Fauchart and Gruber, 2011) that enables a person to integrate varying values and to tackle the challenges that are contained by sustainable entrepreneurship. While much of the world population sees challenges as risks and dangers, some perceive them as opportunities. One of the most commonly quoted research questions in this regard is that of Shane and Venkataraman (2000,

p. 218): "why, when, and how do some people and not others discover and exploit opportunities?". This issue is frequently addressed in the literature (Baron, 2004; Busenitz, 2007). The purpose of this article is to clarify the role of identity coupling in the process of intention forming for those people who have the potential to provide solutions to the challenges that humanity is facing and to strategically implement them in their ventures' mission. More specifically, we aim to shed light on the question which antecedents of intentions are relevant for becoming active entrepreneurially and for acting in sustainable manner simultaneously.

Our contribution to the literature is threefold. First, we utilize the theory of planned behavior (TBP) by Ajzen (1991) and link it to sustainable entrepreneurship and identity coupling. The efficiency and robustness of the TBP in predicting entrepreneurial intentions and behavior has been empirically controlled (Kautonen et al., 2015). While we do not include actual behavior in our model, the original model is hardly capable of capturing intentions of more specific types of entrepreneurship that include secondary goals (besides profit maximization) such as sustainable development in their mission statement. Therefore, we develop an adjusted model that accounts for these multifaceted aspects of entrepreneurial intention, and review the results in light of the identity-coupling concept. Second, this chapter addresses entrepreneurship centered on sustainable development (in short, sustainable entrepreneurship). In terms of quantitative research, the coverage of sustainable entrepreneurship is still relatively scarce in the scientific literature (Hall et al., 2010; Muñoz and Cohen, 2017b). Nevertheless, such research seems desirable, particularly given that extant research has proposed the entrepreneur as a potential problem solver for the ecological and social challenges the world faces today (Cohen and Winn, 2007; Dean and McMullen, 2007). The integration of identity coupling into the process of forming entrepreneurial intentions expands the research space. In this context, we analyze the

influence of the building blocks of identity - namely, of attitudes and social norms - on sustainable venturing intentions, and we specifically address the questions if and how orientations toward entrepreneurship and sustainable development can interact. Third, Muñoz and Cohen (2017b) have called for new methods to be used in sustainable entrepreneurship research and have especially pointed out the deficiency of measurable dependent variables. In this chapter, we apply an experimental method to collect data about the sustainability aspect of venturing intention as a basis for a dependent variable that mainly avoids a social desirability bias.

The remainder of this chapter is structured as follows: initially, we review the current discussions on sustainable entrepreneurship in the scientific community and the literature on TPB that is relevant to this chapter. Second, we use that knowledge to develop our hypotheses. Third, we explain the process of data collection, our sample, and the instruments used in the survey. Fourth, we introduce the methodological basis for this study: choice-based conjoint analysis and SEM. Subsequently, the methods described are applied to test the hypotheses. Fifth, we report the results of the analysis and discuss them in the context of the extant literature. Finally, we indicate the potential limitations of this analysis and discuss the impact of the findings and prospective directions for future research.

2.2 Literature review

2.2.1 Entrepreneurial intention, opportunity, and the TBP

A basic prerequisite for the formation of new firms is the existence of entrepreneurial individuals and desirable opportunities (Venkataraman, 1997). Several factors guide the identification process of such opportunities, among which are intentions. Based on intentions, entrepreneurial individuals screen and scan the commercial environment, and they actively search for prospects to realize their objectives. Krueger and Day (2010) have

found intentions to be the best differentiator between entrepreneurs and non-entrepreneurs. The set of preconditions detailed below determines the presence of intentions.

Two concepts that individuals use to evaluate opportunities are desirability (the extent to which a person believes it possible to realize a utility gain) and feasibility (the extent to which a person considers him/herself capable of exploiting an opportunity) (Shapero and Sokol, 1982). Shapero (1975) has used this idea in a more abstract manner to describe the roots of a credible opportunity that consequently results in the entrepreneurial event (the execution of actions to become an entrepreneur). This reasoning is in line with Ajzen's (1991) TPB, the conceptual inspiration for this chapter. The TPB is able to determine entrepreneurial intentions (Engle et al., 2010; Krueger et al., 2000), acts as a robust model in multiple fields of application (Ajzen, 2014), and also permits the conceptual integration of desirability and feasibility. The TBP overcomes shortcomings of the theory of reasoned action (Ajzen and Fishbein, 1980), the issue of aggregation of behavior, and the poor performance of predictors (Ajzen, 1991). Therefore, it is tailored to explain behavior in specific contexts and uses intentions as an antecedent for behavior.

In following the TBP, three indicators of intentions need to be highly developed to increase the likelihood of a certain behavior. The attitude toward the behavior expresses the desirability of the action. The subjective norm determines the external influence of third parties on the desirability due to social pressure. And the perceived behavioral control reflects the sensed ability and feasibility of the individual to perform well in the behavior assessed. A similar approach that puts less emphasis on the attitude towards a behavior has been implemented by Hockerts (2017) to predict social entrepreneurship intention. To advance their study, our extension of the model aims at predicting quite complex intentions: namely, those for sustainable entrepreneurship including social as well as ecological orientations. We incorporate two dimensions of the decision process, entrepreneurship and sustainability,

within one concept, and we implement the attitudes and norms of both directions simultaneously. Our updated model does not include behavior since actual sustainable entrepreneurship is too rare for a precise measurement in a complex system. We therefore restrict the adaption of the TPB to the part that includes the independent variables and the intention for sustainable entrepreneurship. Further distinctions from the study of Hockerts (2017) are the usage of a covariate estimation in our model, in comparison to variance-based estimation, and a sample of persons who have already made employment decisions, in comparison to a student sample.

2.2.2 Sustainable entrepreneurship

The core of sustainable development is the balance between the environmental-social effects and the economic effects a given action has. Originally, the non-profit-oriented aspects of this balance were perceived as working against economic value creation. The term *trade-off* may depict this relationship, signifying the need for an entrepreneur to choose between growing the business and avoiding the depletion of natural and social resources (Dean and McMullen, 2007; Hall et al., 2010; York and Venkataraman, 2010). In contrast to traditional entrepreneurship guided by the aim of profit maximization, sustainable entrepreneurship tries to reconcile economic, social, and ecological goals (Parrish, 2010). This is also in line with the general literature on this topic that includes non-economic revenues as part of the overall scope of value creation (Shepherd and Patzelt, 2011; Smith et al., 2013; Young and Tilley, 2006). Schaltegger and Wagner (2011) have suggested sustainable entrepreneurship as a key driver of sustainable development since entrepreneurs that pursue sustainable development use their competitive spaces to create benefits for the surrounding society. This idea is in line with the entrepreneurial view of the firm-environment relationship in which the entrepreneur shapes his marketspace through his beliefs and entrepreneurial action (Smith and Cao, 2007).

The two key ingredients of sustainable development are innovation and the existence of individuals willing to create products and services that incorporate sustainable goals (Schaltegger and Wagner, 2011). Especially in the domain of ecology, the strong negative impact of human advances has to be countered by radical innovations (Larson, 2000). Empirical research has found that larger firms tend to engage in incremental innovations (Ettlie et al., 1984; Forés and Camisón, 2016), which suggests that small- to medium-sized enterprises have a greater potential to contribute to sustainable development (Schaltegger and Wagner, 2011). The second ingredient, in addition to innovation, is the presence of individuals able to sense sustainable entrepreneurial opportunities and who are willing to pursue them. The question of who these people are has been a major concern of sustainable entrepreneurship research (Shepherd and Patzelt, 2011; Spence et al., 2011). This article, therefore, aims to shed light on the psychological origins of sustainable entrepreneurship.

Muñoz and Cohen (2017b) have identified several sub-themes of sustainable entrepreneurship that are closely related to our analysis: entrepreneurial self-efficacy, motivation and intention, values and attitudes, business orientation, and moral cognition. While early research has mainly focused on the origins and types of ecologically aware entrepreneurs between the poles of profitability and intrinsic motivations (Linnanen, 2005; Walley and Taylor, 2002), the focus has moved to the antecedents of holistic sustainable entrepreneurship value creation. Sheperd et al. (2009) have laid the groundwork for measuring sustainability orientations, De Clercq and Voronov (2011) have analyzed the impact and moderators of legitimacy on sustainable entrepreneurs' conduct, and Muñoz and Cohen (2017c) have identified two major dimensions of sustainable entrepreneurship, social-ecological embeddedness and entrepreneurial synchronicity. In this chapter, we synthesize these findings in a comprehensive model and analyze their interdependencies.

Two recent articles in the field of sustainable entrepreneurship of particular interest are Shepherd, Patzelt, and Baron (2013) and York, O'Neil, and Sarasvathy (2016). The first has addressed the issue that entrepreneurs face when confronted with potentially profitable opportunities that stand in contrast to their values. The article has identified a cognitive disengagement process in which the entrepreneur decouples himself from values that would hinder him from pursuing certain opportunities. In a certain sense, these findings seem to underpin the idea of an internal trade-off. In contrast to this, York et al. (2016) have analyzed the impact of identities and their underlying logics on the behavior of entrepreneurs. They reason that entrepreneurs engaged in environmental ventures have managed to balance the realms of commercial profitability and ecological sustainability. They have identified three identity types: commercial dominant, ecological dominant, and blended coupling. These reflect the main driving identities of entrepreneurial behavior. More fine-grained identities found by Muñoz et al. (2017a) support the idea of identity coupling in sustainable entrepreneurship. We believe that the disengagement effect of Shepherd et al. (2013) may mainly be prevalent among entrepreneurs with weak sustainable identities. The stronger individuals integrate their identities into the forefront of venturing, the less likely they should be to decouple from their identities.

Even though the sample of Shepherd et al. (2013) shows relatively high values for pro-environmental values, this could be a result caused by self-report bias. Even commercially dominant and blended coupling types will report to be pro-environmental. This issue is most distinctive in the environmental context (Kormos and Gifford, 2014). We therefore aim to apply a theoretically well-rooted model to identify individuals' intentions with a sustainable-dominant or, at least, blended coupling identity that comprises social as well as ecological values. We assume that these should be less likely to disengage themselves from their values and attitudes. Additionally, we eliminate the issue of self-report bias.

2.3 Hypotheses

2.3.1 Beliefs and personal attitudes

Entrepreneurs may only be motivated extrinsically by potential financial gains. They must weigh such gains against the acceptance of personal risks (Kirzner, 1997; Knight, 1921; Schumpeter, 1934). This idea has been challenged by more recent research because it excludes many other possible alternative explanations for entrepreneurial activity (Carsrud et al., 2009). One alternative approach has identified personal attitudes and intrinsic satisfaction as key drivers for the creation of new companies (Ageev et al., 1995; Herron and Sapienza, 1992). Notably, this idea does not contradict the classic concept of utility maximization since utility gains may materialize not only by financial earnings but also through the fulfillment of intrinsic goals (Pfeiffer and Reize, 2000). Kuckertz and Wagner (2010) have pointed out that opportunities in the realm of sustainable entrepreneurship may not always yield superior rents and, therefore, might be less attractive for individuals motivated purely by profit. For those with strong attitudes and beliefs about sustainable development, such opportunities can still be desirable. They not only generate economic rents but also provide environmental and social benefits. In turn, they increase, ceteris paribus, the utility for the aforementioned type of individuals. Nonetheless, individuals may pursue sustainable entrepreneurial opportunities without any intrinsic motivation (Shepherd and Patzelt, 2011), a fact the approach used in the current chapter takes into account.

Values and beliefs are linked to behavior and employment decisions because they play an important role in the assessment of situations and choices (Judge and Bretz, 1992). The definition used in this article is based on Bansal and Roth (2000, p. 731), who have stated that "values are enduring, emotionally charged abstractions that are important to individuals." Based on this, values and beliefs may be interpreted as preferences for particular results (England, 1967). To illuminate the relationship between attitudes and sustainable

entrepreneurship, two types of attitudes are examined: the attitude toward entrepreneurial behavior in general and the attitude toward sustainable development. The aim is then to assess the combined effect of both these attitudes on venture choices. The influence of entrepreneurial attitudes on the intention to start a business is well established (Engle et al., 2010; Kautonen et al., 2013; Lüthje and Franke, 2003). We therefore, concur that this well-established association also holds true for sustainable venturing intentions. In contrast, the association between attitudes in favor of sustainable development (in short, sustainability attitudes) and the intention to act sustainably is not equivocal, partly due to the possibility that extrinsic incentives can crowd out intrinsic motivation (Patzelt and Shepherd, 2011). This means that intrinsically motivated individuals dislike receiving monetary incentives for sustainable actions since rewards blur the signal of their intrinsic motivation. Research on environment-related (Cordano and Frieze, 2000; Gadenne et al., 2009) and sustainability-related behavior (Roxas and Coetzer, 2012) of business managers has found support for a positive link for this kind of behavior with related attitudes. Similar to the setting of Shepherd et al. (2013), these studies have analyzed entrepreneurs and managers who already are active in an organization with duties related to sustainability. Our approach is aimed at individuals who might strategically include sustainability in their future ventures. Owing to intentions acting as the precursors of behavior, intentions should have similar effects—especially in the context of sustainable entrepreneurship, which has been argued to be strongly related to values and laden with emotions (Poldner et al., 2015). This study, therefore, posits that the desirability of sustainable entrepreneurship for those individuals with strong sustainability attitudes is greatest if they act in accordance with their orientation. We therefore, make the following hypotheses:

Hypothesis 1a *Individuals with stronger entrepreneurial attitudes have, ceteris paribus, a stronger intention to start a sustainable venture.*

Hypothesis 1b *Individuals with stronger sustainability orientation, have ceteris paribus, a stronger intention to start a sustainable venture.*

Concerning the question if entrepreneurial and sustainability-related attitudes interact in the context of sustainable venturing, different arguments have been presented and supported by empirical evidence. In a recent article, Shepherd et al. (2013) have analyzed the link between pro-environmental values, entrepreneurial self-efficacy, and entrepreneurial decision-making. They have built on moral self-regulation theory (Bandura, 1991) and have postulated that an internal conflict between self-worth and value compliance arises when a person has both strong pro-environmental values and has a high level of entrepreneurial self-efficacy. Individuals that seek to avoid this conflict might disengage from their values and reduce the emphasis on them during the decision process. As a result, Shepherd et al. (2013) have found that environmentally oriented individuals with high entrepreneurial self-efficacy are more likely to choose options that harm the environment than are people with a low self-efficacy score.

Opposed to this, York, O'Neil, and Sarasvathy (2016) have found that environmental entrepreneurs couple pro-social and commercial identities. More generally, the question appears to be what would be the most preferred way to ultimately resolve a possible tension that arises from the two conflicting attitudes. While, on the one hand, the profit orientation associated with entrepreneurial attitudes could counteract sustainable goals, on the other hand, the combination of both attitudes could enable the individual to identify a new set of opportunities for venturing that would generate even greater long-term utility according to the concept of identity coupling. Spence et al. (2011) have called for a combination of rational and emotional drivers as motivations for sustainable entrepreneurs. They have identified

three types of entrepreneurs on the spectrum of commitment–indifference, out of which we believe that only the *committed* fits into the definition of a sustainable entrepreneur who actively strives to generate value in the realms of economy, ecology, and society. Thus, the decoupling process of Shepherd et al. (2013), while leading to short-term utility in ad-hoc decision-making, might not be well suited for decisions that have a lasting effect such as employment choices. The situation may differ depending on whether the focus is on currently active entrepreneurs or the employment decisions of potential future entrepreneurs. Particularly in the latter case, it again appears more plausible that individuals would aim to maximize long-term utility by coupling dual identities rather than by decoupling their values. In this case, according to Shapero and Sokol (1982), a strong entrepreneurial attitude can increase feasibility, and high sustainability orientation can raise the desirability of an opportunity. In turn, they jointly amplify the wish to pursue sustainability-related opportunities. This idea has been supported by the findings of Kuckertz and Wagner (2010) who identify a positive association between sustainability orientation and entrepreneurial intention, which, however, diminishes with increasing business experience. We therefore, propose the following hypothesis:

> **Hypothesis 1c** *A positive moderation effect exists between sustainability orientation and entrepreneurial attitudes on the intention to start a sustainable venture.*

2.3.2 Social norms

Beyond addressing the characteristics of the individual and his or her role in determining sustainable venturing intentions, this chapter also integrates the influence of social interactions and institutions that are additional drivers for decisions made by individuals in the TPB context (Giannetti and Simonov, 2004). Repeated social interactions lead to social norms. These are non-legal agreements concerning the behavior of a defined group of people who sanction non-compliance and reward observance (Elster, 1989). Social

norms affect the individual's costs and the benefits of the choice of an employment option, and these norms, therefore, play an important role as they influence the expected utility of different options (Giannetti and Simonov, 2004). Engle et al. (2010) conducted a study in 12 countries wherein they include social norms as a predictor of entrepreneurial intent. Among the independent variables tested, they only find social norms to be significant in all countries. In addition, communities with strong entrepreneurial engagement reward entrepreneurial action and share common value and belief systems (Peredo and Chrisman, 2006).

As the definition of sustainable entrepreneurship includes the alignment of entrepreneurial behavior with societal goals, it seems reasonable to assume that the sustainability-related norms of social groups play an equally important role in the decision to pursue a sustainable venture. Multiple stakeholder groups, including employees, governmental institutions, and local communities, demand that business models do not jeopardize the natural environment (Driscoll and Starik, 2004). The gained legitimacy when meeting these demands may enhance the future prospects of the potential venture and, therefore, increase its desirability (Wang et al., 2017). An analysis of the impact of social norms relating to sustainable development on behavior has found a positive link between norms in personal surroundings and eco-friendly actions (Ostrom, 2000). Furthermore, Meek et al. (2010) have identified two kinds of norms that positively affect the number of solar energy firms in various American states, namely, environmental consumption norms and family interdependence norms. Both relate to core aspects of sustainable development.

This is further supported by the findings of Chen, Lupi, He, and Liu (2009) who interviewed 304 households located in China's Wolong Nature Reserve that participated in a payment for ecosystem services (PES) program. These households received a certain sum over a given period for supporting forestry on their land instead of using the land for agricultural purposes. At the end of the program, the participants' intention to re-enroll in

another PES program was assessed. The researchers then estimated the impact of various factors on this intention. Controlling for factors such as program duration, the households' economic situation, demographic conditions, land plot features, and respondents' characteristics, Chen et al. (2009) have found a direct link between the re-enrolment rate of the neighborhood and household re-enrolment intention. They state that a 10% decrease in re-enrolments in the neighborhood lowers the respondent's intention by 6.4%. While Spence et al. (2011) have attributed individual motivation as the strongest driving effect on sustainable entrepreneurship, they have also acknowledged the impact of normative motivation.

Overall, the evidence suggests that concerns about being punished for deviation from or about being rewarded for conforming to group rules and norms influence the intentions of individuals. Muñoz and Dimov (2015) have identified two ways in which sustainable entrepreneurs deal with norms. They act either as conformists who align themselves to pro-sustainability social norms or as insurgents who rebel against non-sustainable normative patterns. The second type compensates for the lack of support through strong entrepreneurial intention. As a result, the joint influence of social norms on both entrepreneurship and sustainability has to be considered in the context of sustainable entrepreneurship. We therefore, make the following hypotheses:

Hypothesis 2a *Individuals perceiving stronger entrepreneurial norms have, ceteris paribus, a stronger intention to start a sustainable venture.*

Hypothesis 2b *Individuals perceiving stronger sustainability norms have, ceteris paribus, a stronger intention to start a sustainable venture.*

2.3.3 Locus of control, self-efficacy, and perceived behavioral control

Intentions not only foster the initial ability to recognize an opportunity but also influence the probability of the exploitation of the opportunity. Researchers have previously highlighted relations between several traits of potential entrepreneurs and those entrepreneurs' willingness to act on opportunities. Of special interest in this research are two traits widely cited in the psychological literature: the locus of control and self-efficacy. These personality characteristics have frequently been linked to entrepreneurial action (Mueller and Thomas, 2001; Shane and Venkataraman, 2000; Zhao and Seibert, 2006).

Locus of control has been of major interest to entrepreneurship researchers, especially in the 1980s (Perry, 1990), partly because it was a component of the original TPB (Ajzen, 1991). Initially introduced by Rotter (1966), the construct describes the mindset of a person in terms of that person's self-assessed beliefs about the control over their life. More internally oriented individuals have a strong conviction that the main factors that influence the outcomes of their actions are their own effort, abilities, and skills. In contrast, more externally oriented people tend to believe that external circumstances that they cannot influence mainly determine their lives. Extant research has found robust positive effects that link a more internal orientation to the likelihood of becoming self-employed (Hansemark, 2003; Mueller and Thomas, 2001). The trait of self-efficacy has been introduced as:

> "…people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances to the extent that their level of motivation, affective states and actions are based more on what they believe than on what is objectively true".
>
> (Bandura, 1986, p. 391)

The entrepreneurship literature widely uses this definition (Boyd and Vozikis, 1994; Krueger and Brazeal, 1994). People that score highly on this personality dimension, especially in the

entrepreneurial context, can attest for themselves a distinct ability to successfully execute their plans on opportunities (Mitchell and Shepherd, 2010). Self-efficacy has also been linked to the locus of control in the context of the TPB (Armitage and Conner, 1999). An internally oriented mindset as well as high levels of self-efficacy have been associated not only with stronger entrepreneurial intentions but also with a greater probability of acting on opportunities to become self-employed (Krueger and Day, 2010; Shane and Venkataraman, 2000).

Judge, Locke, and Durham's (1997) have combined these two traits conveniently in the measure of the core self-evaluation scale (CSES). Armitage and Connor (1999) have argued that self-efficacy and the locus of control are both elements of perceived behavioral control in the context of the TPB framework. Ajzen (1991) has utilized self-efficacy in the TBP as a proxy for perceived behavioral control (Judge et al., 2003), and the locus of control can broaden the concept so that it is applicable to a wider range of behavioral situations (Boyd and Vozikis, 1994). The CSES encompasses these two traits and extends them through adding self-esteem and neuroticism. In our opinion, the CSES can be divided into two parts: on the one side, the traits self-efficacy and locus of control that mainly influence conscious decisions; on the other side, self-esteem and neuroticism that mainly affect the outcomes of affective decision processes. We believe that the choice to become self-employed is mainly a rational one and, therefore, made consciously. In consequence, we attribute the findings regarding CSES in this context largely to self-efficacy and locus of control, which fits well into the overarching concept of the TPB.

For example, Ferris et al. (2012) have found that individuals with a high level of core self-evaluation set objectives that are more ambitious and pursue these more persistently than the average person. They posit an orientation toward positive goals as an explanation for this difference. This behavior is compatible with the challenges of an entrepreneurial

environment, and particularly those of sustainable entrepreneurship. Theoretical arguments and empirical evidence have supported the idea of entrepreneurs having strong core self-evaluation. Individuals who score highly on core self-evaluation not only find their work more intrinsically satisfying (Judge et al., 2000) but also have generally stronger intrinsic motivation (Ferris et al., 2012). This also results in individuals who set and pursue more challenging (Erez and Judge, 2001) and more intrinsically motivated objectives (Johnson et al., 2008). Such individuals thus have a stronger commitment to their (self-imposed) objectives and are, therefore, more persistent in pursuing them (Erez and Judge, 2001). It follows that high core self-evaluation levels, especially those that relate to conscious decisions, are also positively associated with the ability to consider intrinsic motives during the selection of goals based on personal attitudes. This is particularly useful for individuals who embark on the challenge of pursuing sustainability and profitability simultaneously. That is because doing so requires an ability to proactively counter stressful situations and respond positively to performance feedback that involves challenging trade-offs (Bono and Colbert, 2005). Consistent with the findings of York et al. (2016), these ramifications of high levels of self-efficacy and internal locus of control should enable individuals to couple their identities and, thus, to be less prone to the decoupling process suggested by Shepherd et al. (2013). Given that there is, due to the fact that simultaneously private and social benefits are involved (O'Rourke, 2005), a largely unavoidable tension between the goals that entrepreneurs who aim for sustainable development need to pursue jointly, we propose the following hypothesis:

> **Hypothesis 3** *Individuals with higher levels of self-efficacy and a strong internal locus of control have a stronger intention to start a sustainable venture.*

In this hypothesis, we deviate from the directedness of the model's elements towards intention since the independent variable is simultaneously included in two TPB models. A

scale for such a measure has not been created, and we see the self-reported values for a highly unfamiliar scale critical. **Figure 2** summarizes the set of hypotheses and shows the correlations between the independent variables derived from the TPB. The resulting model allows to account for all aspects that are relevant, so that the intention to act sustainably and entrepreneurial are covered simultaneously.

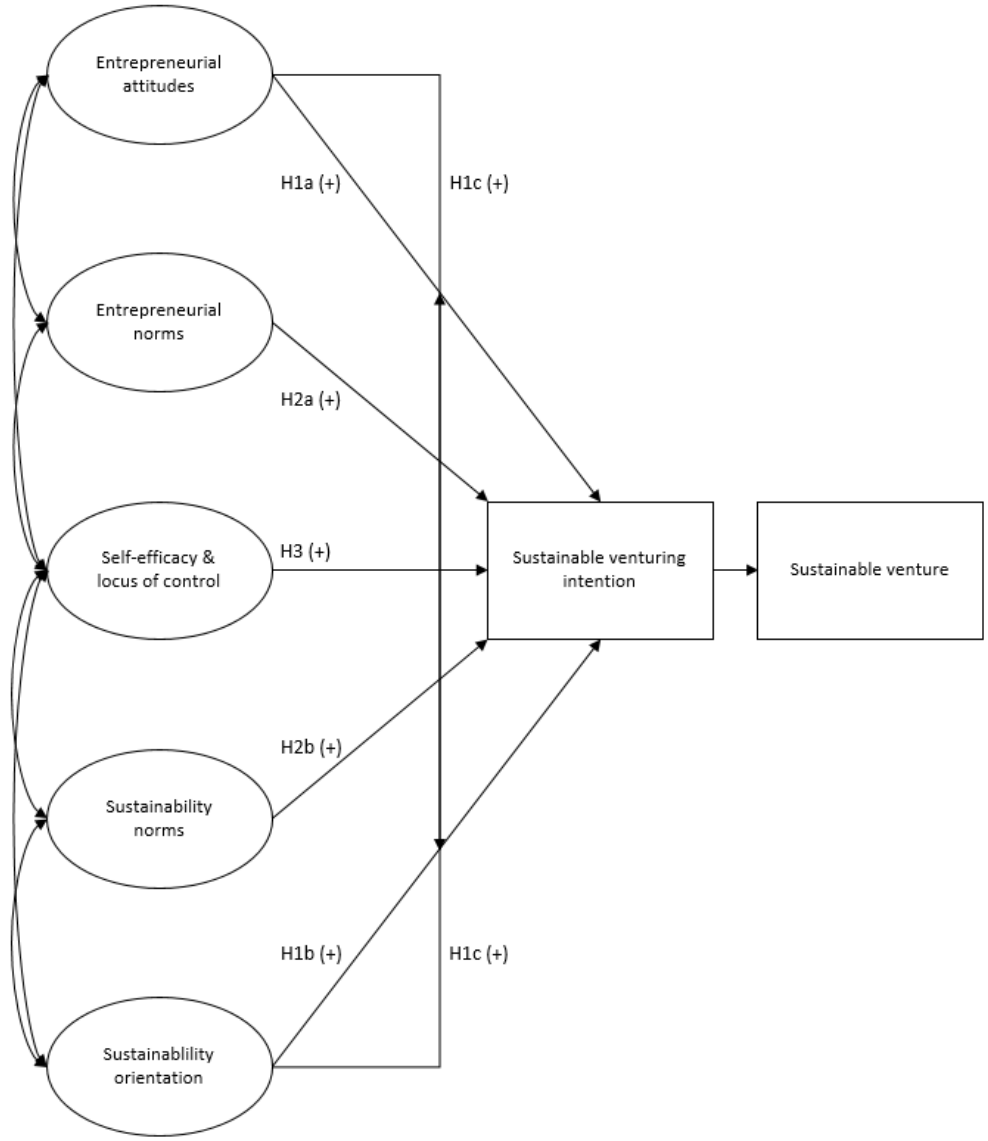

Figure 2 Framework for hypotheses

2.4 Data and variables

To test our hypotheses, we implemented a survey that integrates the Sawtooth software to present an anonymous online questionnaire with three parts: a cover letter; a questionnaire asking for demographic information, personality-related items and attitudes, and perceptions on social norms; and a conjoint design. The survey was distributed via the alumni office of a large German university to 2,000 potential respondents. After two e-mail reminders were sent to the targeted group, 277 participants completed the questionnaire, which represents a response rate of 14 percent.

The data reflects 58% male and 42% female respondents. The average age of those who completed the survey was 43.2 years. The distribution of age is slightly skewed towards younger people on account of the fact that entrepreneurs are generally younger than the average person in Germany (Metzger, 2017). Most respondents either held a master's degree (33.21%) or a doctorate (29.79%). Therefore, the data gathered consists of individuals who not only are more likely to start a sustainable venture but also in tendency should be successful in doing so. The main variables for our analysis are summarized in **Table 1**.

The survey elicited entrepreneurial and sustainable venturing intentions from the respondents separately. First, to measure basic entrepreneurial intentions, we adopted a question that utilizes a 5-point Likert scale, anchored with "completely agree" and "completely disagree" (Lüthje and Franke, 2003). The associated statement was: "I intend, within the next five years, to become or remain self-employed." We thereby ensured that already self-employed respondents can also respond. Second, we applied a conjoint design to measure the importance of sustainable motives in the course of venturing. A detailed explanation of this variable follows in the methods section of this chapter. The measure allows rating the importance of sustainable motives in the decision to launch a potential new venture. We took the logarithm of this variable to arrive at a normal distribution. The two

measures multiplicatively combined to generate the dependent variable, namely, sustainable venturing intention. To score highly on this measure, the individual needs needed to fulfil both conditions: showing a high general venturing intention and ascribing a strong importance to sustainability goals in the venturing process.

Table 1 Summary of the main variables

	Variable	Exo/ Endo	Type	Mean	Std. dev.	Alpha	Loading
1	Self-employment intent	Endo	Likert scale	2.47	1.56	n/a	
2	Sustainability content (log)	Endo	Conjoint analysis	3.04	0.69	n/a	
3	Self-efficacy and locus of control	Exo	Latent	0.00	1.00	0.69	
			Confident				0.72
			Success				0.68
			Tasks				0.58
			No control of tasks				-0.52
			Control of life				0.69
			No control of career				-0.61
4	Entrepreneurial attitudes	Exo	Latent	-0.003	1.01	0.59	
			High income				-0.72
			Own boss				0.80
			New company				0.70
5	Entrepreneurial norms	Exo	Latent	0.05	0.99	0.80	
			Achievement				0.74
			Autonomy				0.86
			Risk				0.61
			Creativity				0.73
			Responsibility				0.79
6	Sustainability-oriented norms	Exo	Latent	0.01	0.98	0.85	
			Freedom				0.76
			Equality				0.71
			Solidarity				0.84
			Nature				0.77
			Tolerance				0.82
			Responsibility				0.63
7	Sustainability orientation	Exo	Latent	0.03	0.98	0.765	
			Eco-challenge				0.77
			Corp. responsible				0.87
			Pioneer				0.85
			Employees				0.09
			Finance rating				0.20
			CSR				0.77
8	Parents self-employed	Exo	Binary	0.31	0.46	n/a	
9	Self-employed	Exo	Binary	0.29	0.45	n/a	

The reduced CSES, entrepreneurial attitude, entrepreneurial norms, sustainability norms, and sustainability-related orientation all were operationalized as items rated on the same 5-point Likert scale. The six CSES items of Judge et al. (2003) we use are: "I am confident I will get the success I deserve in life"; "when I try, I generally succeed"; "I complete tasks successfully"; "Sometimes, I do not feel in control of my work (reversed)"; "I determine what will happen in my life"; and "I do not feel in control of my success in my career (reversed)".

We employ Kuckertz and Wagner's (2010) six-item construct to measure sustainability orientation. It comprises the following items: "German firms should take an internationally leading role in the field of environmental protection; Firms that are environmentally oriented have advantages in recruiting and retaining qualified employees; The environmental performance of a company will in future be considered more and more by financial institutions; Corporate social responsibility should be part of the foundations of each company; I think that environmental problems are one of the biggest challenges for our society; I think that entrepreneurs and companies need to take on greater social responsibility." We also use the measure for entrepreneurial attitudes developed by Lüthje and Franke (2003) that consists of three items: "I'd rather be my own boss than have a secure job; You can only make big money if you are self-employed; and I'd rather found a new company than be the manager of an existing one."

We use the University of Michigan's Panel Study of Entrepreneurial Dynamics (PSED) scale for entrepreneurial norms. Its five items are: "The social norms and culture of your personal environment are highly supportive of success achieved through one's own personal efforts; The social norms and culture of your personal environment emphasize self-sufficiency, autonomy, and personal initiative; The social norms and culture of your personal environment encourage entrepreneurial risk-taking; The social norms and culture of your

personal environment encourage creativity and innovativeness; The social norms and culture of your personal environment emphasize the responsibility that the individual has in managing his or her own life."

We could not identify any instrument for measuring sustainability norms in the extant literature. The closest fitting scale is that of Meek et al. (2010) for environmentally responsible consumption. However, this scale does not include social aspects and does not measure norms in the personal environment. Because we additionally wanted to measure entrepreneurial and sustainability norms in a comparable manner, we refrained from using this scale and instead opted for developing a new scale utilizing the wording of the scale for entrepreneurial norms. To ensure content validity we based our questions on the categories of Shepherd, Kuskova, and Patzelt's (2009) sustainable development value (SDV) scale. We conducted a pre-test with a student sample to validate the measure. The Kaiser–Meyer–Olkin value of 0.777 was satisfactory, and, therefore, we include the scale in its original version. The six items of the measure are: "The social norms and culture of your personal environment are highly supportive of the value of freedom of the individual; The social norms and culture of your personal environment emphasize the equality of all human beings; The social norms and culture of your personal environment encourage solidarity in communities; The social norms and culture of your personal environment emphasize a caring relationship with nature; The social norms and culture of your personal environment encourage tolerance toward the unknown; The social norms and culture of your personal environment give priority to shared responsibility for all actions."

In addition to the major variables of concern, we include two more binary variables in the analysis as controls: the self-employment status of the individual and the individual's parents. Both seem to be interrelated not only with the dependent variable of sustainable venturing intention but also with the variables influencing pure entrepreneurial intent. For

self-employment status (Kolvereid and Isaksen, 2006) and self-employed parents (Dunn and Holtz-Eakin, 2000; Parker, 2004), the scientific literature has reported links between these two variables and other influences on entrepreneurial intentions. The inclusion of self-employment status is particularly relevant as it includes experience in the entrepreneurial space and addresses a potential sampling bias caused by the relatively high share of self-employed respondents (26%). While such a bias cannot be ruled out (Gelman, 2007), the inclusion of this control ensures that the effects of the main variables are independent of the self-employment status. We are therefore, confident that the results reflect the impact of attitudes, norms, self-efficacy, and the locus of control for an average individual.

2.5 Methods

We apply choice-based conjoint analysis (CBC) to analyze the importance of sustainability characteristics in the decision-making process for the start of a new venture. One of the major concerns regarding the direct retrieval of information from survey participants is self-reporting bias because of social desirability. This issue is relevant in a variety of research areas (Bertrand and Mullainathan, 2001; Maxfield et al., 2000) and appears to be particularly salient in the context of our research. While the data collection method of an online survey and the associated anonymity may dampen such bias, the application of CBC eliminates the issue far more comprehensively. Conjoint analysis enables the researcher to retrieve information on decision-making processes in a so-called decompositional manner (Shepherd and Zacharakis, 1997). The individual is presented with a set of stimuli representing an object with certain attributes. An example of a stimuli set can be seen in **Table 2**. Respondents' choices made under the CBC approach are most similar to real-life situations (Moore et al., 1998; Riquelme and Rickards, 1992). We therefore use an approach based on a factorial conjoint design that represents a subset of all potentially possible

Table 2 Example of CBC stimuli set

	Venture 1	**Venture 2**	**Venture 3**	**Venture 4**
Social benefit for society	Social benefit as a complement (medium)	Social benefit as a coincidence (low)	Social benefit as core function (high)	Social benefit as a complement (medium)
Environmental protection	Environmental protection as core function (high)	Environmental protection as a coincidences (low)	Environmental protection as core function (high)	Environmental protection as a complement (medium)
Risk of failure	20% risk	20% risk	80% risk	20% risk
Income	+ 20% income	+ 20% income	+/- 0% income	+/- 0% income
Choice (e.g.)	X	O	O	O

attribute manifestations. The primary criteria that determine the measurement approach adopted for this chapter are: closeness to reality and that a non-linear estimation of preference utilities is feasible. In this context, choice-based elicitation of data points greatly reduces the risk of social desirability issues and common method bias (Chang et al., 2010).

In our study, the participants decided on their most desirable potential start-up, based on four criteria: the change in income relative to current income, the risk associated with the change (expected income was assumed to be the major factor influencing economic decisions), the role of ecological goals, and the role of social goals for the start-up. The four dimensions chosen represent the main influences of the trade-off when our first hypothesis was derived. The levels associated with these criteria were as follows: relative income (+20%, +/-0%, -20%), risk of failure (20%, 50%, 80%), and ecological and social goals (as coincidental, complementary, or as a core task). The manifestations of the latter two criteria build on the types of sustainable entrepreneurs in Spence et al. (2011) and on the classification made by Schaltegger and Wagner (2011). Each respondent made decisions on 17 choice sets (of which the first two were included to familiarize them with the procedure). Each set included four selectable start-ups with different manifestations of the four criteria.

Based on the 277 responses, the sample added up to 4,155 data points. A fractional design determined the utilized choice sets, representing a subset of all potential combinations. Of 81 possible combinations, 16 were applied to compose the choice sets. We adjusted the stimuli per set orthogonally to minimize the likelihood of having the same manifestation in one choice set.

The information in the respondents' choices made it possible to calculate the utilities of individual participants for the aforementioned criteria. We applied a hierarchical Bayes model to do so as it outperforms logit estimations when a CBC analysis is used (Orme, 2005). To determine the importance of each criterion in the decision process of the respondent, we calculated the utility difference between the manifestation rated lowest and highest for a given criterion. The sum of the importance for ecological and social goals represents the sustainability orientation of the venturing intention in our study. The estimates of the study are comparable to the results in the pre-test of the CBC tool for the student sample conducted before the main survey.

To test our hypotheses formally, we applied structural equation modeling (SEM) with robust standard errors that employs a set of statistical procedures to reveal the underlying causal relationships between variables. SEM comprises two sub-models: the path model and the measurement model. The path model determines the links between the model's dependent and independent variables. The measurement model entails constructs that can be either single-item (observed) or multi-item (latent) measures. We conducted confirmatory factor analysis to determine the factor loadings of the items that constitute the latent constructs (Gefen et al., 2000). We allowed the variables of our model to correlate so as to control for interdependencies, which is a normal procedure in TPB. The two approaches in SEM are partial least squares (PLS) method and covariance analysis. Two major advantages of covariance-based analysis over PLS can be identified. The simultaneous estimation of the

measurement and path models in covariate analysis means that it is possible that the model parameters represent a global optimum. Only covariance analysis allows the application of goodness-of-fit indicators. These are essential for a comprehensive assessment of the validity of the model and enables a comparison between models (Gefen et al., 2000). These advantages support the application of covariance analysis if the underlying framework of the model is theoretically well grounded (Markus, 2012). As the TPB has been successfully tested in various applications, it is assured that this is the case for the model used in this article. This, together with the sufficiently large number of observations, makes covariance analysis the optimum choice for estimating our model.

The current model also incorporates additional control variables. The self-employment status of both individuals and their parents was included as an additional independent variable with the potential to predict sustainable venturing intention. In principle, those variables can be correlated with each other and with all the variables dealing with the entrepreneurial dimension of the model (entrepreneurial attitudes, entrepreneurial norms, and the CSES). Covariance analysis makes it possible integrate these covariances. Finally, an interaction term between entrepreneurial and sustainability orientation was included to test Hypothesis 2b. During the construction of the interaction variable, named *Entre.att. X Sust.att.*, both constituent variables were mean-centered (Aiken et al., 1991). We validated the results of this approach by also applying the unconstrained method of Marsh et al.'s (2004), and found no bias.

2.6 Results

Prior to the presentation of the SEM estimates for the model, the results of the optimization algorithm for the CBC analysis should be evaluated. First, the values for relative importance in the sample are 29.97% for income, 46.75% for risk, 11.07% for ecological

goals, and 12.21% for social goals. These results indicate that risk and income play a dominant role for the majority of individuals when determining their venturing intention. However, the importance values for the different dimensions vary markedly among the respondents. Second, the root likelihood (RLH) value is an indicator of goodness-of-fit for the estimated parameters with the actual decisions made by the individuals (Orme, 2005). The RLH shows the probability of a correct choice for each choice set when applying the utility values of the individuals. The pure chance RLH value is 0.25 in our study because there are four stimuli per choice set; in comparison, the value of 0.69 means the prediction via estimated utilities is 2.75 times better than pure chance. The result indicates a good fit between the estimated utilities and the choices of the participants.

Turning to the SEM estimation, we applied established measures to evaluate the goodness-of-fit of the overall model. Several researchers have called for the combination of relative fit indices with absolute fit indices to gain a thorough insight into model quality in the context of SEM (Hu and Bentler, 1999). Given that the $\chi 2$ criterion is extremely sensitive to deviations from multivariate normality and from the size of the sample (Markus, 2012), we focused on the $\chi 2/df$ (degrees of freedom) measure that addresses that issue. The value of 1.55 is below the recommended cut-off value of 2 and thus indicates a good fit. To obtain a more holistic overview, we next assessed the values of the fit indices RMSEA, SRMR, and CFI. The results for RMSEA (0.045) and SRMR (0.067) indicate a good fit (Hu and Bentler, 1999) and thus suggest a good specification of the model; the value of the CFI (0.905) is marginally above the cut-off threshold of 0.9 recommended for an acceptable fit in SEM. This is probably due to the rather complex relational system and the high number of included factors and indicators. Additionally, CFI is more meaningful in the case of exploratory than in confirmatory models (Rigdon, 1996). Given these satisfied goodness-of-fit indices, the estimated path coefficients can reliably be interpreted.

Figure 3 displays the results of the SEM used to test the proposed hypotheses. As we used a covariate estimation for the model, the measurement and structural model were estimated simultaneously. The path coefficients depicted are standardized to allow comparison of the effect sizes. Significance levels are based on the non-standardized coefficients. Sustainable orientation and entrepreneurial attitudes have a significant positive associations with the dependent variable, which supports Hypothesis 1a and 1b. Hypothesis 1c also finds support since the interaction of entrepreneurial attitudes and sustainability orientations links positively and significantly to sustainable venturing intention. The positive coefficient of entrepreneurial norms is significant, thus supporting Hypothesis 2a.

Hypothesis 2b is not supported directly because the path from sustainability norms to the dependent variable is insignificant. One explanation for this result might be that sustainability norms are most strongly interwoven with the overall model. They show a high correlation (0.48) with entrepreneurial norms. This seems reasonable since the perceived strength of a normative background should have an influence on all kind of norms. Furthermore, they significantly correlate with sustainability orientation (0.21). When all significant links to other variables are considered, sustainability norms have an indirect positive effect on sustainable venturing intention of 0.09. This suggests that Hypothesis 2b might not be wholly unsupported. The association of self-efficacy and locus of control with the dependent variable is weakly negative but insignificant, and it, hence, does not support Hypothesis 3. Moreover, self-employment has a strong influence on the dependent variable. In comparison to all other links in the model, this path has the second highest coefficient and is significant. This effect is largely due to the higher level of pure intent to remain self-employed by those who already are.

However, there is no significant relationship with pure sustainability content based on the CBC (see **Table 2**). In contrast to the respondents' self-employment status, their parents

being self-employed does not have a significant effect on the dependent variable. However, the analysis did identify a positive influence of the self-employment of the parents on the self-employment status of the respondents, which is in line with extant research (Chlosta et al., 2012).

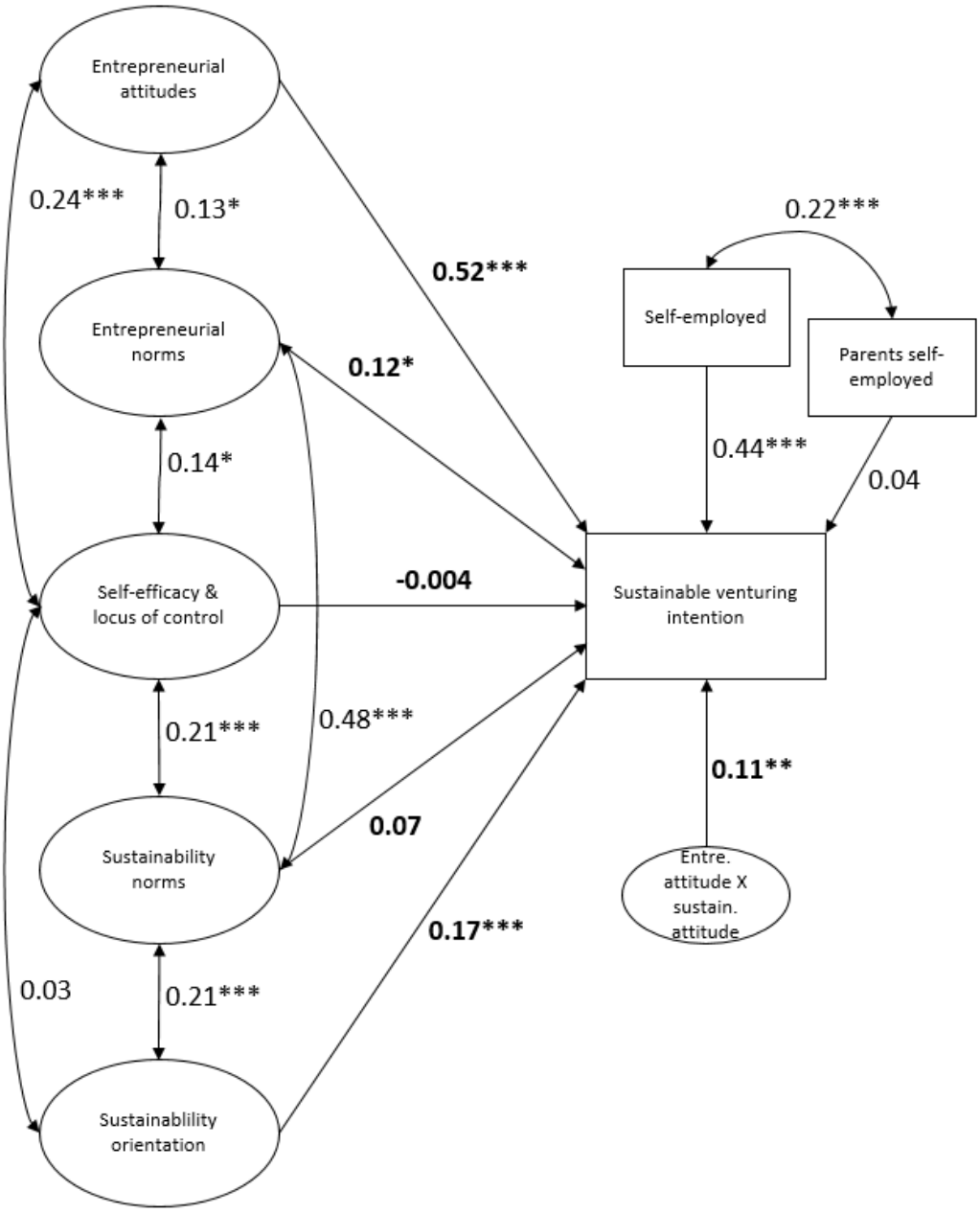

Figure 3 Results of the structural equation model

Notes: Path diagram reports standardized coefficients; *** p < 0.01; ** p < 0.05; * p < 0.10

We applied several checks to ensure the results obtained from the SEM were robust. First, we estimated the model by excluding self-employed respondents (see **Figure 4**) and found that all results, and particularly those concerning our hypotheses, remain unchanged, with the only exception being that the coefficient for entrepreneurial norms becomes insignificant. Second, we bootstrapped the model by using 20 repetitions. We did not conduct more repetitions owing to the time-consuming nature of the bootstrapping process, especially in the case of non-convergence. The results of the path coefficients remained stable under the robustness checks. Third, while SEM has many advantages for testing theoretical models, such as allowing for the correlation between independent variables and simultaneous estimation (Tomarken and Waller, 2005), it has some limitations with regard to the inclusion of control variables. An inclusion of additional controls weakens the overall fit of the model to the data and makes the interpretation of the outcomes less reliable. We, therefore, also estimated an ordinary least square (OLS) regression model that incorporated

Table 3 Correlation table

	Variable	1	2	3	4	5	6	7	8	9
1	Intent	1.00								
2	Sustainability (log)	0.053	1.00							
3	Self-efficacy and LOC	0.137	0.034	1.00						
4	Entre. attitudes	0.558	0.069	0.177	1.00					
5	Entre. norms	0.094	0.19	0.124	0.096	1.00				
6	Sust. orientation	0.013	0.378	0.003	-0.052	0.104	1.00			
7	Sust. norms	0.062	0.215	0.153	0.016	0.367	0.257	1.00		
8	Parents self-employed	0.168	-0.026	0.000	0.121	-0.021	-0.08	0.032	1.00	
9	Self-employed	0.618	0.011	0.065	0.406	0.024	-0.048	0.017	0.207	1.00

Notes: Correlations above 0.1 significant at $p < 0.05$; minor differences to correlations in Figure 2 are due to independent estimation of correlations

additional control variables that could not be included in the SEM analysis. Prior research has indicated that appropriate additional controls are age, gender, individual risk aversion, academic degree, study field for that degree, and perceptions about the support for and barriers to entrepreneurship. An overview of correlations of all included variables can be found in **Table 3**. The coefficient values for the variables included in both the OLS estimation and SEM are most similar, and there are no changes in signs and significance levels for all variables of interest. Furthermore, the OLS model (**Table 4**) is highly significant,

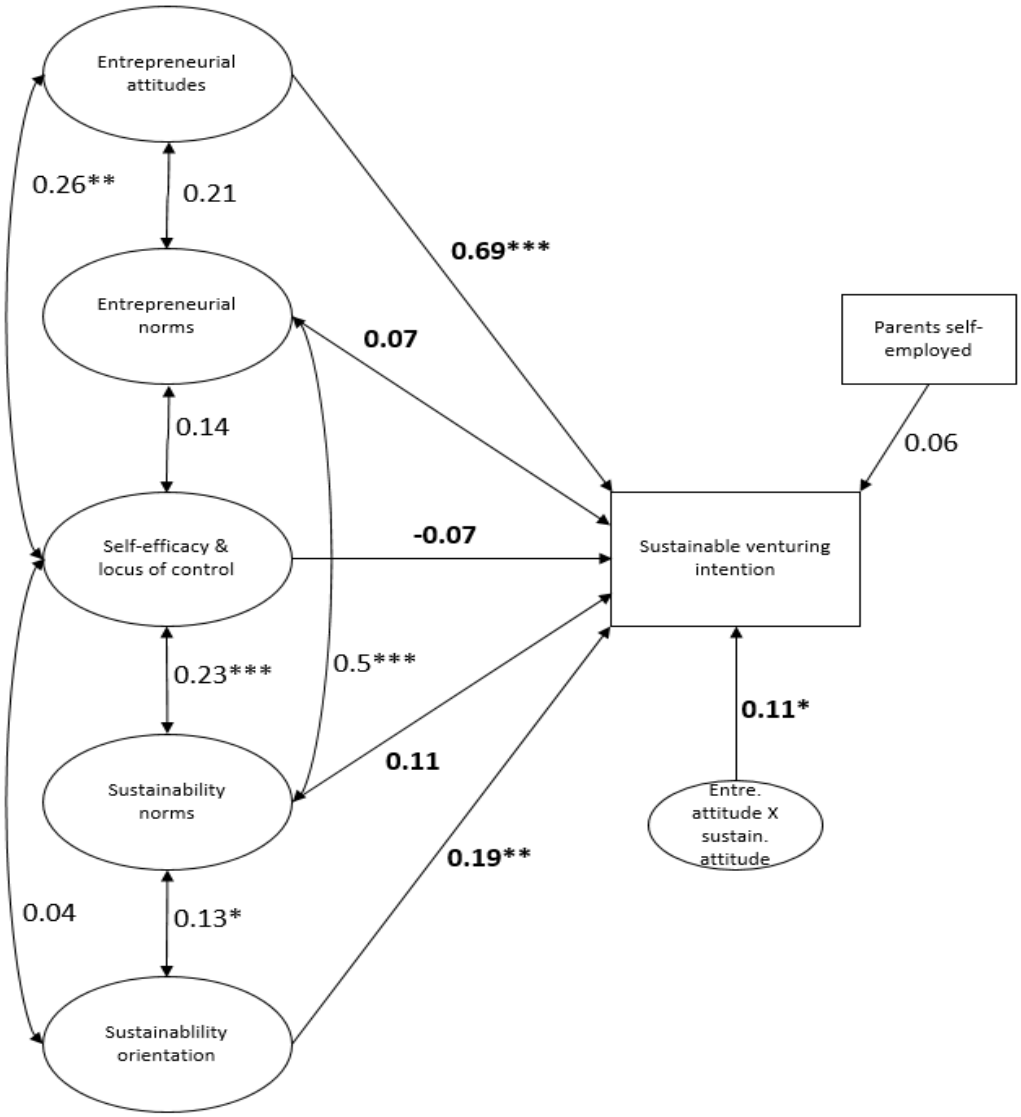

Figure 4 Results of the structural equation model (without self-employed)
Notes: Path diagram reports standardized coefficients; *** p < 0.01; ** p < 0.05; * p < 0.10

Table 4 Results of linear regressions (robustness check)

Variable	Restricted model (only controls)	SEM model	Full model
Self-efficacy & Locus of control		0.34 (0.45)	0.25 (0.44)
Ent. attitudes		1.98*** (0.25)	1.97*** (0.29)
Ent. norms		0.60** (0.24)	0.53** (0.25)
Sustain. orientation		0.76*** (0.23)	0.60** (0.24)
Sustain. norms		0.32 (0.24)	0.26 (0.25)
Ent. attitudes * sust. orientation		0.53** (0.22)	0.43* (0.24)
Self-employed	5.90*** (0.62)	4.75*** (0.66)	4.48*** (0.70)
Parents self-employed	0.09 (0.58)	0.44 (0.50)	0.30 (0.49)
Age	- 0.01 (0.02)		- 0.03 (0.02)
Gender	0.24 (0.6)		0.43 (0.57)
Risk	0.86*** (0.28)		0.39 (0.26)
Positive image of entrepreneurship	0.59* (0.32)		0.29 (0.33)
Services for start-ups	0.61* (0.32)		0.13 (0.31)
Hard to get a loan	- 0.04 (0.33)		- 0.05 (0.29)
Regulation hostile toward start-ups	- 0.13 (0.28)		- 0.20 (0.26)
Academic degree (categorical)	included (9 categories)	not included	included (9 categories)
Discipline (categorical)	included (7 categories)	not included	included (7 categories)
F	7.57 (29, 245)	38.69 (7, 267)	10.45 (29, 245)
Prob > *F*	< 0.0001	< 0.0001	< 0.0001
R^2	0.4085	0.5036	0.5529
Observations	275	275	275

Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

and an adjusted R2 of 0.55 indicates that the estimation explains the variance of the dependent variable very well. In comparison to a regression model that includes only control variables, the value of the adjusted R2 is 0.15 higher in the full model. A Chow test ($F = 15.82$; $p < 0.001$) indicates that the difference between the restricted and full model is highly significant. When excluding self-employed respondents in the OLS estimation, results also do not change compared to the corresponding SEM model (results are available upon request). In summary, therefore, our results appear highly robust across a number of additional sensitivity analyses.

2.7 Discussion and implications

This research identifies a positive association of entrepreneurial attitudes with sustainable venturing intention, a result which is in line with other empirical findings (Engle et al., 2010; Kautonen et al., 2013; Lüthje and Franke, 2003), and one which confirms the importance of entrepreneurial attitudes to entrepreneurial intentions. Beyond this, sustainability orientation plays a significant role in acting sustainably when pursuing a venture. Furthermore, a positive interaction effect between the two independent variables adds to the notion that a trade-off between entrepreneurial attitudes and sustainability is hardly probable. This suggests that decoupling (Shepherd et al., 2013) is neither the only mechanism influencing the behavior of entrepreneurs nor the one that guides the decision-making process at the beginning of the entrepreneurial journey regarding the long-term strategic goal. Rather, the results support the notion of Gamble and Moroz (2014) that entrepreneurial attitudes and social mission orientation jointly predict successful venture creation and that entrepreneurs can integrate rational and value-related aspects to align their ventures with societal needs. These results align well with our initial reasoning that coupling of identities as described by York et al. (2016) rather guides the vocational choice of an

individual. While the average entrepreneur might be prone to disengagement from sustainable orientation, an entrepreneur with coupled identities and a clear mission to follow up on sustainability goals should be impervious to disengagement.

Furthermore, the current research contributes to the extant scholarship by showing that entrepreneurial norms directly support the sustainable venturing intention and that sustainability norms, while not directly related to sustainable venturing intention, do correlate strongly with other influential variables in the model. The differing modes of direct and indirect impact on the dependent variable might be explained through the nature of norms. Bénabou and Tirole (2005) have found that rewards from the community affect the utility gained by the individual when engaging in a certain behavior. The visibility of effort in a certain task determines the degree to which social norms exert an effect on behavior. Entrepreneurial action in most cases has an immediate effect and is readily observable to the surrounding society. Efforts taken to preserve nature or develop social communities might not be visible at the same level and can have a delayed impact. Therefore, the expected reward through social norms is higher for entrepreneurial action than for sustainable action. This might explain the non-significant coefficient of sustainability norms in the regression. Additionally, our scale for sustainability norms has a strong normative character. In the social entrepreneurship setup, the effect of moral obligation on intention is insignificant as well (Hockerts, 2017).

The variable representing perceived control does not yield significant effects on the sustainable venturing intention. This result could be explained based on the findings of Cordano and Frietze (2000) and Hockerts (2017). While Cordano and Frietze (2000) have reported similar path values as the ones in our model, Hockerts (2017) obtained a relatively strong positive and significant link between perceived behavioral control and the intent. The two articles differ in the realm they are analyzing. The first discusses environmental aspects

of entrepreneurial decision-making, and the later focuses on the social venturing intention. The diametrically opposed effects of their findings most likely explains our results, as we combine both realms. This may suggest a more complex influence of perceived behavioral control in the context of sustainable venturing intentions than has been thought to date.

Across all explanatory variables, self-employment status has a strong effect as well; this is in line with work on serial entrepreneurship that indicates that experienced entrepreneurs evaluate the option to found or continue a new venture more positively than novices do (Amaral et al., 2011). However, our findings show that even after controlling for these additional effects by excluding individuals already self-employed, the mechanisms proposed in the hypotheses mainly remain valid. Only the path from entrepreneurial norms to the dependent variable becomes insignificant. This most likely is due to the exclusion of already self-employed individuals as they are already in an environment with strong entrepreneurial norms. Yet, the findings should matter for policy makers and other practitioners interested in for-benefit enterprises and firms with broader goals than profit alone.

With respect to the TPB that we chose as the framework, intentions are formed by the interaction of individuals' attitudes toward a certain behavior, social norms, and perceived behavioral control (Ajzen, 1991). As we modify the TPB and incorporates other aspects, we are able to account for the complexity of sustainable entrepreneurship. Overall, our extension identifies novel relevant aspects that contribute to improving the prediction of intentions on sustainable entrepreneurship. We show how the inclusion of pro-social motives in the analysis can help to explain shifted impact trajectories in the context of entrepreneurship. The non-significant paths fit with the original TBP, as Ajzen (1991, p. 188) states: "the relative importance of attitude, subjective norm, and perceived behavioral control […] is expected to vary across behaviors". This holds true especially in relation to the findings by Hockerts (2017). In the realm of social entrepreneurship, the effect of perceived

behavioral control seems to be more prevalent than in the setting we analyzed. A reason for this difference may be the additional inclusion of environmental aspects in our utilized variables. Even though sustainable entrepreneurship encompasses the goals of social entrepreneurship, the underlying mechanisms guiding the respective intention may differ.

In summary, the findings of this study can offer useful and relevant practical implications for policy makers and other actors (for example, universities) whom are concerned with fostering sustainable development in practice. The results should not only help to identify those individuals who have the potential to solve the challenges mentioned in the introduction but also help to grow this group of potential entrepreneurs. Specifically, students need to be informed of sustainability issues during their courses, for example, by means of depictions of wicked challenges. For this group, there is indeed evidence that intentions lead to behavior (Hockerts, 2017). This leads us to believe that the issue of the attitude behavior gap in long-term oriented decision-making as occupational choice is less severe. Exposure to social and environmental problems should help foster a sustainability orientation based on understanding the need to address such problems. However, it is equally important to support the development of positive attitudes to (and the skills required for) entrepreneurship among individuals with a strong sustainability orientation. It appears that, if both attitudes interact positively, such support would accelerate positive social and environmental effects that are derived from new venture creations. This would improve the capability of future entrepreneurs to resolve tensions between profits and sustainability.

Furthermore, based on our findings, organizational actions should be aimed at developing a strong institutional culture by promoting sustainability and entrepreneurial norms, for example, in educational establishments. That might be achieved via extra-curricular competitions seeking entrepreneurial solutions to sustainability issues to heighten the desirability of sustainable ventures. It is likely that such actions would be complementary

because we have tested interactions between attitudes and norms in the SEM without finding any negative linkages (these were all not significant and are, thus, not included in the reported model but are available on request). Of course, both directions are also relevant for policy-making, in general, beyond the education sector.

2.8 Conclusion, limitations, and future research

The current research addresses the issue of how to foster intentions for sustainable enterprises for which profitability is not the ultimate objective (Markman et al., 2016). The study develops a model that explains the determinants of sustainable entrepreneurship by building on Ajzen's (1991) TPB. In doing so, the study extends the model so as to answer parts of the question "why, when, and how do some people and not others discover and exploit opportunities?" (Shane and Venkataraman's 2000, p. 218) in the context of sustainable development. In addressing this question, this research offers insights at the level of the individual entrepreneur into those mechanisms that can counter social dysfunctionality and moral disengagement among firms and that can support compassionate, emphatic, and pro-social organizations. In particular, this research lends support for the claim of identity coupling in the controversy between a *trade-off* and a convergence of entrepreneurial and sustainability orientations. We identify entrepreneurial attitudes, a sustainability orientation, and entrepreneurial norms as antecedents of sustainable entrepreneurship intentions. These elements reinforce the notion of an identity coupling process that happens at the forefront of entrepreneurial action.

The current study inevitably has some limitations that can open avenues for future research. The size of our sample is sufficient for an SEM, given its single-country focus, but future studies should extend the analysis to other countries. Additionally, future research should seek to obtain larger and more diverse samples. Specifically, although the relatively

high proportion of respondents with a master's or doctoral degree is apt for this research topic, given that highly qualified individuals are, from a knowledge-based perspective, more likely to generate the kind of disruptive innovations that might enable humankind to resolve sustainability issues. Our findings should be tested in future research on samples with lower proportions of such respondents.

With regard to the variables involved, we identified no scale for sustainability norms in the literature and, thus, had to develop a new scale. Although the validity measures for that scale were satisfactory for this study sample and for the pre-test sample, the scale could benefit from further validation in other samples, which consequently could offer another avenue for future research. We are aware of our deviation from the classical TPB model through using a more generalized version of perceived behavioral control, but feel confident that it is appropriate in our model. On the one hand, the variable shows strong correlations with other independent variables, especially with entrepreneurial attitudes, as one expects in a TPB model; on the other hand, our results fit well with the findings of other authors in the fields of social entrepreneurship and environmental management.

The aforementioned, double-edged nature of impact of the perceived control on sustainable venturing intention opens up new prospects of research as it remains unclear what causes the diametrical effect in the social and environmental space. Finally, our experimental measurement of sustainability relevance allows one to address novel questions in the future. What are individuals willing to sacrifice in terms of economic gains and security to stay true to their ideals? What role do attitudes and norms play in this trade-off? Addressing such issues could help to understand the underlying decision processes further and then to develop novel approaches to encouraging sustainable entrepreneurship.

3 Entrepreneurial decision-making, between self-interest and sustainability: A reputation multitask model

Abstract

Besides the multifaceted challenges that the entrepreneur faces, the considerations to act sustainably and to balance this goal with the profitability of a venture pose an additional challenge that has become more important in the recent decades. This chapter aims to take a first step towards building a theoretical framework for entrepreneurial decision-making in this realm. In joining the two principal agent models of Holmstrom and Milgrom (1991) and Bénabou and Tirole (2005), I formulate a multitask, reputation-based model. On this basis, recommendations for optimal incentive structures for sustainable entrepreneurs are deducted.

3.1 Introduction

Decision-making is one of the fundamental tasks an entrepreneur has to accomplish. In the face of great uncertainty that is normally associated with the business endeavors taken by start-ups, it might even be the most crucial ability of a founder. The ability to structure complex and unorganized information and to combine it within a well-reflected decision is essential to running a profitable business. The questions of how entrepreneurs come to a decision and which underlying mechanisms and characteristics influence this process have been a major concern in the entrepreneurship research community (Shepherd et al., 2015). Due to the relatively young nature of the sub-discipline of sustainable entrepreneurship, this topic has only been covered sparsely in the context of sustainable start-ups. The main research direction in this regard has been the identification of characteristics that have an impact on the decision to become an entrepreneur, particularly a sustainable entrepreneur (Kirkwood and Walton, 2010; Nga and Shamuganathan, 2010; Van de Ven et al., 1984). Entrepreneurs who endeavor to grow a business and to take into consideration all aspects of

sustainability, namely, concurrently creating benefits in the fields of economy, ecology, and sociology (Hall et al., 2010), need to deal with a choice dilemma of these fields' partly conflicting properties. The processes that guide the decision processes for catering and balancing these objectives have been analyzed by Shepherd, Patzelt, and Baron (2013) from a psychological perspective. To the best of my knowledge, a purely economic view on this issue has not been addressed yet.

The approach that I apply to determine which aspects do play a role in the dilemma of pursuing purely economic and public welfare goals simultaneously is based on the assumption of a utility optimizing entrepreneur, as Douglas and Shepherd (2000) describe. The basic setting is a simplified multi-task principal agent model as originally introduced by Holmstrom and Milgrom (1991). The agent represents risk-averse founders who have to decide on the amount of effort they will exert for two tasks: one creates economic benefit; the other creates public welfare. Their choice is based on the extrinsic incentive for these tasks and their own intrinsic utility gain. The incentives for the entrepreneur are set by the society that acts as the principal. It also maximizes returns by setting the incentives and gaining utility from the outputs produced by the entrepreneur, both economic and sustainable. I extend this model by including a reputational reward for the agent for the sustainable output. The idea of concerns for social reputation was initially presented by Bénabou and Tirole (2005) for single tasks. They have shown that extrinsic incentives can blur the positive signals an agent tries to send about his intrinsic motivation for a pro-social task. This, in turn, lowers the reputational reward and induces an image of a greedy individual that the agent tries to avoid. As a result, intrinsic motivation can be crowded out by extrinsic reward, and the overall exerted effort by the agent is then lower for a certain range of payment than in the case of no reward at all. The research questions that are addressed with this setup are as follows: *How does reputation affect the choice for effort levels in a multiple task model?* and *How does society need to set incentives for a risk-averse agent to optimize a sustainable output?* Besides

these main questions, the influence of several other parameters on the optimal effort level and incentive structure are analyzed.

The remainder of this paper is structured as follows. Initially, I review the related literature on sustainable entrepreneurship, entrepreneurial decision-making, principal agent theory, and institutional legitimacy to illustrate the research gap. As a first step, the variables used are introduced, and the model applied is explained in detail. Additionally, the context of the setup is determined. As a second step, I use backward induction analysis to determine the optimal levels for the effort exerted by the agent and for the payments of the society to the agent. The obtained insights are being discussed and societal implications drawn. The paper closes with a short summary and a review of its limitations.

3.2 Literature review

As mentioned above, four research directions are explicitly related to this article: (a) theoretical and empirical research on sustainable entrepreneurship, (b) decision theory based on an economic framework, (c) theoretical as well as experimental studies of principal agent theory, especially in the realms of entrepreneurship, and (d) institutional legitimacy in an agent-society setting.

3.2.1 Sustainable Entrepreneurship

There has always been a discussion in the business administration and economics research community as to whether pure economic rents and the social-ecological benefits created by a company are complementary or exclusive (Brønn and Vidaver-Cohen, 2009; Bryson and Lombardi, 2009; Sneirson, 2009). At the beginning of this research topic, the relations have predominantly been analyzed pairwise. Articles aimed in this direction are still being issued. There exists an extensive body of literature on corporate social responsibility (CSR) that links the pro-social behavior of profit-oriented entities to several outcomes (Aguinis and Glavas, 2012). While there have been ambiguous results in the past regarding

the influence of CSR on financial performance, these are seen to be outdated. Van Beurden and Gössling (2008) have performed a comprehensive literature review and have found a distinct positive relationship between CSR and economic performance in the majority of recent papers. Other authors have reported beneficial links of CSR to firm reputation (Brammer and Pavelin, 2006; Minor and Morgan, 2011; Turban and Greening, 1997), which, in effect, also has a positive impact on customer (Lii and Lee, 2012) and employee behavior (Ali et al., 2010; Rupp et al., 2006).

The other direction of research is ecological *green management* and its financial implications on firm performance. Here the results are less conclusive. In a review of quantitative papers, which analyses the relationship of these two measures, Molina-Azorin et al. (2009) have not pinpointed a clear picture of the relationship. They have found a slight tendency towards a positive relationship but admitted that due to limitations, such as diverse measures for profitability and green management as well as endogeneity, a clear conclusion cannot be made. The findings of Albertini (2013) have pointed in a similar direction. In a meta-analysis, she tested the aforementioned relationship, and her results indicated a positive link between *green management* and the financial measure of a firm. Yet she has qualified that her findings are strongly moderated by a set of external variables and are influenced by the measurement properties of the included studies. Overall, there are indicators that suggest that acting in an ecologically responsible manner has a positive impact on the overall financial performance of a business, but this effect is highly conditional.

The more recently evolved concept of sustainability has connected the dots between the realms of economy, ecology, and society. The most prominent idea regarding sustainability is the *triple bottom line* that demands that a business needs to generate profits for all the aforementioned dimensions to be called sustainable (Elkington, 1997). While sustainable development research that focuses on the analysis of established firms has gained acceptance in major scientific journals (Bansal, 2005; Gladwin et al., 1995; Hall and

Vredenburg, 2003; Siegel, 2009), sustainable entrepreneurship is a relatively new direction of research that has been published mostly in journals connected to the subject of entrepreneurship (Hall et al., 2010; Shepherd and Patzelt, 2011). As with every emerging field, the quest for a consistent definition and for theoretical frameworks has been a main objective. In this regard, the definition of sustainable entrepreneurship of Pacheco, Dean, and Payne (2010, p. 471) is the most comprehensive currently: "[…] the discovery, creation, evaluation, and exploitation of opportunities to create future goods and services that is consistent with sustainable development goals."

One major contribution in line with this definition comes from Cohen and Winn (2007) who have extended the realm of opportunities to include sustainable opportunities. In their view, this potential exists because of market failures such as inefficient firms, negative externalities, flawed pricing mechanisms, and imperfectly distributed information. Besides the slowly unfolding theoretical foundation of sustainable entrepreneurship in the literature, a small stream of research has identified those individuals who are likely to become entrepreneurs willing to tackle the complexity of the *triple bottom line*. Sustainable orientations have been assumed to positively influence the decision to become a sustainable entrepreneur, yet they are either crowded out by business experience (Kuckertz and Wagner, 2010) or only increase the likelihood of identifying the relevant opportunities (Wagner, 2012). These empirical findings correspond with the elucidations of Patzelt and Shepherd (2011), who have argued that the probability to sense sustainable opportunities is highest for those individuals who have an extensive knowledge about environmental threats, who feel that these threats are endangering their community, and who are altruistic towards others.

Along with the idea of an unexploited pool of potential for sustainable businesses comes the question of why the pool of sustainable entrepreneurs is so small. One approach, which is currently largely neglected in the field at hand and could yield insights into this question, is that of utility modelling for individual decision processes. The economic impact

of individual attitudes for sustainability, pure economic rents, and social-induced gains through reputation should be analyzed, and this is the main goal of this article. This analysis should give a clearer picture of the coherences between pure profit orientation and sustainable action in entrepreneurship.

3.2.2 Economic decision theory

Entrepreneurial decision-making processes can be classified into four categories: opportunity assessment, entrepreneurial entry, opportunity exploitation, and entrepreneurial exit (Shepherd et al., 2015). In this article, I address explicitly the exploitation of opportunities. Shepherd et al. (2015) have identified two important research fields in the nexus of entrepreneurial decision-making: namely, applied heuristics and the environment as a contextual parameter. These are combined in this analysis to gather a comprehensive understanding of the exploitation decisions of sustainable entrepreneurs. Before I go into further detail, an excursion into the problematic nature of economic decision theory is necessary.

The rational agent, as interpreted by Neumann and Morgenstern (1947), has faced substantial criticism. The idea of a utility-maximizing individual who makes his or her decisions under complete rationality based on the available information has been perceived by behavioral economists to be too constrained to depict reality accurately. An often-cited economic experiment in this regard is the ultimatum game (Güth et al., 1982). In this game, a Player A has to decide which share of a certain sum he will give to Player B, after which he can keep the remainder. Player B either can accept the offer of Player A and receive the given share or can decline the offer. In this case, both players have an outcome of zero. While a utility-maximizing Player A would offer the lowest possible amount and Player B would always accept, this behavior has not been observed in economic experiments. Oosterbeek et al. (2004) have conducted a meta-analysis of the ultimatum game in several countries and have found that the offered share is on average 40% and that the probability of rejection

rises the lower the offer is. These deviations from the theoretical model can be explained either by the abstract ideas of fairness and altruism or by the concept of inequality-averse individuals. A reasonable modification to handle this could be the application of the utility function of Fehr and Ernsts (1999) for the players in the game. This entails both the costs of compassion and the costs of envy that push an individual to solve any game in which all players receive similar outcomes. If in a set of potential Players B the proportion of inequality-averse individuals is large enough, it becomes reasonable for a set of potential Players A, including purely self-interested individuals, to offer a higher share. To deal with shortcomings of the rationality assumption, two directions have been, in general, conceived: either the researcher follows the approach of behavioral economists and utilizes concepts of adjoining disciplines such as sociology, psychology, and neuro-economics or, otherwise, he or she extends the basic economic model with additional conditions for the utility-maximizing individual. Both directions do have their advantages and disadvantages. On the one hand, behavioral economics can explain human behavior more precisely and over a range of differing incidents, but it lacks measurability and unambiguity due to the application of the abstract concepts used in non-economic disciplines (Bruni and Sugden, 2007; Etzioni, 2011). Classic economic modeling, on the other hand, provides measurable concepts that may be applicable for a substantial set of economic problems, yet they may fail in certain setups, such as in the ultimatum game. This might be caused by incomplete knowledge or by limited capabilities for processing information. Wilkonson and Klaes (2012) have attributed theses causes to the *bounded rationality* of an individual. A given model can become rather complex when it accounts for these various shortcomings with the help of model extensions.

One basic assumption regarding entrepreneurs is that the strong dependence of their behavior on economic incentives and the dominant regulation design determine their behavior (Baumol, 1996). The idea of utility maximization has been applied to entrepreneurial entry decisions. The comparison of expected effort, income, and associated

risk with an outside, non-entrepreneurial option, such as a white-collar employment, can be applied as a heuristic to decide if self-employment is an option for an individual (Douglas and Shepherd, 2000). In this particular case, the assessment of an opportunity and the entry decision are modelled through an optimization problem for the individual based on his or her own preferences. The potential entrepreneur determines if the option of self-employed labor generates more expected utility than an activity as an employed person. By taking into account individual preferences, this approach expands the classic economic model. As I mentioned earlier, Shepherd et al. (2013) have examined the behavior of entrepreneurs at the stage in which a cooperation has already been established. They have aimed to explain the divergent demeanor, in contrast to their private values, of individuals when it comes to a choice of opportunities that may have a negative impact on the ecosystem. In a choice-based conjoint analysis, the researchers have found that entrepreneurs often choose options that are not in line with their intrinsic motivations. As an explanation, the researchers have proposed the notion of *moral disengagement*, which is a construct that builds on the idea of Banduras' (1991) self-regulation theory. They have argued that the more attractive an opportunity is in the dimension of economic benefit the more likely the individual is to disengage him- or herself from personal values to avoid an internal conflict. With this psychological approach of explaining human decisions, these researchers have followed the path of behavioral economics. To summarize these two papers, one applies traditional economics at an early stage in the pre-establishment of a firm and during the entry decision, while the other explores the realm of opportunity assessment in an already existent organization by the entrepreneur with psychological constructs. Based on this, two research gaps are apparent: either the entry decision is analyzed with the means of behavioral economics or the decision behavior of established entrepreneurs is modelled through classic economic methods. This paper strives to do the latter and to extend a so-called LEN model

(Milgrom and Roberts, 1992; Prendergast, 1999) to explain effort choices in a trade-off situation between pure economic profit and socio-ecological benefits.

3.2.3 Principal agent theory

Due to the nature of entrepreneurship, the LEN model and its underlying logic have been often applied to analyze the relationship between investors and start-ups and to optimize incentive structures (Arthurs and Busenitz, 2003; Bitler et al., 2005; Sapienza and Gupta, 1994). The relationship between start-ups and their social environment (which contains entities such as customers or institutions) has not been analyzed in the sustainable entrepreneurship literature. Subsequently, I introduce two essential articles of principal agent theory and their findings, which act as the scaffolding for the model described later on. Namely, these articles include one that tackles the multiple-task issue established by Holmstrom and Milgrom (1991) and another by Bénabou and Tirole (2005) about the influence of reputation and social interaction.

Prior to Holmstrom and Milgrom's (1991) article, only models with single tasks had been analyzed, and the interacting relationship between multiple tasks and the impact of incentive schemes on these had been largely neglected. In the course of the debate about variable payment for teachers in the US, these researchers created a model that was designed to solve the question as to whether a performance incentive for test scores of students would undermine teaching efforts for less measurable tasks such as creative thinking. The higher powered the incentive for one particular task in a set of interdependent tasks is and the less well measurable the complementary task is, the more an agent will discriminate his attention against the complementary task. This might result in an overall less desirable output. Therefore, it can be reasonable to rather pay a fixed wage than a variable package in employment situations in which the concomitant execution of several tasks is important (Holmstrom and Milgrom, 1991). In contrast to this multiple-task approach, Bénabou and Tirole (2005) have focused on the effort decision of an agent in a single-task setup. Their

primary concern has been the impact that the reputational concern of an agent has on the exerted effort. They argue that an individual has the desire to appear as pro-social, driven by intrinsic motivation that guides his or her decisions, and as a result builds a positive reputation. When his or her actions are visible, a higher-powered extrinsic incentive undermines the intrinsic motivation of the agent as he or she is no longer able to show his or her pro-social behavior but appears greedy. As a result, the agent does exert a lower level of effort for a particular range of extrinsic incentive schemes.

It may be optimal for the principal thus to either pay nothing at all or to pass a certain threshold of wage payment depending on the cost structure of the agent. The effects of extrinsic rewards for an agent do have diametrically opposed effects on the exerted effort for the particular task for which the payment is granted in the two studies. While in Holmstrom and Milgrom's (1991) model the effort rises with the variable pay for the reimbursed task, Bénabou and Tirole (2005) have proposed the aforementioned crowding-out effect of extrinsic incentives. One question this paper tries to answer is which effect predominates in a two-task setting in which one of the tasks is reputation-influenced. Do the reputational concerns of the agent also exert impact on the non-reputation-based task?

To transfer the concept of reputation into the realm of established entrepreneurial firms, a more holistic framework needs to be applied as the traditional idea of reputation of individuals does not cover enough aspects. Therefore, stakeholder theory can serve as a proxy to explain the ramifications of reputation against the background of an enterprise setting.

3.2.4 Stakeholder theory and reputation

Freeman's (2010) stakeholder theory may be one of the most cited theories in regards to firm reputation. He has stated that an organization is embedded in a social-economic environment consisting of diverse stakeholders. These stakeholders address certain sets of demands to the organization and act based on the fulfilment of those. In the case of a profit-

optimizing firm, the claims of the stakeholders need to be taken into consideration when formulating a strategy and when putting tactics into place since the actions of a group can yield influence on the firm's goals and plans (Donaldson and Preston, 1995).

This reasoning is in line with legitimacy theory and new institutionalism. In this framework, companies adjust to their surrounding social-institutional system to gain the legitimacy to exist (Gray et al., 1996; Mathews, 1993). To build reputation, entrepreneurial ventures have to engage in transaction relationships with multiple stakeholders on a repetitive basis. The additive outcome of historical actions and the corresponding evaluations of affected stakeholder groups constitute the reputation of a firm (Mahon, 2002). Expressed in other words, a company's reputation originates from signals received by these groups and the implicitly expected future actions of the firm. The associated value of reputation lies in the expectations towards the firm. A positive reputation may lower costs of negotiation caused by asymmetric information, even for non-stakeholders. Consequently, the actions of the present will shape the future interactions with both groups, stakeholders and non-stakeholders (Milgrom and Roberts, 1986; Rindova et al., 2007; Shapiro, 1983). The assessment of a firm's reputation may deviate between discrete stakeholders but in total reflects the average impression over time (Hutton et al., 2001). In order to grow a credible and sustainable reputation, it is necessary for an organization to build strong ties to all relevant parties (for examples, employees, customers, investors, communities, and government agencies).

Among the manifold intangible assets a company can own, corporate reputation is quite valuable. Due to its complex nature and the prerequisite of a consistent strategic and behavioral path, it creates a entry barrier that is hard to overleap. Moreover, its inherent characteristics do yield a capability that is difficult to imitate (Fombrun, 1996; Hall, 1992). As I stated earlier, a positive reputation has the potential to lower transaction costs by building trust between the negotiation partners. New prospective customers can base their

decisions as to whom to choose among a set of potential contractors mainly through the reputation of the contenders. It, therefore, comprises the chance to develop a sustainable and significant competitive advantage (Drejer, 2000; Miles and Covin, 2000; Roberts and Dowling, 2002). Some researchers have even assigned reputation a major role in terms of competitiveness (Kay, 1993; Vilanova et al., 2009).

The literature on the topic shows that theoretical benefits that are ascribed to corporate reputation do have empirical backing. This applies to output as well as input factors. On the one hand, a positive reputation increases customer willingness to pay for products and so enables the firm to gain a price premium (Brown and Dacin, 1997), it improves the perception of product quality and in consequence amplifies the sales force effectiveness (Grewal et al., 1998; Milgrom and Roberts, 1986), and it facilitates new product launches (Roberts and Dowling, 2002). In addition, reputation has positive long-term effects as it increases the brand loyalty of customers (Mackenzie, 2007). On the other hand, employees are more attracted to reputable companies, and these firms can retain talents easily (Greening and Turban, 2000; Schnietz and Epstein, 2005; Turban and Cable, 2003). Besides these functional advantages, reputation also has a positive impact on the financial outcomes over a longer period of time (Roberts and Dowling, 2002). Firms with this trait find it easier to identify recovery strategies for overcoming crises.

To come back to the main topic of this paper, I focus on the reputation of companies and entrepreneurial ventures in the non-commercial dimensions of sustainability: namely, ecology and sociology. The research directions that correspond to these dimensions circle around the terminologies of corporate social responsibility (CSR) and green management. As I delineated at the beginning of this subchapter, firms act as recipients of requirements from a diverse set of stakeholders. In this role, they need to take into account the needs of the society, which include the common goods and societal welfare (Van der Wiele et al., 2001). Corporate social responsibility and its relationship with stakeholder theory is a widely

covered topic in theoretical as well as empirical work (Clarkson, 1995; Donaldson and Preston, 1995; Jones, 1995). Based on the instrumental stakeholder theory, McWilliams et al. (2006) have argued that it may be beneficial for companies to enforce CSR activities that are in line with the main demands of their most relevant stakeholders.

This behavior yields multiple advantages. Maintaining a high level of CSR should strengthen the reputation of a firm for being accountable for its actions and being responsible towards its stakeholders (Greenwood, 2007). Most of the stated links between reputations, CSR, and inbound and outbound firm activities have been backed by empirical findings. Minor and Morgan (2011) have shown a positive relationship between CSR activities and a firm's reputation. Corporate social responsibility also has a positive impact on the economic dimension of sustainability, so increasing the financial performance of companies (Van Beurden and Gössling, 2008). Customer behavior (Lii and Lee, 2012) and employee behavior (Ali et al., 2010) are both influenced in favor of a firm that engages in CSR-related operations. In contrast to CSR, *green management* has not been a major concern in leading journals. A theoretical link between proactive stakeholder management and an environmental-friendly strategy has been made and empirically supported (Buysse and Verbeke, 2003). A direct relationship to a firm's reputation still needs to be shown. While there is evidence of a positive influence of *green management* on general firm performance (Dwyer et al., 2009) and financial measures (Albertini, 2013), these findings are less conclusive due to diverse measures for *green management* and diverse moderating effects.

3.3 Model

In this article, I combine the fundamental papers of Holmstrom and Milgrom (1991) and Bénabou and Tirole (2005) to evaluate the optimal incentive structure of a society for a utility-optimizing entrepreneur. The model is structured as follows. The society represents the principal who is able to remunerate the agent, depicted by the entrepreneur, for his efforts

in a two-task setting. These rewards can either be purely monetary or of a more abstract nature, such as the legitimation to operate or other non-monetary benefits. Yet both forms of payment are contained in a single variable for extrinsic motivation for each task. The entrepreneur has to choose which effort he wants to exert in the two tasks, thereby creating economic value and creating socio-ecological value. Thus, $a_e \in \Re$ is the agent's effort level for an economic output, while $a_{sus} \in \Re$ is the effort linked to the creation of sustainable returns. Both effort levels cause private costs $C(a_e, a_{sus})$ for the entrepreneur. A set of assumptions that regard the deployed functions, the principal, and the agent are made. The utility function of the principal is linear and additive with respect to the effort levels exerted by the agent. $C(a_e, a_{sus})$ increases with effort and is convex (for each additional effort unit, the costs increase exponentially). The cost function assumes a certain level of substitutability between the efforts. This means that the costs of exerting effort for task one may, to a certain degree, be influenced by the effort for task two. This linkage is explained later through using an example for the entrepreneur's cost function. The society is risk-neutral against the outcome of the single agent as it can diversify its risk over a high number of entrepreneurs and ventures. Additionally, it can summarize the results of several agents. This results in an additive gross benefit that grows linear with the individual efforts exerted by the entrepreneur in both dimensions. The overall objective of the principal is to maximize:

$$\Pi_P = a_e + a_{sus} - w \tag{1}$$

with w denoting the wage paid by the principal to the agent. As the resources of society are abundant in comparison to a single company, no budget constraint is applied. The wage disbursed by the principal is conditional of two signals, which are observable by the general public:

$$e\left(a_e\right) = a_e + \varepsilon_1 \tag{2}$$

and

$$s\left(a_{sus}\right) = a_{sus} + \varepsilon_2 \tag{3}$$

that are dependent on a pair of surrounding interferences $(\varepsilon_1, \varepsilon_2)$. These can be thought of as ambient forces, such as external market shocks or technological advancements, that lie outside the sphere of influence of the agent. The interferences follow a normal distribution centered at zero with the following variance-covariance matrix, under the assumption of non-correlated variances:

$$\sum = \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix} \tag{4}$$

In contrast to the principal, the single agent cannot diversify his or her risk and, therefore, is risk-averse regarding his utility outcomes. The agent's utility function can be stated as:

$$u(z) = -e^{-rz} - c \tag{5}$$

with r representing a positive risk aversion of the agent that stays constant over all manifestations of z. The basic utility level is reached with z, given a risk-indifferent agent. The agent's utility is reduced by the costs c imposed on him for exerting effort for the two tasks. In my model, z is given by the following:

$$z = wV_y + a_{sus}V_{a_{sus}} + R \tag{6}$$

where w depicts the wage received by the agent, and a_{sus} is a positive constant that represents an intrinsic benefit that the agent gains when he or she performs the task with a sustainable outcome; R denotes the reputational concerns of the entrepreneur in appearing pro-social as well as pro-environmental. I discuss the relevance of the reputational function in a coming step when constructing the certainty equivalent (CE) of the agent. The terms V_y and $V_{a_{sus}}$ embody the valuations the agent has for an extrinsic reward and intrinsic effort, respectively.

Due to the assumption of an absolute level of risk aversion that stays constant over different values of income, the findings of Holmstrom and Milgrom (1987) can be applied,

and linear contracts are the object of study. As corporations that work on a profit-oriented basis do normally not receive a non-performance-based reward from society, a fixed remuneration component is not included in the agent's reward scheme:

$$w = y_e \cdot e(a_e) + y_{sus} \cdot e(a_{sus}) \tag{7}$$

The variables y_e and y_{sus} denote the variable payment the entrepreneur receives for the signals of his or her economic and sustainable effort. On basis of the utility function's exponential form, the certainty equivalent is given by:

$$CE = E\Big[\big(y_e\, e(a_e) + y_{sus}\, e(a_{sus}) \big)\, V_y + a_{sus}\, V_{a_{sus}} + R - c - r_{av} \Big] \tag{8}$$

This formulation entails the expected value of the extrinsic remuneration as well as effort for the sustainable task multiplied by the associated valuation. Additionally, terms for reputation (R), costs linked to the effort levels for both tasks (c), and a discount for risk aversion (r_{av}) are included. In the following paragraphs, I elucidate these elements more specifically and plug them into the certainty equivalent equation.

In borrowing from the work of Bénabou and Tirole (2005), reputational concerns in this paper are defined as follows:

$$R = \chi\Big(\gamma_i E\big[V_{a_{sus}}(a_{sus}, y_{sus}) \big] - \gamma_e E\big[V_y(a_{sus}, y_{sus}) \big] \Big) \tag{9}$$

The reputational term consists of three parts. χ constitutes the visibility of task execution for the society. The first term in brackets depicts the signaling value for the agent of his or her pro-social, pro-environmental intrinsic motivation. It is composed of the utility measure γ_i multiplied by the expected value for the agent's valuation of sustainable effort given a certain level of effort and extrinsic reward for the effort. In other words, it can be interpreted as the perception of intrinsic motivation of the agent from the outside. In contrast, the second term in brackets illustrates the negative signaling value for extrinsic motivation. Like its counterpart, it consists of the utility measure γ_e denoting the displeasure received by the

agent and the expected value of the extrinsic valuation. Based on the effort exerted and the given reward for this effort, an outside observer, such as society, can estimate the value of extrinsic gratification for the agent. In combination, these two terms can be interpreted as the perceived greed of the entrepreneur for the sustainable task. As the agent wants to be appreciated as pro-sustainable, the perception of greediness causes him disutility. To simplify the total term of reputation, I apply the substations that have also been used by Bénabou and Tirole (2005):

$$\mu_i = \chi\gamma_i \tag{10}$$

and

$$\mu_e = \chi\gamma_e \tag{11}$$

As a result, reputation is given as follows:

$$R = \mu_i E\left[V_{a_{sus}}\left(a_{sus}, y_{sus}\right) \right] - \mu_e E\left[V_y\left(a_{sus}, y_{sus}\right) \right] \tag{12}$$

For the purpose of this paper, I selected an exemplary manifestation of the cost function that fulfills certain requirements. It increases quadratic for each effort type and incorporates the aforementioned factor of substitutionality g. The higher this degree is, the more costs are incurred by the agent for each additional unit of effort for the one task, given a certain level of the other task, and vice versa. The factor K denotes the individual's personal cost disinclination. The cost function is thereby given as follows:

$$c = \frac{\mathrm{K}}{2}\left(a_e^{\,2} + a_{sus}^{\,2} + 2\,g\,a_e\,a_{sus}\right) \tag{13}$$

The last element of the CE is the agent's risk aversion. I assumed that the individual dislikes uncertainty, and, therefore, variation in his or her wage reduces utility. The measure ρ depicts the agent's risk preference.

$$r_{av} = \frac{1}{2}\,\rho\,Var(w) \tag{14}$$

Table 5 Variables used in the model

Variable	Description	Variable	Description
Π_P	Profit for society	R	Reputational concerns of the agent
$e(a_e), e(a_e)$	Performance signals	y_e, y_{sus}	Reward for agent's performance
a_e, a_{sus}	Effort levels of the agent	χ	Visibility of effort
$\varepsilon_1, \varepsilon_2$	Measurement errors	γ_i, γ_e	Importance of perception
w	Wage of the agent	μ_i, μ_e	Reputational impact
${\sigma_1}^2, {\sigma_2}^2$	Variances of meas. errors	K	Cost factor of the agent
σ_{12}, σ_{21}	Covariances of meas. errors	g	Degree of substitutability of tasks
$u(z)$	Utility function of the agent	ρ	Risk preference of the agent
r_{av}	Risk aversion	${\varpi_{a_{sus}}}^2, {\varpi_y}^2$	Variances of meas. errors
z	Utility of risk-neutral agent	$\varpi_{ya_{sus}}, \varpi_{a_{sus}y}$	Covariances of meas. errors
c	Cost function of the agent	φ	Probability due to ext. motivation
$V_y, V_{a_{sus}}$	Valuation for ext. and int. reward	θ	Probability due to int. motivation

The uncertainty equivalent, as a result, consists of the extrinsic as well as intrinsic reward for exerting the two tasks, the associated reputational returns, occurred costs for the effort levels, and the risk deduction:

$$CE = \left(y_e a_e + y_{sus} a_{sus}\right) V_y + a_{sus} V_{a_{sus}} + \mu_i E\left[V_{a_{sus}}\left(a_{sus}, y_{sus}\right)\right] - \mu_e E\left[V_y\left(a_{sus}, y_{sus}\right)\right] - \frac{1}{2} K\left(2 a_e a_{sus} g + {a_e}^2 + {a_{sus}}^2\right) - \frac{1}{2} \rho\left({y_e}^2 {\sigma_{\varepsilon_1}}^2 + {y_{sus}}^2 {\sigma_{\varepsilon_2}}^2\right) \quad (15)$$

3.4 Analysis

The aim of this paper to identify the optimal reward levels from the society to individuals who try to maximize their utility in a two-task setting. The reward of the agent is partly composed of intrinsic and reputational elements. To what extent these influence the agent's decision to execute each task is part of this paper's objective. Consequently, the analysis of the model is carried out in four separate steps. The process follows the idea of backward induction so that the optimal manifestations of y_e and y_{sus} can be identified on

the basis of the general reaction to a set of possible payments. First, I determine the entrepreneur's optimal effort levels a_e and a_{sus} for each task isolated from and dependent on each other. Second, I combine the results of step one to obtain the independent values of the effort levels. Subsequently, the utility-maximizing payments for society are obtained under the condition of meeting the participation constraint (PC) of the agent. Finally, I deduce a set of propositions from the results for the payment levels.

By taking into account the utility function of an entrepreneur, contracts offered by society need to balance the marginal surplus with the marginal costs for each additional unit of effort exerted by the agent. In order to obtain the choice of the agent for a_e, the partial derivation of CE with respect to a_e is used:

$$\frac{\partial CE}{\partial a_e} = y_e V_y - \mathrm{K}\, a_{sus} g + K a_e \tag{16}$$

In solving the equation (16) for a_e, the following formula is obtained:

$$a_e = \frac{V_y y_e}{\mathrm{K}} - a_{sus} g \tag{17}$$

This result is close to that of Holmstrom and Milgrom (1991), and it makes sense intuitively. While the valuation of extrinsic motivation and the amount of remuneration increase the realized effort, the individual's cost factor decreases it. The two tasks and their respective effort levels, a_e and a_{sus}, act as substitutes, and the effect increases with the degree of substitutability.

To determine the optimal level of effort for a_{sus}, I once more borrow from the work of Bénabou and Tirole (2005). Analog to the economic effort, the marginal returns in this case also need to be equal to the associated costs. The first derivative of CE with respect to a_{sus} fulfils this condition for an agent with type (V, μ).

$$\frac{\partial CE}{\partial a_{sus}} = y_{sus}\, V_y + V_{a_{sus}} + R'\left(a_{sus}, y_{sus}\right) - \mathrm{K}\, a_e g + K a_{sus} \tag{18}$$

They have stated that it is possible to backward induct an agent's sum of extrinsic and intrinsic motivation by his or her choice of a_{sus}. To limit the complexity of the model, the reputational impact was assumed to be the same for all agents ($\overline{\mu_i}$, $\overline{\mu_e}$). The valuations (V_y, $V_{a_{sus}}$) are normally distributed for all entrepreneurs with the following variances:

$$\begin{bmatrix} V_{a_{sus}} \\ V_y \end{bmatrix} \sim N \begin{bmatrix} \varpi^2_{a_{sus}} & \varpi_{a_{sus}y} \\ \varpi_{ya_{sus}} & \varpi^2_y \end{bmatrix} \tag{19}$$

By utilizing standard signal-extraction, the expected values for V_y and $V_{a_{sus}}$ can be retained (Bénabou and Tirole, 2005).

$$E\left(V_y \middle| a_{sus}, y_{sus}\right) = \overline{V}_y + \theta\left(y_{sus}\right)\left(\mathrm{K}\, a_e g + K a_{sus} - y_{sus}\overline{V}_y - \overline{V}_{a_{sus}} - \overline{R}'\left(a_{sus}, y_{sus}\right)\right) \tag{20}$$

$$E\left(V_{a_{sus}} \middle| a_{sus}, y_{sus}\right) = \overline{V}_{a_{sus}} + \varphi\left(y_{sus}\right)\left(\mathrm{K}\, a_e g + K a_{sus} - y_{sus}\overline{V}_y - \overline{V}_{a_{sus}} - \overline{R}'\left(a_{sus}, y_{sus}\right)\right) \tag{21}$$

with

$$\varphi\left(y_{sus}\right) = \frac{\varpi^2_{a_{sus}} + y_{sus}\varpi_{a_{sus}y}}{\varpi^2_{a_{sus}} + 2y_{sus}\varpi_{a_{sus}y} + {y_{sus}}^2\varpi^2_y} \tag{22}$$

and

$$\theta\left(y_{sus}\right) = \frac{y_{sus}\varpi^2_y + \varpi_{a_{sus}y}}{\varpi^2_{a_{sus}} + 2y_{sus}\varpi_{a_{sus}y} + {y_{sus}}^2\varpi^2_y} \tag{23}$$

An outside observer is able to extract the valuation for extrinsic and intrinsic motivations of the entrepreneur by observing the average valuation of these motivations ($\overline{V}_y$, $\overline{V}_{a_{sus}}$) that manifested earlier and the marginal reward that is conditional on the level of a_{sus}. Marginal reward in this case consists of marginal costs, reputational income, and an extrinsic reward (Bénabou and Tirole, 2005). In the particular case of unanimously distributed reputational concerns for all agents, Bénabou and Tirole (2005) have found a universal solution to the linear differential equation system; this can be adapted to the current case as follows:

$$\Gamma\left(a_{sus}, \mu\left(y_{sus}\right)\right) \equiv \int_0^{+\infty} f\left(K a_{sus} + K g a_e - \left(\overline{\mu}_i \varphi\left(y_{sus}\right) - \overline{\mu}_e \theta\left(y_{sus}\right)\right) K z\right) \mathrm{e}^{-z}\, \mathrm{d}z \tag{24}$$

Solving the equation (24) for a_{sus} gives

$$a_{sus} = \frac{\overline{V}_{a_{sus}} + y_{sus}\overline{V}_y}{K} - Kga_e + \overline{\mu}_e\theta(y_{sus}) - \overline{\mu}_i\varphi(y_{sus}) \tag{25}$$

In substituting equation (25) into (17) and solving for $a_{e,}$ the following is returned:

$$a_e = \frac{y_e V_y - g\left(y_{sus}V_y + V_{a_{sus}} - K\overline{\mu}_i\varphi(y_{sus}) + K\overline{\mu}_e\theta(y_{sus})\right)}{K - K^2 g^2} \tag{26}$$

In substituting equation (17) into (25) and solving for $a_{sus,}$ the following is returned:

$$a_{sus} = \frac{y_{sus}V_y + V_{a_{sus}} - K\left(gy_e V_y + \overline{\mu}_i\varphi(y_{sus}) - \overline{\mu}_e\theta(y_{sus})\right)}{K - K^2 g^2} \tag{27}$$

By keeping all other variables constant, the extrinsic motivations y_e and y_{sus} increase the effort for the task associated with the reward. In contrast, higher-born individual costs (K) and a higher degree of substitutability of tasks lower the effort exerted by the entrepreneur. For an economic effort a_e, the level of substitutability plays a major role. It determines to what extent the valuation of intrinsic and extrinsic motivations for the sustainable plus reputational concerns has an impact on the effort decision of the agent. Higher valuations for the sustainable rewards diminish the effort exerted in the economic task. Interestingly, the crowding-out effect of reputational concerns has a reversed effect on the effort level of the economic task. While a higher valuation to seem pro-social increases the economic effort according to a function that grows with y_{sus}, lower greed aversion decreases it.

I call this a reputational spillover effect. For sustainable effort a_{sus}, the intrinsic valuation for a_{sus} raises the effort level in addition to the extrinsic valuation. In the same way as for economic effort, the remuneration of the opposing task and the linked valuation lower the exerted effort to the degree of substitutability of both tasks. The crowding-out mechanism of reputation has a similar impact on sustainable effort (see Bénabou and Tirole, (2005). The external reward has a more negative impact on the exerted effort the more

intrinsically motivated the agent wants to be perceived, and a higher greed aversion has the same effect.

The first two steps of the initially described process have now been completed, and I can turn to the optimization problem of the principal on the supposition of the given behavior of the agent. The principal maximizes his or her outcome by choosing those reward levels y_e and y_{sus} at which the marginal returns as well as marginal and reputational costs of the agent are equal. The target function of the principal can be obtained by substituting equation (7) into (1), which results in the following formulation:

$$\Pi_P = (1 - y_e)\, a_e + (1 - y_{sus})\, a_{sus} \tag{28}$$

In a second step, I substitute the equations (26) and (27) into (28). To harness complexity and make the equation system solvable, I need to introduce an assumption. $\varphi(y_{sus})$ is set to 1 and $\theta(y_{sus})$ is set to 0.5; this represents a certain proportion of $\varpi_{a_{sus}}{}^2$ to $\varpi_{a_{sus}y}$ given a distribution of $V_{a_{sus}}$ and V_y dependent of y_{sus}. The target function in this particular case then is given as follows:

$$\Pi_P = \frac{(1 - y_e)\left(y_e V_y - g\left(y_{sus} V_y + V_{a_{sus}} - K\overline{\mu}_i + \frac{1}{2} K\overline{\mu}_e\right)\right)}{-K^2 g^2 + K} + \frac{(1 - y_{sus})\left(y_{sus} V_y + V_{a_{sus}} - K\left(g y_e V_y + \overline{\mu}_i - \frac{1}{2}\overline{\mu}_e\right)\right)}{-K^2 g^2 + K} \tag{29}$$

Analogously to the optimization problem of the agent, I can generate the partial derivatives with respect to y_e and y_{sus}. These are given by the following:

$$\frac{\partial \Pi_P}{\partial y_e} = \frac{(1 - y_e) V_y - (1 - y_{sus}) K V_y g - y_e V_y - g\left(y_{sus} V_y + V_{a_{sus}} - K\overline{\mu}_i + \frac{1}{2} K\overline{\mu}_e\right)}{-K^2 g^2 + K} \tag{30}$$

and

$$\frac{\partial \Pi_P}{\partial y_{sus}} = \frac{(1 - y_{sus}) V_y - (1 - y_e) V_y g - y_{sus} V_y - V_{a_{sus}} + K\left(g y_e V_y + \overline{\mu}_i - \frac{1}{2}\overline{\mu}_e\right)}{-K^2 g^2 + K} \tag{31}$$

Setting the equations (30) and (31) equal to zero to obtain a maximum and solving for y_e and y_{sus} respectively results in the following:

$$y_e = \frac{1}{2} \frac{V_y + g\left(V_y y_{sus} + V_{a_{sus}}\right) + Kg\left(V_y y_{sus} - V_y - \overline{\mu}_i + \frac{1}{2}\overline{\mu}_e\right)}{V_y} \tag{32}$$

and

$$y_{sus} = \frac{1}{2} \frac{V_y - V_{a_{sus}} + g\left(y_e V_y - V_y\right) + K\left(V_y g y_e + \overline{\mu}_i - \frac{1}{2}\overline{\mu}_e\right)}{V_y} \tag{33}$$

The results in equations (32) and (33) are still relative to the remuneration of the respective other task, but the basic underlying mechanisms can be interpreted. Following intuition, the valuation for remuneration of the agent should be positively linked to the optimal incentive amount. From equation (32) and (33), it is apparent that this inference is highly dependent on the degree of substitutability of tasks (g) and the individual cost factor of the agent for exerting effort (K). In return, the impact of these two factors on the incentive scheme is strongly moderated by the payment for the opposite task. The effect of intrinsic valuation for the sustainable task is evident from the two equations. While an increase of this variable increments the ideal incentive for the economic task, it decreases the optimal reward level for the sustainable task. The effects of reputational concern are contrary to the reasoning of Bénabou and Tirole (2005) for single tasks. A principal should lower his or her reward for the output of the economic task when the inclination to appear pro-sustainable is highly distinct in the entrepreneur. The opposite is true for the sustainable task. In contrast to this, the optimal incentive is positively linked to the agent's repulsion towards seeming greedy for the economic task, and the optimal incentive is negatively linked to the sustainable task.

To obtain results for the reward levels the principal should pay in order to maximize his or her own outcome, I substitute equation (32) into (33), and vice versa. By solving the resulting equations for the respective variable, the following is given:

$$y_e = \frac{K^2 g\left(\frac{1}{2}\overline{\mu_e} - \overline{\mu_i}\right) + K g^2 V_y + K g\left(V_y + V_{a_{sus}} + \overline{\mu_i} - \frac{1}{2}\overline{\mu_e}\right)}{V_y\left(K^2 g^2 + 2Kg^2 + g^2 - 4\right)} + \frac{V_y\left(g^2 - g - 2\right) - g V_{a_{sus}}}{V_y\left(K^2 g^2 + 2Kg^2 + g^2 - 4\right)} \tag{34}$$

and

$$y_{sus} = \frac{K^2 g^2\left(V_y + \overline{\mu_i} - \frac{1}{2}\overline{\mu_e}\right) + K g^2\left(V_y - V_{a_{sus}} + \overline{\mu_i} - \frac{1}{2}\overline{\mu_e}\right) - K\left(V_y g + 2\overline{\mu_i} - K\overline{\mu_e}\right)}{V_y\left(K^2 g^2 + 2Kg^2 + g^2 - 4\right)} + \frac{V_y(g-2) + V_{a_{sus}}\left(-g^2 + 2\right)}{V_y\left(K^2 g^2 + 2Kg^2 + g^2 - 4\right)} \tag{35}$$

3.5 Propositions

Due to the high complexity of the obtained solution, numerical examples are conducted for both incentive schemes. This facilitates the comprehensibility of the overall model. While keeping all other variables constant, I vary each parameter independently and observe the resulting optimal extrinsic motivation for the agent. The manifestation of all non-variated variables is 0.5, unless stated differently. This practice is based on an article by Block (2011). The chosen manifestations are just one potential option and serve as a threshold, while other combinations are conceivable. As the individual cost factor of the agent (K) and the degree of substitutability (g) are those variables influencing the outcome of the equations the most, I qualify their impact on the variations in the following paragraphs.

Table 6 depicts the numerical example for the reward given by the principal agent for economic output; **Table 7** gives the numbers for sustainable output. In the first step, I analyze the results of **Table 6**. The progression of the optimal incentive value over the

Table 6 Optimal extrinsic motivation based on model parameters (economic)

K	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**
y_e	0.73	0.68	0.62	0.58	0.54	0.5	0.47	0.45	0.43	0.42	0.43
K	**2.2**	**2.4**	**2.6**	**2.8**	**3**	**3.2**	**3.4**	**3.6**	**3.8**	**4.0**	**4.2**
y_e	0.46	0.53	0.71	1.31	---	-1.24	-0.64	-0.46	-0.38	-0.33	-0.31
g	**0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**
y_e	0.5	0.48	0.47	0.47	0.49	0.6	-0.16	0.25	0.3	0.31	0.32
μ_e	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_e	1.6	1.2	0.8	0.4	0	-0.4	-0.8	-1.2	-1.6	-2	-2.4
μ_i	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_e	-1.4	-0.6	0.2	1	1.8	2.6	3.4	4.2	5	5.8	6.6
V_y	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_e	---	0.9	0.65	0.57	0.53	0.5	0.48	0.47	0.46	0.46	0.45
V_{sus}	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_e	1.4	1.08	0.76	0.44	0.12	-0.2	-0.52	-0.84	-1.16	-1.48	-1.8

Note: K = 2.5; all other parameters are set to 0.5.

individual cost factor is described by a curve with a positive curvature that drops after a certain value. The initial slope and degree of curvature as well as the manifestation of K at which the function drops are determined by g. The effect of g on the drop realizations is relatively unambiguous. The higher the degree of substitutability is, the lower is the level of K at which the drop happens.

Proposition 1: Individual cost factor on economic extrinsic incentive

From equation (34), it follows, ceteris paribus, that a certain level of the individual cost incurrence exists at which the optimal incentive for the agent sharply declines.

By transferring this rationale into a real-world application, it implies that society has a reason to pay a certain intrinsic motivation to the entrepreneur. This holds true to a point at which the cost function of the agent dramatically increases for each additional unit of effort exerted. At the point of this shift, the optimal remuneration might even become negative and might

depend on the other factors of the model. The entrepreneur then has no reason to accept the contract offered and will not exert any effort. The effect is amplified by the degree of substitutability of the two tasks (I discuss this in the second proposition). In summary, there is a certain cut-off value for the efficiency of the entrepreneur after which it makes less sense for society to compensate him or her for his or her effort.

The curve shape of the relationship between the degree of substitutability and the optimal extrinsic motivation for economic effort is dichotomous. Below the value of 1 for the individual cost factor, the function increases weakly over the degree of substitutability. Above this threshold, the progression of the function is similar to the one described above in Proposition 1. A positive curvature and drop after a certain value of g describe the curve. The following propositions can be stated analogous to Proposition 1:

Proposition 2: Degree of substitutability on economic extrinsic incentive

From equation (34), it follows, ceteris paribus, that a certain level of the degree of substitutability of tasks exists at which point the optimal incentive for the agent sharply declines for high individual costs.

also,

*Proposition 3: D*egree *of substitutability on economic extrinsic incentive*

From equation (34), it follows, ceteris paribus, that over the degree of substitutability of tasks the optimal incentive for the agent increases for low individual costs.

The joint outcome of these two assertions is that an advice directed at society is twofold. On the one hand, society deals with efficient entrepreneurs. These should be rewarded independent of the degree of substitutability. On the other hand, less efficient agents have to be treated more divergently. Society either should offer higher-powered extrinsic incentives to entrepreneurs with business models that have a low level of task substitutability. Or it should pay a low remuneration to start-ups that suffer higher costs for additional exerted effort because of substitutability. For entrepreneurs who do not follow a clearly

oriented strategic approach regarding incorporation of sustainable goals, the optimal incentive is so small that it is uncertain whether the entrepreneurs would accept a potential contract at all. Consequently, society should pay a premium to economic outcomes of entrepreneurs for whom sustainability is a core concern of their business and who do not have to bear heightened additional costs to reach goals in the realm of sustainability. The degree at which the balance switches from high to lower extrinsic motivation is dependent on the efficiency of the agent. The less efficient the entrepreneur is, the lower is the degree of substitutability at which the drop of optimal reward is located.

The impact of reputation on the optimal incentive scheme is two-sided. Both the urge of the entrepreneur to appeal as pro-sustainable and the compulsion to avoid being seen as greedy have a linear but divergent effect on the optimal extrinsic reward for economic output. The extent to which the divergence is represented in the slopes of the curves is defined by the ratio of the $\varphi(y_{sus})$ to $\theta(y_{sus})$. The moderation effects of individual cost factor and the degree of substitutability are complex. Given a low value of individual costs and a low degree of substitutability, the effect of increasing the concern to appear sustainable on the optimal reward is negative. The opposite is true for the rising aversion for an image of avarice. While a high level of individual costs inverts these links, an extremely high value of this variable produces the same but amplified outcome as the low manifestation. A high degree of substitutability reverses the aforementioned relationships between pro-sustainable as well as greediness concerns and optimal extrinsic motivation for low and high individual costs. The previously defined linkage between the three variables on an extremely high level of individual costs is independent of the degree of substitutability. The following propositions can, therefore, be stipulated:

Proposition 4: Reputational concerns on economic extrinsic incentive

From equation (34), it follows, ceteris paribus, that the relationship between the optimal incentive for the agent and reputation-related factors is linear and either positive or negative for low and high individual costs and degree of substitutability. The slope is dependent on the combined degree of the latter two variables.

also,

Proposition 5: Reputational concerns on economic extrinsic incentive

From equation (34), it follows, ceteris paribus, that for exceedingly high individual costs the impact of rising image concern for a pro-sustainable appearance is negative on the optimal incentive for the agent; in contrast, increasing the aversion for an image of greediness raises the reward scheme.

The reputational spillover effect that is observable at the level of effort optimization by the agent also exists for the optimization problem of the principal. For low and high levels of efficiency for the entrepreneur, the relationship between reputational concerns and optimal payment is not straightforward. For entrepreneurs who are either efficient and have a clear strategic sustainable direction or less efficient and see sustainability more as an additional trait of their practice, an increase of concern for a positive reputation should decrease the reward coming from society. In contrast, agents who are efficient and do not concentrate on sustainable business models or who are strategically coherent but less efficient should be rewarded higher—in a linear relationship to their reputational concern. Extremely inefficient businesses should receive less the more they care for the pro-sustainable image, independent of their strategic direction.

Turning to valuations of the agent and its influence on the optimal payment scheme, I initially analyze the outcome regarding intrinsic valuation for the sustainable task, and afterwards I turn to the valuation for extrinsic incentive. The description of the curve shape for intrinsic motivation is relatively straightforward as it resembles the shape of the

greediness curve, only diverting in the factor of the slope. As a result, I postulate the following proposition:

Proposition 6: Intrinsic motivation on economic extrinsic incentive

From equation (34), it follows, ceteris paribus, that the relationship between the optimal incentive for the agent and the intrinsic motivation is linear—and either positive or negative for low and high individual costs and for the degree of substitutability. The slope is dependent on the combined degree of the latter variables. For especially high individual costs, the slope is positive but the absolute level likely negative.

The implications of this with respect to intrinsic motivation are similar to those mentioned regarding aversion to an image of greediness. While the description of the relationship between intrinsic motivation and extrinsic incentive can be resumed concisely, the relationship between extrinsic valuation and reward needs to be more extensively outlined, regarding the second of which the curve shape characterizing this link is an asymptote approaching a certain value of extrinsic remuneration. The direction of convergence is determined by the levels of individual costs and by the degree of substitutability. Agents with a low amount of individual costs are represented by a decreasing function, independent of the level of substitutability. Especially high costs engender an increasing curve over the level of extrinsic valuation. For high costs, the degree of substitutability defines the slope of the function. A low degree produces a decreasing curve. A high degree produces an increasing curve. In summary, the following propositions can be stipulated:

Proposition 7: Extrinsic motivation on economic extrinsic incentive

From equation (34), it follows, ceteris paribus, that over the level of extrinsic motivation the optimal incentive for the agent decreases for low individual costs. The optimal incentive increases for very high individual costs.

also,

Proposition 8: Extrinsic motivation on economic extrinsic incentive

From equation (34), it follows, ceteris paribus, that over the level of extrinsic motivation the optimal incentive for the agent decreases for a low degree of substitutability, given high individual costs. For a high degree of substitutability, it increases.

The ideal reward from the society for efficient entrepreneurs should be positive at any given valuation of the agent. The more utility the entrepreneur obtains from a unit of extrinsic motivation, the less the principal has to pay per unit. In case of an especially inefficient start-up, the principal should not pay any positive amount except for those businesses with a clearly distinct profit-oriented strategy. Here, it may make sense to offer any remuneration when they assign a high value to it. Given an inefficient agent, the optimal payment depends on the substitutability of the task that the entrepreneur engages in. A sustainably oriented entrepreneur should be treated as if he or she was efficient. An agent who is primarily driven by economic motivation should receive similar payments as an exceptionally inefficient entrepreneur.

After reviewing the impact of the entrepreneur's relevant traits and the substitutability of tasks, I now turn to the analysis of the optimal incentive scheme for sustainable outcomes. In **Table 7** the outcomes for optimal remuneration given a set of characteristics are listed. On a general level, the curves depicted seem to be a horizontally mirrored reflections of the curves described in the passage regarding incentives for the economic task. Initially the relation between ideal pay and the individual's cost structure is reviewed. The curve describing the link between these two variables is concave. After reaching a maximum at approximately 1, the function decreases. At a certain level of the individual cost function, the curve drastically increases and afterwards approximates to a lower value. The curve in this segment is convex. Analogous to Proposition 1, the following proposition is stipulated:

Proposition 9: Individual cost factor on sustainable extrinsic incentive

From equation (35), it follows, ceteris paribus, that a certain level of the individual cost incurrence exists at which the optimal incentive for the agent sharply increases.

The value of the individual cost factor at which the shift to a positive incentive occurs is determined by the degree of substitutability of tasks. A higher degree leads to a lower shift point. The real-world implications of these findings can be interpreted as follows. Efficient entrepreneurs with a sustainable orientation should receive a low positive incentive; inefficient players should not receive any remuneration. Those agents having a more purely profit-oriented business model should not be paid a positive extrinsic incentive if society wants to maximize its benefit. This procedure makes sense in the case of an effective entrepreneur. The clearer the strategic orientation towards profit generation is, the lower the level of individual cost factor is from which it is reasonable to pay a positive amount for

Table 7 Optimal extrinsic motivation based on model parameters (sustainable)

$\boldsymbol{K}$	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**
y_{sus}	-0.2	-0.09	-0.01	0.05	0.08	0.08	0.04	-0.05	-0.2	-0.46	-0.86
$\boldsymbol{K}$	**2.2**	**2.4**	**2.6**	**2.8**	**3**	**3.2**	**3.4**	**3.6**	**3.8**	**4.0**	**4.2**
y_{sus}	-1.51	-2.68	-5.09	-12.5	---	17.63	10.2	7.77	6.58	5.89	5.45
$\boldsymbol{g}$	**0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**
y_{sus}	-0.31	-0.31	-0.4	-0.64	-1.23	-3.63	11.06	2.94	1.95	1.57	1.38
$\boldsymbol{\mu_e}$	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_{sus}	2.2	-0.13	-2.47	-4.8	-7.13	-9.47	-11.8	-14.1	-16.5	-18.8	-21.1
$\boldsymbol{\mu_i}$	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_{sus}	-6.63	-5.43	-4.23	-3.03	-1.83	-0.63	0.57	1.77	2.97	4.17	5.37
$\boldsymbol{V_y}$	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_{sus}	---	-9.98	-4.69	-2.93	-2.05	-1.52	-1.16	-0.91	-0.72	-0.58	-0.46
$\boldsymbol{V_{sus}}$	**0**	**0.2**	**0.4**	**0.6**	**0.8**	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**
y_{sus}	-2.23	-2.79	-3.35	-3.91	-4.47	-5.03	-5.59	-6.15	-6.71	-7.27	-7.83

Note: K = 2.5; all other parameters are set to 0.5.

sustainable output. Analogous to the considerations regarding reward for economic output, the full picture of the optimal incentive scheme is highly dependent on the degree of substitutability of tasks. Inverting the findings of Proposition 2 and 3, the following propositions can be stipulated:

Proposition 10: Degree of substitutability on sustainable extrinsic incentive

From equation (35), it follows, ceteris paribus, that a certain level of the degree of substitutability of tasks exists at which the optimal incentive for the agent sharply increases for high individual costs.

and,

Proposition 11: Degree of substitutability on sustainable extrinsic incentive

From equation (35), it follows, ceteris paribus, that over the degree of substitutability of tasks the optimal incentive for the agent decreases for low individual costs.

These results reinforce the reasoning provided in the paragraph dedicated to individual costs. The agents who should receive a remuneration for sustainable output from society are either efficient pro-sustainable entrepreneurs or less efficient with a clear-cut orientation towards profit maximization.

Analyzing the effect of reputational concern on the optimal incentive for sustainable output, I recognize a different pattern than for economic output. This finding is counterintuitive to that of Bénabou and Tirole (2005) in that for those entrepreneurs with a business model comprising sustainable objectives and high levels of substitutability of tasks the optimal pay increases relatively to the need to appear pro-sustainable. The relationship of these two variables stays the same for efficient and profit-oriented agents and is inverted for inefficient ones. For the aversion of a greedy image, the opposite is true. Thereby, the following propositions can be stipulated:

Proposition 12: Reputational concerns on sustainable extrinsic incentive

From equation (35), it follows, ceteris paribus, that the relationship between optimal incentive for the agent and reputation-related factors is linear and positive for a low degree of substitutability.

and,

Proposition 13: Reputational concerns on economic extrinsic incentive

From equation (35), it follows, ceteris paribus, that for individuals with high level of substitutability the impact of a rising image concern for a pro-sustainable appearance on the optimal incentive for the agent is positive when they are efficient. In case of inefficient agents, the relation is reversed.

These findings seem to contradict the idea that intrinsic motives are crowded out based on reputational concerns. Entrepreneurs who do not incur additional costs when they exert both kinds of effort do not seem to suffer from reputational backlash when carrying out sustainable tasks. To the contrary, the willingness to appear pro-sustainable raises the optimal incentive level of additional sustainable output. The same holds true for efficient but less clearly sustainability-oriented businesses. Their inefficient counterparts cannot benefit from the effect. However, the analysis here is focused on optimal incentive levels from the perspective of the principal and, therefore, no direct statement can be made about the optimal effort level and crowding out effects.

In a last step, I turn to the impact of valuations for extrinsic and intrinsic rewards on the optimal incentive scheme. Comparable to the case of remuneration for economic output, the relationship between optimal payment and the valuation of payment can be described by an asymptote. Agents with a higher valuation for extrinsic motivation should receive a higher payment if they pursue a strategy that has a high level of substitutability. There are diminishing returns for each additional unit of valuation on the growth of remuneration. The same mechanism holds true for entrepreneurs with a low individual cost factor who partake

in tasks that are less substitutable. Agents with a similar degree of substitutability between the tasks performed but with inefficient practices do face a declining relation between optimal payment and their valuation for an extrinsic reward.

Proposition 14: Extrinsic motivation on sustainable extrinsic incentive

From equation (35), it follows, ceteris paribus, that over the level of extrinsic motivation the optimal incentive for the agent increases for a high degree of substitutability as well as for low individual costs, independent of the respective opposite variable. It decreases when society faces a weakly substitutable task set and an inefficient agent.

It seems reasonable for society to reward extrinsically motivated entrepreneurs, who either follow a sustainable approach or are efficient in their sustainable outputs. This is in line with an idea of sustainable entrepreneurs who can scale their operations with the help of profitable operations.

The relationship between extrinsic motivation and the valuation for intrinsic rewards is linear. In terms of direction, the link is the opposite of the effects in the case of valuation for extrinsic motivation. The only constellation in which the linkage is positive is in the instance of a profit-oriented and inefficient agent; this results in the following proposition:

Proposition 15: Intrinsic motivation on sustainable extrinsic incentive

From equation (35), it follows, ceteris paribus, that over the level of extrinsic motivation the optimal incentive for the agent decreases for a high degree of substitutability as well as for low individual costs, independent of the respective opposite variable. In the case of a lowly substitutable task set and an inefficient agent, it increases.

Pro-sustainable as well as efficient agents require less payment if they score higher in valuation for internal motivation to exert an effort level that meets the needs of the principal.

3.6 Limitations and conclusion

The aim of this analysis was the conceptual design of a principal-agent model that encompasses the approach of multitask issues and the impact of reputational concerns on economic effort decisions. The starting point of the article was the trade-off that entrepreneurs face: to either act on purely economic terms or integrate sustainability concerns into their actions. The resulting model is a first draft that gives social indications as to how to incentivize economic agents when they care for sustainable goals. The analysis draws from principal-agent theory (Eisenhardt, 1989; Grossman and Hart, 1983) and extends it by combining the findings of Holmstrom and Milgrom (1991) as well as Bénabou and Tirole (2005). The analysis entails the idea of a sustainable entrepreneur who needs to be incentivized by society to create benefits on several dimensions. In this sense, this analysis widens this particular research direction in the broader stream of entrepreneurship literature. Specifically, the period after the establishment of the business is given a formal microeconomic framework.

As this is a first draft of the model, there are some limitations associated with it. Due to reasons of complexity, I implemented a partially defined model that is guided by assumptions. These assumptions concerned the principal's reward structure, the cost functions of the agent, and the expected probabilities of extrinsic and intrinsic valuation. The purpose of the model creation has been to show the fundamental mechanics of the trade-off and to give guidance for policy makers about incentive structures. In this context, the applied assumptions seem reasonable. Additionally, I did not implement the participation constraint of the agent into the model so that the obtained numerical solutions have to be tested against non-negativity when they are plugged into the certainty equivalent. From this perspective, the model lacks elegance but not completeness.

Further research thus should be directed at the removal of the currently applied constrictions on the model. This should allow for a more holistic view of the incentive

problem. Additionally, empirical validation with the assistance of experimental settings is required. Humans as economic players do not always act rationally given the available information. Factors that might have been neglected by the model at hand may be identified by observing a setup that recreates the trade-off described in this article.

4 Pro-social behavior, cooperation, free-riding, punishment, and the brain: A PRISMA literature review

Abstract

Neuro-economics has been proposed as a potentially new approach to explain human behavior in social-exchange situations. As it combines methods from neurophysiology and economics, it may enable us to better understand the neural roots of decision-making in areas that are related to pro-social behavior and cooperation. In this study, I utilize the PRISMA framework to conduct a structured literature review of studies that have used this approach and have dealt with the dictator game, ultimatum game, trust game, and public good game. Ninety-eight studies were identified that meet the content- and quality-based requirements. They were allocated to particular research streams, and their findings were set in context with each other.

4.1 Introduction

One major issue with classical microeconomics is that often one of its main assumptions fails: rationality in human behavior. There has been considerable literature that shows that individuals frequently do not act according to the expected self-interested, value-maximizing planning (Camerer, 2003). This is especially true in social situations in which an individual has to deal with multiple players who participate in an economic exchange. Predicted by microeconomic theory, the individual should aim to maximize his or her expected benefit when he or she chooses it from different options. The choice is determined by his or her preceding experiences and the inherent utility function. Social exchange happens as soon as two or more people interact with each other, and the result of this exchange is defined by the collective decisions (Seo and Lee, 2012). The players in such a social situation try to anticipate the behavior of the others given their history of actions. A

proxy for future behavior is intentions (Billeke et al., 2013). A problem with intentions is that they can quite easily be falsely predicted from past behavior. Additionally, the players also have to incorporate the belief of the other party about their own intentions and the changes of intentions over the course of decisions (Billeke et al., 2013).

While cooperation between people and utility maximizing over the long run may be preferable, individuals still always have the incentive to deviate from cooperation and to maximize their own benefit in the short term (Stallen and Sanfey, 2013). Even though cooperation and trustfulness are moral norms and may even lead to an increase of utility for the individual because of a pro-social attitude (Dunning et al., 2014; Yamagishi et al., 2015), there is substantial evidence that humans are not good at cooperating. The main obstacle is that cooperation is often conditional on the cooperation of others and that a certain percentage of people are going to *free ride* at someone else's expense (Fischbacher et al., 2000). One prominent issue that arises from this can be observed in the phenomenon of overfishing. Humankind needs to coordinate its fishing quotas to prevent a depletion of the natural resource of fish—an endeavor at which it is currently failing (Stallen and Sanfey, 2013). A similar problem holds true for trust in more short-term exchange situations. Particularly in anonymous, one-shot games, faith in the altruistic behavior of the exchange partner is risky. Due to the selfish inclination of the individual, the likelihood to get nothing in return for a benevolent act is high, and both parties know this fact. Therefore, an exchange based on trust is unlikely (Rilling and Sanfey, 2011). Yet, in reality as well as economic games, the behavior of placing trust in somebody and in engaging in cooperation is observable. For example, a considerable proportion of individuals place their trust in unknown others and receive reimbursement from others with whom they have or will have no affiliation (Camerer, 2003). Besides these two aforementioned circumstances, there is an abundance of social situations in which the human mind acts irrationally. A relatively well-known phenomenon is altruistic punishment. If an individual faces economic unfairness from

another, he or she is often willing to punish the deviator from the fairness norm even at his or her own costs (Frith and Frith, 2008; Sanfey et al., 2014). This is generally true for social situations in which a certain behavior is expected by social norms (Boyd et al., 2003; Rand et al., 2013). While this behavior might not make sense for the individual, it may be beneficial for the overall species as *free riding* becomes costlier. Therefore, the majority of people offer a share of their initial economical endowment to others who are less well-off based on such fairness norms (Crone, 2013). The intentions of this behavior remain unclear as both intentional roots are conceivable: altruism or the avoidance of punishment. Another descriptive example of irrational behavior is the increased *good-will* that more attractive persons on average are met with (Solnick and Schweitzer, 1999). These examples show that humans and their intentions are affected not only by the classical microeconomic pursuit of financial well-being but also by other factors that might not be derived easily. Pro-social behavior, trust, and cooperation are substantially influenced by preferences toward other social players (Falk and Fischbacher, 2006; Fehr and Camerer, 2007). As these preferences are mainly invariant over the human span of life (Eisenberg et al., 1999), it is reasonable to assume that the behaviors initially mentioned are consistent (Hahn et al., 2015). Yet, in situations with a stranger this information is private, and, additionally, the perception of risk is dependent on the setting of the situation (Weber et al., 2002).

The behavior in social exchange situations is thus complicated to explain and even harder to predict. This issue has been addressed by researches from an economic as well as a psychological perspective. They have approached this through several explanations, including the temporary development of cooperation (Perc and Szolnoki, 2010; Santos et al., 2008), altruistic punishment (O'Gorman et al., 2009; Ule et al., 2009), and unsolicitous participation (Hauert et al., 2007). A relatively new approach to explain human economic behavior in social situations involves neuro-economics. As the name indicates, this approach combines the methods of neuropsychology with those of experimental economics. It strives

to reveal the neurological processes in the human brain that modulate behavior and that, based upon this, provide a theoretical framework for social exchange situations (Glimcher and Rustichini, 2004). The approach draws upon the methodological advantages of the two fields. Camerer (2008b, p. 369) has condensed this fact precisely: "The potential of neuro-economics is in combining the clearest experimental paradigms and statistical methods in economics, with the unprecedented capacity to measure a range of neural and cognitive activity that economists like Edgeworth, Fisher, and Ramsey daydreamed about but did not have.". While essential knowledge about particular brain regions and about their presumable functions is available, the latest research has focused on the interactions of several areas to empirically determine the underlying mechanisms in social situations (Van Rooij and Van Orden, 2011). Belluci et al. (2017), therefore, have highlighted the potential to combine the findings of studies that investigate the neuro-biological underpinnings of different economic games.

The aim of this structured literature review is to examine this potential and to give a holistic overview of the current findings of neuro-economics in the period from 2011 to 2016. The potential audience may, on the one hand, be neuro-scientists who want to identify relevant research gaps, and, on the other hand, they may be economists who plan to implement this sophisticated methodology within their own research. The particular research questions that I answer are as follows: *Which brain region systems prevail in distinct social settings and mirror particular intentions? Which areas interact in a conflictive as well as supporting manner? Which theoretical models and ideas are reinforced by neuro-physiological, empirical findings?*

The structure of this article is laid out as follows: Initially, I explain the considered economic games: namely, the dictator game, the ultimatum game, the trust game, and the public good game. In tandem with this, I lay out fundamental concepts used in psychology and economics to explain the behavior of individuals in such economic-exchange games. In Section Three and Four, the methodology of this study is described, and descriptive results

are presented. Section Five contains findings from the literature research that is focused on results from before 2011 about the most crucial brain areas in the given context. Following this, I present the identified research directions in the current literature. In conclusion, the results are collected, paths for future research are highlighted, and the limitations of the study are stated.

4.2 Economic games and psychological concepts

Of the four considered economic games, the dictator game is the least complex. The game is played by two players of whom one has an initial financial endowment and needs to make a decision as to how much of the given sum should be transferred to the other player. The second player has to accept the decision and does not have any say in the distribution. Economic theory predicts that the dictator should not give away any share of his money, and, indeed, often this type of distribution can be seen in the real world. Yet, there are instances in which the dictator decides against financial maximization and shares a small fraction of his wealth with the other player (Bolton et al., 1998). Originally, the game was used to measure altruism, but a set of additional potential explanatory approaches such as empathy and guilt or utilitarianism have also been proposed for the deviation from the rational choice (Stallen and Sanfey, 2013). An alternative approach to explain the irrational behavior of the dictator in this game is inequity aversion. This is an assumption about the utility function of some people. They favor equal distribution between all participants and are willing to forego their own income to make distribution less unequal (Fehr and Schmidt, 1999). Additionally, factors such as emotions (Andrade and Ariely, 2009), social hierarchy, power differences (Sivanathan et al., 2008), and attractiveness of the recipient (Rosenblat, 2008) wield an influence on the decision of the dictator and on the satisfaction with the outcome for both players.

An extension of the dictator game is the ultimatum game. It is similar in execution. The main difference is that the second player can either accept or reject the offer made by the first player. In the case of acceptance, both players receive the proposed share of the initial amount. In the case of rejection, both players receive nothing. If one assumes rational behavior from both players, the proposer should offer the lowest possible sum to the receiver who then should accept the offer. In experiments, however, it has been established that this behavior is rare. In most cases, the proposer suggests a division that is close to an equal split, and the respondent accepts. In other cases, when the split is too distant from an equal split, the second player tends to reject the offer even though this behavior hurts himself or herself (Fehr and Gächter, 2002). While at first glance the ultimatum game seems to resemble a relatively easy binary decision for the responder, it contains complex social considerations including social status, maintenance of social norms, and the prevention of rejection (Gospic et al., 2011). Two dimensions can be identified that play a stronger influential role in the decision-making process in comparison to the dictator game: social norms and strategic behavior. A main purpose of the ultimatum game is to examine the importance of fairness in socio-economic situations (Pillutla and Murnighan, 1995). Fairness is a social norm from which deviation is punished so as to sustain the norm in the long run, as seen in the ultimatum game (Fehr and Gächter, 2002; Ruff et al., 2013; Spitzer et al., 2007). Such punishing behavior is called altruistic punishment as the individual foregoes a personal gain to serve the common good. This behavior most likely is not carried out consciously but triggered by anger or outrage caused by unfair treatment (Pillutla and Murnighan, 1996; Van't Wout et al., 2006). This is in line with the well-accepted notion that emotions modulate decision-making (Lerner et al., 2015). As the proposer knows that the respondent will most likely reject unfair offers, he or she will adjust his or her offer to forego a potential punishment. This leads to a fair offer and a likely acceptance.

A relevant concept in the context of social situations in general and in economic exchange in particular is the *theory of mind*. The theory describes humans' cognitive ability to assign mental states and strategic reasoning to others and, in a sense, to see the world through their eyes (Frith and Frith, 2005). Based on supposed beliefs, desires, and intentions, the individual can position himself or herself strategically to reap the most beneficial outcome. Both players do have this capability and, therefore, need to solve complex optimization issues to find the dominant strategies. A whole string of research has emerged to formalize this challenge under the assumption of rationality: game theory.

A game similar to the ultimatum game is the trust game. As the name implies, the main purpose of this game is to measure trust. In comparison to the ultimatum game, the receiver in this game has other options in reacting to the initial split. An important deviation between the two games is an intermediate step in which the money transferred from the first player to the second is multiplied by a certain positive factor larger than one. As a result, the respondent has two options: he or she either keeps the whole sum or retransfers a split back to the first player, thereby rewarding him or her for the trust shown to the second player. Applying a game-theoretic approach to this exchange results in a dominant strategy for the initial player. By backward inducting the behavior of the second player under the assumption of rationality, he or she would not trust him or her. As a rational respondent would always keep all money for himself or herself, it would not be reasonable to give up any amount of the initial endowment. In reality, humans often rely on trust in social-exchange situations even when they deal with strangers. This behavior contrasts with the fundamental statements of microeconomic theory. Yet, it seems reasonable that humans act this way and trust others since it would be far too expensive to employ control mechanisms for even the simplest exchanges.

Essential for human cooperation, trust has been studied in various situations by using the trust game. For example, the application of the aforementioned control mechanisms as

compulsive and non-compulsive contracts (Malhotra and Murnighan, 2002) or the impact of social rank (Lount and Pettit, 2012) have been empirically tested. Two major factors that guide the decision to trust and to reward trust are reputation and reciprocity. Comparable to fairness, reciprocity is a social norm that demands an individual to return favors he or she has received (Gouldner, 1960). It may also stimulate selfish individuals to act as though they were *pro-social* because they expect to obtain compensation at a later point in time. This is referred to as *direct reciprocity*. While this kind of reciprocity may explain trust and cooperation between acquaintances, it lacks the power to justify the same between strangers. In such cases, *strong reciprocators* play an important role. They tend to punish deviators and reward those who comply with reciprocity at their own costs, and they thus strengthen cooperation in mankind (Buckholtz and Marois, 2012). Reputation is an abstract depiction of a person's past behavior and, based upon it, the prospect of future conduct. A reputation to typically reciprocate enables trust and, therefore, is valuable in itself (Nowak, 2006). When dealing with strangers, the individual approximates trustworthiness through noticeable properties of the counterpart and the reputation of similar players (Stanley et al., 2012).

The three games hitherto presented tend to be used in studies as single-shot games, but they can also be played over several rounds. Besides the aforementioned factors that influence the decision-making process, learning effects play an important role in these settings. The major theory in the field of psychology concerning temporal-dependent decision-making is reinforcement learning. This theory states that learning happens when the individual evaluates the outcomes of past decisions and forms expectations about future outcomes for all options available. Over time, the given person updates his or her expectations of the choice set and thereafter sets assumptions about the underlying mechanisms that determine the outcome. The update process uses the deviation between the expected value of an outcome and the true realization to form a more precise expectation (Kishida and Montague, 2012). After some decisions are taken, the person learns which

option yields the optimum outcome of the options tested up until that point. The individual then needs to balance two strategies to handle this information. Either he or she decides to *exploit* the optimal option or tries to *explore* further the space of options. The second behavior likely results in some worse outcomes but may lead to a better optimal option (Sutton and Barto, 1998). While the additional dimension of time adds to the complexity of the decision-making process, it also leads to relatively stable outcomes in a series of repeated games between the same players. The participants learn about the behavior of the counterpart and resolve to implement a certain strategy that they exploit.

This holds true as well for the last game that in most cases is played over multiple rounds: the public good game. This game is different from the other games introduced so far. The number of participants is not restricted to two, and the decisions are not made successively but simultaneously. The sequence of events is as follows. Initially, the players decide upon the amount of their endowment that they will invest into the public good without knowing the decisions of the other players. The sum of all the investments is multiplied by a certain factor that increases the overall amount. The resulting outcome is divided equally across all players. In consequence, those players who invest more money in the public good than the average contribution are likely to receive less back than the initial investment. The issue is aggravated by *free riders* who do not contribute at all and only seek to reap the benefits of the public good. The fact that decisions are made simultaneously does not allow for backward-induction, and, therefore, no dominant choice is prevalent. Empirical investigations of the players' behavior in this game have found that at the start of a multi-round game contributions are close to equal contributions but decay over the course of rounds (Fehr and Fischbacher, 2004). While the possibility to punish *free riders* or recompense fair contributors helps to establish a stable cooperation (Balliet et al., 2011), these mechanisms are costly and often hard to implement effectively. Neuro-economics may help in such cases. For example, Krajbich et al. (2009b) have designed a setup based on functional

magnetic-resonance imaging (FMRI) and a machine-learning algorithm that was able to identify *free-riders* on the basis of their cerebral activity.

In synopsis, the human decision process and its guiding factors in socio-economic exchange situations are a complex black box. The discourse about emotions and rationality counterparts is centuries old, and it has been discussed by prominent philosophers such as Plato, Kant, and Freud (Peters, 1970). It is reflected in the current discussions in neuro-economics as to whether certain brain areas are mainly active in emotion-related decisions and others in more reason-guided decisions. Areas such as the striatum, amygdala, medial prefrontal cortex (MPFC), orbitofrontal cortex (OFC), and the insular cortex have been ascribed the functionality to process emotional routines, while areas such as the dorsolateral prefrontal cortex (DLPFC), anterior prefrontal cortex (APFC), and posterior parietal cortex (PPC) seem to handle cognitive tasks (Phelps et al., 2014). Additionally, it is unclear if the value of emotional aspects and objective aspects in social situations are computed in a *common currency* so that the can be added and subtracted in a decision process or if they are generated in separated spaces modulating each other's influence on the overall valuation (Ruff and Fehr, 2014).

4.3 Methodology

4.3.1 Framework

The guiding framework for this systematic literature review is the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009). The steps included in this framework are carried out in the following sequence: identifying literature, screening the yielded set, testing for eligibility, and carrying out the qualitative synthesis and/or meta-analysis. The detailed process is depicted in **Figure 5** and is outlined in the following paragraphs.

4.3.2 Identification

The search group consisted of three persons: two student assistants and me. We searched the databases EBSCOHOST, Web of Science, Science Direct, SAGE, and Emerald for articles in the period between the 1st of January 2011 and the 31st of December 2016. We focused on peer-reviewed journal articles and excluded books, book chapters, and other electronic documents. The search terms consisted of a combination of two word groups. The first group contained the words: fMRT, MRT*, brain*, neuro*, EEG, magnetic resonance*, fMRI, ERP, mental*, neural*, and rTMS. This represented the neuro-physiological aspects of the research questions. The second group included the words: dictator*, ultimatum*, trust*, public good*. In total 44 search terms were employed. The database search yielded 2482 results. In addition, three more records were manually identified in the later stages of the full-text eligibility review in the reference sections of the included articles.

4.3.3 Screening

In an initial step, the database of obtained literature was cleared of 1,982 duplicates. In the further screening process, we crosschecked the remaining articles. The person who initially entered an article into the database did not decide about its inclusion after the screening process. With this procedure, at least two pairs of eyes screened the included literature. We limited the remaining texts to peer-reviewed articles written in English. We excluded books, book chapters, scientific reports, and other types of documents. Besides the document type, we also checked the fit of the abstracts' content to the research question. They needed to state that neurophysiological measures such as functional magnetic resonance imagining (fMRI), electroencephalography (EEG), event-related potentials (ERP), or repetitive transcranial magnetic stimulation (rTMS) had been applied to determine neurological consequences of decisions made. Additionally, one of the games introduced in

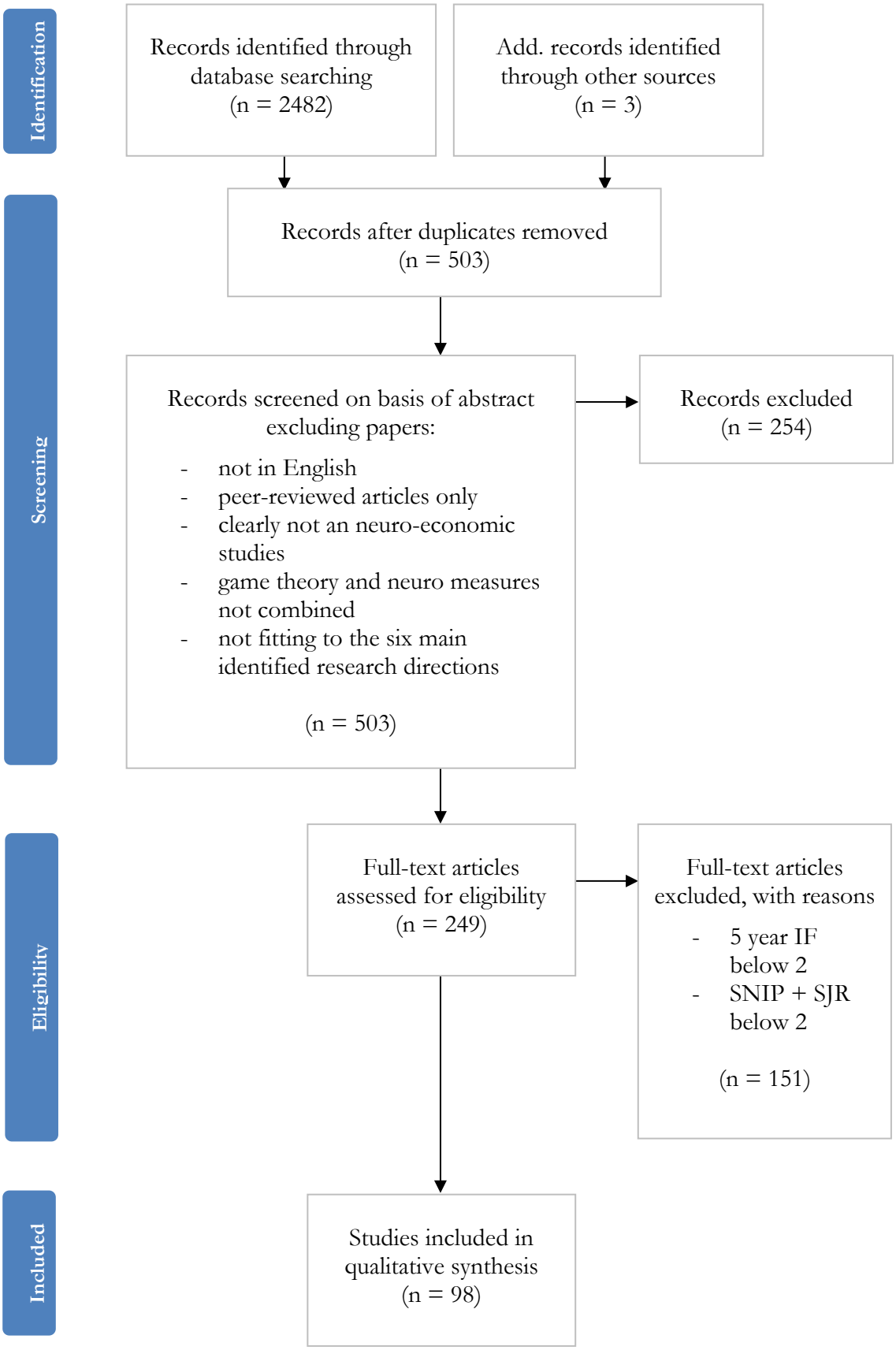

Figure 5 PRISMA flow diagram based on Moher et al. (2009)

Section 4.2 needed to be included in the analysis. Besides the separate mention of these two methods, it had to be clear that they were applied jointly as this was not always the case. During the initial phase of article collection, six research themes in the field of neuro-economics were identified from the articles: (1) reward and punishment (the differences of these domains and the influence of punishment on cooperation), (2) aging (the evolution of the brain and decision-making over a lifespan) and gender, (3) social context, affect, and emotions (situational influences and mind-set), (4) learning (temporal processes in multi-round games), (5) drugs and hormones (the addition of substances and the impact on the decision process), and (6) impairments and disorders (reduced functionality due to a psychological condition or manipulation). While most of the articles fitted into one or multiple of these research directions, a few could not be allocated to any line of research and, as a result, were excluded from the analysis. Half of the initially screened documents did not meet one or more criteria mentioned here; this left 249 articles for the test of eligibility.

4.3.4 Eligibility

I deployed two filters to ensure the quality of research of the full-texts included in the final sample. As an absolute cut-off measure, the article had to be published in a journal with an impact factor (IF) in the preceding five-year that was above 2. Because the impact factor varies strongly between disciplines such as economics and neurobiology, a second relative measure was utilized to identify the most reputable journal of their fields. An accumulative value of the scales from the source-normalized impact factor (SNIP) and scientific journal ranking (SJR) had to pass the threshold of 2 to be deemed an appropriate journal for the inclusion. For both measures, absolute and relative, the value of approximately 2 represents the mean of all journals in the sample. Therefore, the articles included in the final sample for full-text analysis were published in an above-average quality journal in their discipline. The distribution of quality over journals was skewed, and, therefore, a higher number of articles was excluded (n = 151) than included (n = 98).

4.4 Descriptive results

The number of publications per year in highly ranked journals over the time frame observed remained mostly stable. The number of papers was: 15 for 2011, 2012, 2013, and 2016; 16 for 2014; and 25 for 2015 (an outlier). The majority of publications occurred in specialized neurological [69], psychology [18], and natural [10] sciences journals. Two articles were published in medical journals and one in an information systems journal. Most astonishing is the low relevance of the topic in the sphere of business administration and economics with one article published in 2011 and another in 2012. Most of the papers were empirical analyses [87] of a particular game and its related brain regions. The remaining articles consisted of: non-systematic literature reviews [10] of related topics such as fairness, cooperation, and learning in social decision-making situations; meta analyses [3]; and a case study [1]. The most analyzed game was the ultimatum game, which was utilized 60 times; the trust game [28] and the dictator game [21] were less frequently played, while the public good game [6] was the least-used game. The brain regions mentioned in all articles were (in descending order of number of mentions): Cingulate Cortex [69] (consisting of Anterior Cingulate Cortex (ACC) [55] and Posterior Cingulate Cortex (PCC) [14]), Insula [59] (consisting of Anterior Insula Cortex (AIC) [53] and Posterior Insula Cortex (PIC) [6]), Striatum [54] (consisting of Caudate [22], Putamen [10], and Nucleus Accumbens (NAcc) [8]), Dorsolateral Prefrontal Cortex (DLPFC) [40], Ventromedial Prefrontal Cortex (VMPFC) [39], Temporal Parietal Junction (TPJ) [28], Dorsomedial Prefrontal Cortex (DMPFC) [27], Frontal Gyrus [23], (Prae-) Cuneus [20], Amygdala [17], Thalamus [16], Supplementary Motor Area (SMA) [12], Lobulus Parietalis [12], Oppicital Cortex (OPC) [12], Temporal Gyrus [10], Cerebellum [8], Ventrolateral Prefrontal Cortex (VLPFC) [7], Superior Temporal Sulcus (STS) [7], Central gyrus [6], Parietal Cortex [6], Posterior Medial Gyrus [3], Lingual Gyrus [3], Frontal Sulcus [3], and (Para-) Hippocampus [3].

Figure 6 links the seven most-mentioned brain regions to the games that are analyzed in this literature review. The height of the bars represents the relative frequency the respective region was mentioned in the articles concerning one game. Even though the relative weights may be biased due to the differing absolute numbers of mentions, it still is possible to determine strong variations in relative importance of regions between brain regions. The striatum and the DLPFC seem to play an important role in the decision processes involved in the dictator game. While they in combination with the VMPFC also are prevalent in the ultimatum game, they are superseded in importance by the ACC and AIC. The TPJ was mentioned relatively rarely in the context of this game. In contrast to this, the TPJ was considerably more important in the trust and public good game. Additionally, the DMPFC was deemed relevant in these kinds of social situations. In the following Section 4.5.1, fundamental findings regarding the specified regions are explained and put in the context of the results of **Figure 6**.

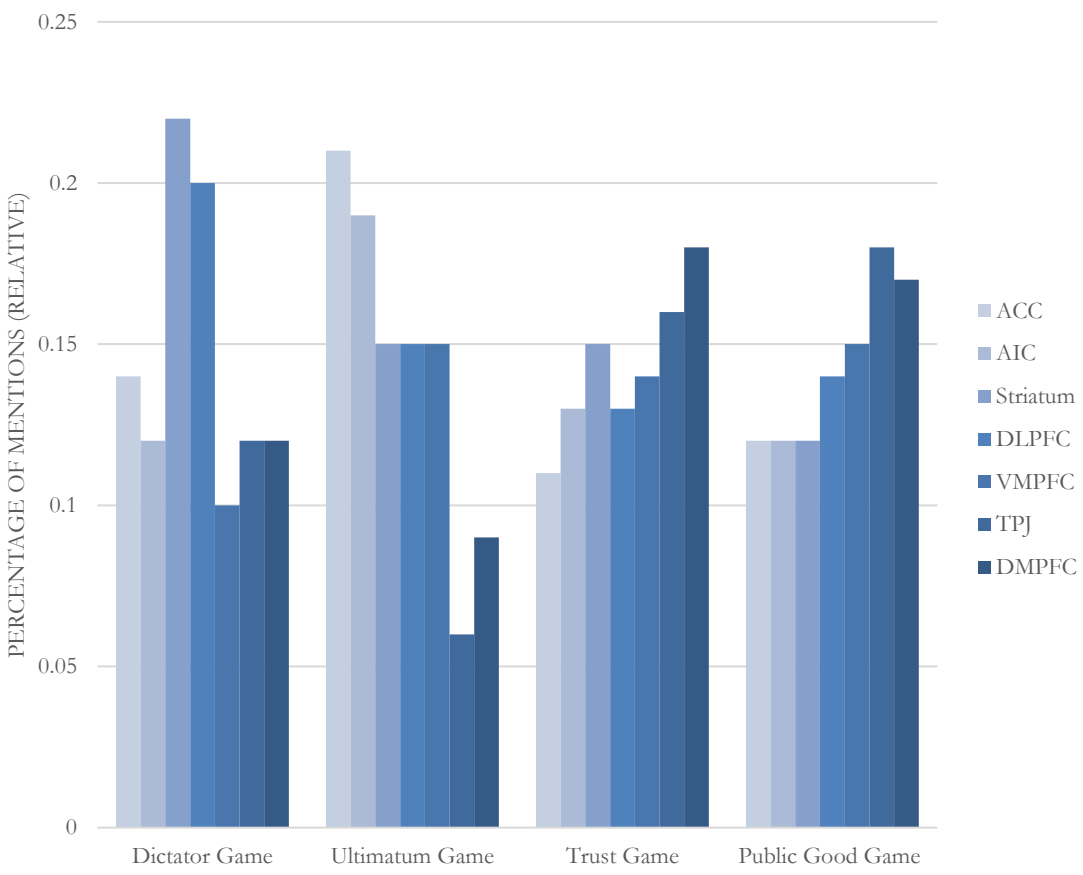

Figure 6 Brain regions and games

Table 8 Research direction combinations

	Aging and gender	Reward and punishment	Social context	Learning	Drugs and hormones	Impairments and disorders
Aging and gender	**4**	3	5	2	1	1
Reward and punishment	3	**15**	17	6	3	11
Social context	5	17	**17**	5	1	6
Learning	2	7	5	**7**	1	4
Drugs and hormone	1	5	1	1	**0**	3
Impairments and disorders	1	12	6	4	3	**10**
Total without doubles	**13**	**47**	**39**	**20**	**6**	**27**

Most of the reviewed articles touched on two or more of the research directions listed in section 4.3.3. **Table 8** depicts the number of papers that can be ascribed to the respective directions. The values on the diagonal represent such articles that can be allocated to one particular topic. The remaining entries represent papers that match two areas of research. Furthermore, the dataset contains several articles that fit to more than two research directions. The most prevalent research directions are *reward and punishment*, *social context, affect and emotions*; these three represent the basics of neuro-economics and are often times relevant for the other areas. To enable a coherent analysis, the articles are assigned a main research direction in **Table 9**, and this distribution outlines the foundation for Section 4.5.2. Besides the research direction *drugs and hormones*, the other directions are relatively balanced in the amount of papers they contain.

Table 9 Main research directions

Research direction	**Articles**
Aging and gender	Güroğlu et al. (2011), van den Bos et al. (2011), Harlé and Sanfey (2012), Steinbeis et al. (2012), Moor et al. (2012), Crone (2013), Fett et al. (2014), Steinmann et al. (2014), van den Bos et al. (2014), Ma et al. (2015), Van Hoorn et al. (2016), Will et al. (2016), Dulebohn et al. (2016)
Reward and punish-ment	Rilling and Sanfey (2011), Hewig et al. (2011), Strobel et al. (2011), Buckholtz and Marois (2012), Morishima et al. (2012), Volk and Köhler (2012), Guo et al. (2013), Xiang et al. (2013), Wu et al. (2014), Aimone et al. (2014), Gabay et al. (2014), Feng et al. (2015), Hutcherson et al. (2015), Strang et al. (2015), Christov-Moore and Iacoboni (2016), Zhang et al. (2016), Corradi-Dell'Acqua (2016), Wang et al. (2016)
Social context	Chang et al. (2011), Wright et al. (2011), Wu et al. (2011), Ruz and Tudela (2011), Campanha et al. (2011), Stanley et al. (2012), Civai et al. (2012), Fahrenfort et al. (2012), Harlé et al. (2012), Kim et al. (2012), Lelieveld et al. (2012), Phelps et al. (2014), Guo et al. (2014), Riedl et al. (2014), Mussel et al. (2014), Fareri et al. (2015), Bault et al. (2015), Zheng et al. (2015), Will et al. (2015), Yu et al. (2015), Fabre et al. (2015), Spapé et al. (2015), Hu et al. (2016)
Learning	van Rooij and Van Orden (2011), Kirk et al. (2011), Seo et al. (2012), Stallen and Sanfey (2013), Billeke (2013), Weng et al. (2013), Fouragnan et al.(2013), Ruff and Fehr (2014), Osinski et al. (2014), Billeke et al. (2014), Gilam et al. (2015), Chung et al. (2015), Hahn et al. (2015), Kirk et al. (2016), Kaltwasser et al. (2016)
Drugs and hormones	Gospic et al. (2011), Crockett et al. (2013), Verdejo-Garcia et al. (2015), Kopsida et al. (2016)
Impair-ments and disorders	Kang et al. (2011), Koscik and Tranel (2011), Osumi et al. (2012), Kishida and Montague (2012), Scheele et al. (2012), White et al. (2013), Gromann et al. (2013), Ruff et al. (2013), Sripada et al. (2013), Gromann et al. (2014), Luo et al. (2014), Vieira et al. (2014), Billeke et al. (2015), Gradin et al. (2015), Gu et al. (2015), Nihonsugi et al. (2015), McAdams et al. (2015), Civai et al. (2015), Shao et al. (2015), Belfi et al. (2015), White et al. (2016), Klapwijk et al. (2016)

4.5 Qualitative results

4.5.1 Findings before 2011

In the following analysis, I list findings that are referred to in the articles included in the literature sample but are excluded from the period under review. This section is conceived to introduce those readers unfamiliar with the subject to the presumable functionalities of selected brain regions.

The cingulate cortex has been mainly analyzed in the context of the ultimatum game. The anterior part of this cortex shows activity in case of unfair offers (King-Casas et al., 2008; Sanfey et al., 2003). Tomlin et al. (2006) have clarified that the different parts of the cingulate cortex serve distinct roles. While the medial section is relevant for the proposer of an offer, the anterior and posterior part are essential for the reactor to an offer. In more detail, the ACC deals with conflicting impulses from emotional and cognitive sources (Botvinick et al., 1999), exerts cognitive control (Kerns et al., 2004), and transfers these impulses into actions (Hayden and Platt, 2010). This corresponds well to the dorsal ACC's ability to detect social norm violations (Eisenberger et al., 2003; Güroğlu et al., 2010; King-Casas et al., 2008). Additionally, the ACC is important to determine trust (Krajbich et al., 2009a) and reciprocate it (Baumgartner et al., 2009), but the interplay with other regions is still unclear. The PCC is utilized in the process to evaluate rewards (Ballard and Knutson, 2009; McClure et al., 2007) and the retrieval of autobiographic information (Cavanna and Trimble, 2006; Maddock et al., 2001). Both the ACC and the PCC are involved in the task to sense a counterpart's mental condition. While the PCC provides access to relevant memories (Gallagher and Frith, 2003), the ACC in combination with the anterior insula enables the individual to determine emotional states through empathy (Fan et al., 2011; Singer et al., 2004).

The insula cortex has been ascribed a wide range of tasks that range from detecting negative states and emotions such as anger, anticipation of pain (Ploghaus et al., 1999),

disgust (Phillips et al., 1997), and arousal (Critchley et al., 2000) to performing more complex functions such as combining cognitive and emotional impulses (Lamm and Singer, 2010; Singer et al., 2009) and evaluating others' trustworthiness (Kurth et al., 2010). Additionally, the anterior part of this brain region is involved in interoceptional sensing and cognition of emotional states (Craig, 2002; Craig and Craig, 2009). The AIC plays a relevant role in social situations since it enables one to feel empathy and compassion (Immordino-Yang et al., 2009; Singer et al., 2006). Sanfey et al. (2003) first mentioned the role of the AIC in the context of the ultimatum game. They reasoned that the reception of an unfair offer would provoke negative emotions and would, therefore, activate the AIC. This claim has been backed up repeatedly (Güroğlu et al., 2010; Halko et al., 2009) and has been extended into a more general proposition that states that the AIC is activated through negative emotions caused by norm violations (Hsu et al., 2008; Montague and Lohrenz, 2007; Spitzer et al., 2007). As a result, the magnitude of AIC activation has been assumed to predict rejections of unfair offers (Damasio et al., 2000; Rilling et al., 2008). Another important functionality of the AIC is the monitoring of risk (Preuschoff et al., 2008), the anticipation of risk (Mohr et al., 2010) and the avoidance of unfavorable outcomes (Kuhnen and Knutson, 2005). The AIC's ability to process trust information and to evaluate trustworthiness (King-Casas et al., 2008; Todorov et al., 2008; Winston et al., 2002) is closely related to this field of functions. Given this information, it is not unexpected that the AIC in combination with the striatum is activated during the trust game (Baumgartner et al., 2009; King-Casas et al., 2005). In this game's initial phase, it is relevant to determine trustworthiness in the initial phase and to deal with betrayal and norm violations in the later phase.

The striatum consists of three entities: the caudate, the putamen, and the NAcc. The striatum acts as a detector, tracker, and evaluator of social and non-social rewards (King-Casas et al., 2005; Montague and Berns, 2002; O'Doherty et al., 2004). Part of its functionalities are the processing of gaps between expected and actual results of actions and

updating the expectancy of prospective rewards (O'Doherty, 2004; Pessiglione et al., 2006). Potential triggers for an activation of this brain area are unprecedented, negative, or unexpected incidents (Horvitz, 2000; Saxe and Haushofer, 2008). The NAcc has been linked to the anticipation of rewards in the social and non-social sphere (Knutson et al., 2001; Tabibnia et al., 2008). Depressed persons exhibit less activation in the NAcc when being confronted with positive incentives (Epstein et al., 2006). In the social domain, the striatum reacts to events that are in line with the individual's values and preferences. This holds true for fairness (Tabibnia et al., 2008), inequality-adverse behavior (Tricomi et al., 2010), and pro-social as well as pro-self behavior (Van den Bos et al., 2009). Therefore, the striatum is the brain region that mainly drives altruistic punishment. It rewards the individual for punishing others who have behaved unfairly even if this behavior is monetarily disadvantageous to the punisher. The social reward outweighs the non-social costs (De Quervain et al., 2004; Sanfey et al., 2003; Singer et al., 2006). Through repeated interactions, this section of the brain tracks actions and outcomes to learn about the environment and other players (Balleine et al., 2007; O'Doherty et al., 2004). The striatum, therefore, is highly relevant for evaluating the reputation of others and for aligning behavior (King-Casas et al., 2005; Krueger et al., 2007). In cooperation with the insula cortex, it guides the decision to trust someone.

The dorsolateral part of the prefrontal cortex (DLPFC) exerts processes of cognitive control (Miller and Cohen, 2001) and has been attributed the ability to contain selfish impulses in social-economic situations (Knoch et al., 2006; Rilling et al., 2007). More generally speaking, the functionalities of the DLPFC contain self-control (Hare et al., 2009) and strategizing (Spitzer et al., 2007), both of which are tasks ascribed to rational behavior. Against the backdrop of economic games, the implementation of social norms in the decision process is an important purpose of the DLPFC (particularly the right part of the cortex)—first and foremost if the norm contradicts the self-interest of the individual (Knoch et al.,

2006). Evidence from the ultimatum game backs up this claim. The activation of the DLPFC is positively correlated with the rejection rate of unfair proposals (Sanfey et al., 2003), and constraining the brain region with rTMS reduces the rejection rate (Van't Wout, 2011). A study by Güroglu et al. (2010) has shown that the DLPFC with the help of the TPJ enables the individual to assess intentionality and to override social norm obedience. This ambiguity has also been reflected in findings in the trust-game setting. On the one hand, to betray the other's trust and thereby to violate a social norm activate the DLPFC (Baumgartner et al., 2009), on the other hand, the inhibition of the DLPFC leads to a decrease of reciprocity and cooperation (Knoch et al., 2009). The DLPFC seems to be relevant in conscious decisions that are in line with the individual's preferences, regardless of whether these are aligned with social norms or not. In comparison to other brain areas, the DLPFC evolves most during adolescence, both texturally and functionally (Crone et al., 2006).

In comparison to the DLPFC, the VMPCF also modulates emotional responses; it, however, does not initiate a conscious process but rather acts as an automated dampener (Phillips et al., 2008). As an example, the VMPCF regulates resentment and aggression (Davidson et al., 2000). A second functionality of the VMPFC is the valuation of tangible rewards (for example, monetary rewards) and abstract goods (for example, equality or fairness), a task which it accomplishes in conjunction with the striatum (Kable and Glimcher, 2007; O'Doherty, 2004; Rolls, 2004). As a result, activation in this brain region is associated with lower rates of rejection in the ultimatum game (Tabibnia et al., 2008). Individuals with an injured VMPFC show a disproportionately high rate of rejections (Koenigs et al., 2010). This is in line with the proposed functionalities of this brain area since the negative emotions towards unfair offers are attenuated and since more fair offers elicit an activation in the VMPFC signaling a rewarding experience (Fliessbach et al., 2007; Tabibnia et al., 2008). Similar to the striatum, the VMPFC is involved in estimating reward expectations (Knutson et al., 2005; Schoenbaum et al., 2009). Especially the lateral part of this brain region is

essential for integrating negative stimuli into the learning process; this guides the adjustment of behavior to new information (Kringelbach, 2005; Kringelbach and Rolls, 2004). This functionality, in combination with the ability to valuate abstract goods such as trust and reciprocity, makes the VMPFC essential for cooperation (Wood et al., 2006). This reflects in findings of studies that analyze the trust game and the public good game. Physical impairments of the VMPFC lead to less trust (Krajbich et al., 2009a), unconditional trust activates the VMPFC more than conditional trust (Li et al., 2009), and assumed cooperative behavior of others in the public good game elicits a reaction in this brain area.

Two cortices closely associated with the theory of mind are the TPJ and the DMPFC (Apperly et al., 2004; Lamm et al., 2007). The TPJ seems to be involved in processes that include taking others' perspective and inferring their intentions and potential goals that they pursue (Saxe and Kanwisher, 2003; Van Overwalle, 2009; Young et al., 2010). This also includes the ability to assess the effects of actions on other parties (Hampton et al., 2008). Orienting attention is a major task of this brain region: the TPJ enables the individual to shift his or her attention from his or her own perspective to that of others (Mitchell, 2008). Given these functionalities, the TPJ is essential for strategic reasoning (Hampton et al., 2008; Saxe and Kanwisher, 2003) and for predicting the behavior of others (Van Overwalle, 2009; Völlm et al., 2006). The abilities of the DMPFC are closely related to those of the TPJ, and they likely complement each other. Similar to the TPJ, the DMPFC is involved in evaluating the mental conditions of others (Frith and Frith, 2003) and in strategic reasoning (Coricelli and Nagel, 2009). One particular functionality of the DMPFC is the perception of others (Amodio and Frith, 2006) and judgements about their trustworthiness in cases where there has been no interaction before (Krueger et al., 2007).

The findings regarding these brain areas fits well with the amount of relative mentions depicted in **Figure 6**. Reward expectation and the compliance or non-compliance to fairness norms are relevant in the dictator game. Social-norm detection and negative emotions

causing rejections of unfair offers are important in the ultimatum game. Taking the perspective of other players and strategic reasoning is vital in the type of situation embedded in the trust and public good game. Interestingly, these functions do not seem to play a larger role in the ultimatum game.

4.5.2 Findings from 2011 until 2016

In this section, the most current results in the field of neuro-economics are presented and categorized into the six research themes that I mentioned in Section 4.3.3. The category *reward and punishment* includes articles that do not analyze the setups of economic games that comprise secondary effects (for example, social preconditions or impairments). It, therefore, can be seen as the most basic out of all the categories and, therefore, is the starting point of the review.

Reward and punishment

Altruism and pro-social behavior is one of the focuses of this research direction. Morishima et al. (2012) have found a strong correlation of TPJ volume and the activation of this area in situations of advantageous inequality. This link does not hold for disadvantageous inequality. This implies that taking the perspective of disadvantageous others may only be reasonable for individuals if they can afford to do so. Self-other resonance (somatosensory cortex and superior parietal lobule), which is lowered by a top-down control (MPFC, DLPFC, and TPJ), is another driver for altruism (Christov-Moore and Iacoboni, 2016). Hutcherson et al. (2015) have proposed a dynamic model of altruistic choice in which the ventral striatum and the somatosensory cortex respond to selfish impulses and the right TPJ to altruistic ones. Choice is determined by the convergence of impulses to a certain threshold. If the thresholds are narrowly defined, errors in choice can occur.

Altruistic punishment strongly contradicts rational choice and is partly driven by an activation of the ACC that is caused by expectations of norm compliance and by unpleasant feelings towards unfairness represented in the insula (Corradi-Dell'Acqua et al., 2016; Hewig

et al., 2011). This behavior is observable irrespective of whether the unfair treatment is directed at an individual or at a third party (Civai et al., 2012). Guo et al. (2013) have shown that perception of fairness is context-dependent. In a loss context, higher rates of rejection and thus stronger activations of the DLPFC, AI, ACC, and striatum are observed. This modulation is not present when observing third parties receiving offers. The difference here is mainly driven by the lower valuation of fairness for oneself by the striatum (Wu et al., 2014). For logical reasons, the same brain regions and the striatum are involved in punishing behavior. The reward-sensitive NAcc (striatum) shows more activation in the case of unfair offers directed at oneself than for unfair offers toward third parties. This indicates that rewards for revenge support the detection and punishment of fairness-norm deviations (Strobel et al., 2011). Fairness expectations influence the reaction to ultimatum game offers as well. Activation of the VMPFC is positively correlated to positive deviations from expectations, in line with earlier research. The AIC shows a U-shaped activation pattern over the spread between negative and positive deviations that conforms to the norm violation detection function of this brain area. The striatum tracks positive (ventromedial part and VMPFC) and negative (dorsolateral part and ACC) deviations from expectations with co-activations in related areas (Xiang et al., 2013). Strang et al. (2015) have examined the role of the DLPFC during altruistic punishment for the proposer. They deployed transcranial magnetic stimulation (TMS) to restrict the right DLPFC, and they found that the constraint hinders the subjects from adhering to fairness norms and from strategically maximizing their outcomes while playing with potential punishers. This behavior is driven by the inability to act strategically and is not changed by fairness evaluations or preferences. Intentionality is an additional factor that influences the decision to act according to fairness norms. If a respondent intentionally gives up the option to punish, the proposer acts more favorably for the respondent and vice versa. On the neurophysiological dimension, the intentional reduction of the punishment threat activates the VMPFC. This conforms to the functionality

of this brain region described above (Zhang et al., 2016). The articles of Aimone et al. (2014) and Wang et al. (2016) have addressed the role of the ACC and the insula in the decision to trust. In accordance with earlier findings, the activations of both brain areas counter a trusting behavior. The insula induces betrayal anxiety, and the ACC restrains the urge to trust a stranger.

Besides these articles that address particular research questions, there exist several unstructured reviews and meta-analyses that are concerned with single games or that introduce neuro-economics. The paper by Riling and Sanfey (2011) has built the basis of the current research. They addressed the scientific psychology community and presented findings related to the concepts presented in Section 4.2. Volk and Köhler (2012) have highlighted the advantages of neuro-economics by showing several instances of economic research that could be enriched by utilizing neuro-physiological techniques. The general relevance of neuro-economic research has been emphasized by Buckholz and Marois (2012). They claimed that this research enables one to understand the roots of cooperation and pro-social behavior. They derived a model of brain area interaction for explaining altruistic punishment. The model states that the DLPFC chooses an action of the response space and is guided by the MPFC, which itself, in turn, integrates information about intent from the TPJ and about arousal and harm from the amygdala. In the first meta-analysis of the ultimatum game played in fMRI, Gabay et al. (2014) found robust activations in the anterior insula, ACC, SMA, and putamen (striatum) as a consequence of unfair treatment. The same areas without the insula show activity when rejecting distribution proposals. Feng et al. (2015) conducted a meta-analysis to condense the findings regarding fairness. They have supported the notion of a dual system that guides the decision-making process. On the one hand, an intuitive domain exists that consists of the anterior insula and the VMPFC and that causes automated responses as altruistic punishment. On the other hand, a conscious domain co-exists that either subdues an automated response, so utilizing the VLPFC, DMPFC, left

DLPFC, and ACC, or strategically acts in alignment to fairness norms, so using the right DLPFC.

Social context, affect, and emotions

The idea of a dual system is challenged by the proposition of regulative links between various brain regions. Emotions and affect may substantially influence decision-making and cause variation of outcomes in otherwise identical situations. Besides these factors, other aspects such as risk evaluation, social context, and temporal effects can have an impact on social-decision behavior (Phelps et al., 2014). Some findings support this claim: respondents of an ultimatum game who have been confronted with a sad stimulus before the game reject a higher number of unfair offers. This change in behavior is mainly attributed to the insula and to decreased activation in the striatum (Harlé et al., 2012). Chang et al. (2011) have suggested an effect of expected behavior on decision-making and select guilt anticipation as an illustration. In accordance with van den Bos (2009), they obtained activations in the insula, SMA, DACC, DLPFC, and TPJ for rewarders of trust and activations of the VMPFC, NAcc, and DMPFC for betrayers of trust. Particularly the insula and SMA do show a positive link with guilt sensibility, while the NAcc is negatively coupled with this construct. Besides predetermined emotions, emotions affected by social circumstances such as the proximity between individuals, the characteristics of others, and the behavior of others play an important role in social decision-making processes. The effect of social distance has been tested in all games analyzed in this work. Wu et al. (2011) conducted an ERP study of dictator games between strangers and friends. Unfair offers were evaluated more negatively, also on the ERP scale, when the offers came from a friend and not a stranger, and these offers elicited a stronger activation of the VMPFC/ACC. There could be two possible causes for this result: either it could be the result of the violation of expected fairer offers from a friend or of the detection of the social norm breach modulated by the closeness of the friend. Three other studies have analyzed the impact of social proximity on the ultimatum game within an

ERP setting. Surprisingly, the same ERP signal turned positive in the case of a friend proposing, and rejection rates decreased in the ultimatum game (Campanhã et al., 2011; Yu et al., 2015). This change may be an indicator that in this setup the VMPFC plays a more important role than the ACC. The ultimatum game requires more conscious functions than the detection of social norm violations. The impact of proximity is accentuated by the fact that even a digital, remotely-sent touch does influence the acceptance rate of offers and has a lasting effect. The social information seems to be stored in memory-handling brain regions (Spapé et al., 2015). Fareri et al. (2015) have shown that the social value of a positive personal tie enables trust. The value is perceived as a reward in the ventral striatum and MPFC. The findings of Fahrenfort et al. (2012) and Bault et al. (2015) have extended these insights into human cooperation. They assigned the MPFC, ACC and PCC, anterior insula, and striatum non-social tie-related functions such as reward evaluation, empathy, and altruism. The posterior superior temporal sulcus (pSTS) and the TPJ play a role in tracking the value of the social tie and, therefore, moderate the decision-making process. This is supported further by an observed functional link between the pSTS and the MPFC.

Social proximity is only one factor among other characteristics that influences economic behavior. Reputation and sex are also important ascendancies. Building on the dual-system model, Fabre et al. (2015) have stated that female proposers in the ultimatum game are treated more favorably since the respondents are more willing to engage in conscious processes rather than to automatically reject unfair offers. The individual trustworthiness of strangers is represented in the striatum, which shows the highest activity when the decision to trust is in conflict with race-reputation information, which, in turn, is stored in the amygdala (Stanley et al., 2012). The perception of one's own social status has an effect on the fairness perception. A higher status leads to higher rejection rates in the ultimatum game. Unfairness results in activations in the anterior insula, the ACC, and the DLPFC, which conforms to previous research. The thalamus and the amygdala moderate

positively the effect on rejection rates, which implies a representation of social status by these brain regions (Hu et al., 2016).

Besides relatively time-stable characteristics, fast-changing and alterable signals such as facial expressions also wield influence on social-economic exchanges. If additional information regarding trustworthiness is present, individuals mostly are able to detach themselves from emotions processed in the anterior insula by activating the ACC when they face untrustworthy counterparts. The longer decision time in comparison with trustworthy partners may reflect the conflict resolution that is happening between affective (insula) and deliberate (frontal cortices) stimuli (Ruz and Tudela, 2011). With no aiding information, non-trustworthy facial impressions induce a bias towards rejecting offers, which seems fair on an objective scale. The neurophysiological analysis of the phenomenon shows increased activity in the VMPFC with functional links to the amygdala and insula (Kim et al., 2012). In contrast, a smile increases the chance of an offer being accepted. A smile dampens the negative physiological effect of unfair offers. Supporting the above-mentioned findings, the female gender has a similar effect as a smile (Mussel et al., 2014). The ability to evaluate trustworthiness based on faces is mainly constrained to human faces. The DMPFC and VMPFC enable the individual to rate the trustworthiness of human faces rather than virtual representations of such (Riedl et al., 2014).

Relativity represents an important factor in fairness considerations. On the one hand, individuals care about their treatment in comparison to others. An experimental setup shows that against the backdrop of relatively more unfair offers in a reference offering, respondents tend to accept more offers, and vice versa. The insula, explicitly the medial posterior insula, detects objective disparity and incorporates it into social behavior. This effect is support by activations in the TPJ and precuneus, which are parts of the *theory of mind* brain system. These brain regions reflect envy in the decision-making process (Wright et al., 2011). These findings have been supported and extended by Zheng et al. (2015) who additionally identified the

DLPFC as an origin of lower rejection rates when the reference respondents receive an unfair offer. This indicates an adaption process to social context. On the other hand, the relative contribution of a dispensable amount influences the perception of fairness as well. High contributors apply stricter rejection rules that are driven by activations in the anterior insula, ACC, TPJ, and, especially, the right DLPFC. In contrast, volatility in the ventral striatum and VMPFC represents a positive reward for perceived fairness in low contribution cases (Guo et al., 2014).

Social distinctions also can be caused by the exclusion of individuals from groups. A study by Lelieveld et al. (2012) has shed light into the *common currency* issue. The neural signal of ache due to social exclusion, which is signaled by the dorsal ACC, can be attenuated by a monetary reimbursement. Such a payment also changes the behavior of the excluded individual towards the excluder in a more benevolent direction. Will et al. (2015) have analyzed social exclusion in regard to altruistic punishment and forgiveness. Punishment of excluders is linked to activations in the anterior insula and pre-SMA, regions that are related to emotional processing and decision implementing. The opposite action, forgiveness, encompasses a larger system of brain areas that includes the TPJ, DMPFC, DACC, VLPFC, and DLPFC. This is reasonable since forgiving someone who caused harm to oneself requires self-control and mentalizing the other's reasoning.

Learning

Many social interactions are not one-shot games but repeated interactions. A time-variant analysis is necessary to understand the entanglement of brain regions (Van Rooij and Van Orden, 2011). A very interesting aspect in this context are learning processes and how they influence decision-making. Social norms are reflected in the decision behavior of humans. The decision behaviour is guided by social preferences and an underlying model of the environment that has been updated by reward-prediction errors over the course of time (Seo and Lee, 2012). One fundamental piece of information that needs to be learned in social

exchanges is associated risk. In acting as proposers in an ultimatum game, individuals utilize more unequal splits and, therefore, riskier options in order to explore their environments, and they use less risky splits to optimize their outcome. Rejections after riskier proposals cause stronger activity in the MPFC and medial posterior region than after relatively safe proposals. Based on their experiences, individuals deploy the TPJ, the LPFC, the insula, and the PCC after acceptances and, additionally, the MPFC after rejections so as to update their behavior and expectations (Billeke et al., 2013). Billeke et al. (2014) have found that in a repeated ultimatum game proposers tend to offer fairer splits during the last rounds. They have attributed a lack of adaption to high levels of activation in the ACC. Counterintuitively, they have also detected a positive link between ACC/PCC activation and behavior adaption after rejections. Therefore, they have attributed ACC activity to the strategic expectancy of behavioral change in the counterpart and PCC activity as a signal of adaption to the expectations of the other player.

On the receiving end of the ultimatum game, respondents are able to learn the fairness level of certain proposers over the course of several offer rounds. One cause for the learning process might be an updating signal measured through feedback negativity, which has been asserted to relate to activity in the ACC. It is most pronounced in the case of unfair offers. The effect is amplified by the individual's level of negative reciprocity (Kaltwasser et al., 2016). The information gathered through this learning process is attached to visual cues such as, for example, faces with the result that faces associated with unfair offers evoke a similar brain activation as the unfair offers themselves (Osinsky et al., 2014). Learning is essential for the development of trust. Initial trust prior to any exchange is distinct from dynamically updated trust and can be predicted by EEG measurements (Hahn et al., 2015). Reputation is a factor that interferes with reinforcement learning and initial trust. Trustors tend to keep the idea of trustworthiness even if the trustee's behavior signals otherwise. On the neurophysiological dimension, this is reflected in a weaker activation of the caudate

(striatum) in the case of a trustworthy individual that abuses the other's trust. The VLPFC mediates the lower activity in the striatum. This implies a more deliberate decision not to retaliate. The effect of reputation on initial trust is visible in the MPFC (Fouragnan et al., 2013). The distinction of brain areas that affect initial trust and trust learning supports the findings of Hahn et al. (2015). Trust is a basic building block of cooperation. Therefore, mechanisms such as rewarding, punishing, and learning also play an important role in the formation of cooperative behavior. The VMPFC and the striatum show an elicited response to reciprocity that indicates a perceived reward for received cooperation. Other brain areas identified as relevant for cooperation are the DMPFC, ACC, insula, DLPFC, and the TPJ (Stallen and Sanfey, 2013). Chung et al. (2015) were able to predict cooperation and deflection based on EEG signals, especially in the centroparietal and temporal areas of the brain, measured shortly after the outcome phase of a public good game. Results from varying setups have suggested that temporal areas such as the TPJ are used in this instance to infer the state of the other players' minds.

Emotions affect decision-making, especially in the case of perceived unfairness. People who experience mainly fair offers tend to accept more offers on average than those who are confronted with unfair offers. The latter show higher activations in the insula that signal anger while those who are fairly treated have stronger activity in the VMPFC (Gilam et al., 2015). The negative effects of anger can be alleviated by rational decision-making. Either the DLPFC or interoception decreases the effect of the anterior insula by activating the posterior insula as well as the somatosensory and temporal cortex (Kirk et al., 2011). In contrast, desirable outcomes such as altruism can be augmented as well. Compassion is learnable and reflected in activations of the DLPFC, inferior parietal cortex, and nucleus accumbens. These brain areas may enable the individual to better empathize with less well-off others (Weng et al., 2013).

Aging and gender

While learning is an active process, passive development of brain regions happens during the phase of adolescence that influences behavior. The appreciation of intentionality is an ability that develops on the neuronal level. Independent of age and intentionality of offers, unfairness always elicits an activation of the insula and the dorsal ACC. Older adolescents have shown enhanced signals in the TPJ and DLPFC that result in higher acceptance rates for unintentional unfair offers (Güroğlu et al., 2011; Van den Bos et al., 2014). In contrast to these findings, Steinmann et al. (2014) have also reported stronger activations for adults and adolescents in regions related to the theory of mind, but they have found the opposite for the dorsal ACC and the DLPFC. These results may hint that the deviating behavior of children and adolescents is mainly caused by constrained perspective-taking abilities. Similar outcomes are available in the setting of the trust game. Age correlates positively with a change of perspective as well as with activity in the TPJ and DLPFC during adolescence (Van den Bos et al., 2011). Additionally, older individuals show higher initial levels of trust and higher reward cooperation than younger players, but they also punish deceptive behavior in a stronger fashion. To be specific, cooperation arouses the VMPFC and the caudate nucleus less and the PCC more in older respondents. Deception has been shown to initiate a stronger reaction in the ACC for this age group (Fett et al., 2014). Besides the increased activation of the DLPFC (representing impulse control) and the TPJ (representing perspective taking), the behavior of adolescents may partly be explained by the decreasing importance of the DMPFC (representing self-focus) in the decision-making process (Crone, 2013).

A second important aspect that distinguishes children, adolescents, and adults is impulsivity. The DLPFC is essential for behavioral control, and its influence on strategic behavior evolves over age. As a result, older individuals act more strategically than younger ones (Steinbeis et al., 2012). This is especially true when they reject unfair offers in the

ultimatum game. Adults apply more rigorous norms to fairness and reject more often, aided by higher DLPFC and lower insula activation (Harlé and Sanfey, 2012). A setup in which impulse control plays an important role is decision-making after social exclusion. The findings in this area are, however, inconclusive. Moor et al. (2012) and Will et al. (2016) have shown that all age brackets punish excluders after exchanges. While Moor et al. (2012) have identified activations in the TPJ, temporal junction, LPFC, and, particularly for adults, the ACC and insula, Will et al. (2016) have found activity in the ventral striatum, DLPFC, and parietal cortex during punishment and in the DMPFC during forgiveness. Surprisingly, adolescents exhibit enhanced signals in the dorsal striatum and lateral PFC when forgiving their excluders. The results indicate that there exist explicit differences in age when dealing with economic situations that include a social setting. Research from Van Hoorn et al. (2016) has illustrated that older adolescents update their expectations through learning and contribute less in the public good game than their younger peer group. Additionally, they are less amenable to the presence or evaluation of third parties. The authors have named the TPJ, the DMPFC, the precuneus, and the STS as areas with the strongest differences in activation between socially unaffected and affected settings. They have found interactions between age and setting in the DMPFC and STS, with stronger activations for younger individuals. The TPJ activity is predictive of contributions to the public good. Therefore, DMPFC/STS and TPJ may be relevant for diverting aspects of reading others' minds.

Besides age, gender is a determining factor for socio-economic decision-making. Evaluations of fairness deviate between genders. Female respondents decline a higher rate of ultimatum game offers. The stricter threshold of females is represented in a stronger activation in areas of the VMPFC and the striatum (Dulebohn et al., 2016). While the striatum activation is in line with the preliminary findings of the literature, the VMPFC activation contrasts these. The fact that facial attractiveness has an influence on goodwill between exchange partners has been outlined above. The effect of this characteristic seems

to be accentuated if the evaluator is male and the reference person is female. Male respondents accept more unfair offers from attractive females and show signs of discomfort when those females are treated unfairly. This behavior is reflected in differences in frontal feedback-related negativity in an EEG measurement (Ma and Hu, 2015).

Hormones and drugs

A rather small research stream has investigated the effects of hormones and drugs on particular brain regions and, consequently, behavior. Gospic et al. (2011) and Kopsida et al. (2016) have focused on substance impact on the acceptance rate during the ultimatum game. While both studies have found lower rejection rates in comparison to a control group, the dispensation of benzodiazepine reduces the involvement of the amygdala in the decision process (Gospic et al., 2011), and an increase in testosterone strengthens the activation of the DLPFC and the caudate (striatum) (Kopsida et al., 2016). The substances, therefore, have the same effect on the outcome but take different roads within the brain. Serotonin has a similar effect on behavior in the ultimatum game. A depletion of the hormone increases retaliatory tendencies and engenders a reluctance to accept an unfair offer. This change of behavior is caused mainly by the striatum. On the one hand, lower activation in the ventral part devaluates fair offers; on the other hand, stronger activation in the dorsal part leads to increased punishment. This influence is prevalent only for exchanges in which the individual holds a personal stake. The research of Verdejo-Garcia et al. (2015) has combined substance abuse and personality disorders as variables that can impact results during the ultimatum game. In comparison to the control groups, differences in activation show in the insula, the ACC, and frontal temporal areas. The authors have ascribed deviating behavior to the disproportional share of frontal brain functions and missing emotional recognition.

Impairments and disorders

A particularly interesting research stream has utilized lesions within the brain and the corresponding interference with brain areas that are either permanent or temporarily induced

by transcranial direct-current stimulation (tDCS) to determine the role of particular areas in decision-making processes. Four areas have been analyzed in the literature included in this review. A lesion of the insula increases the level of reciprocal trust to an irrational high level; this lends support to the notion that this cortex detects social-norm violations (Belfi et al., 2015). Further corroboration can be found in Kang et al. (2011) who managed to alter the decision of the individual to trust by letting individuals touch warm and cold pads. They have shown a physical linkage between the temperature-sensing ability of the insula and its role in helping individuals to trust others. Coldness induces less trust and a stronger insula activation. Similar results have been found for the amygdala. Damage to the amygdala leads to highly trusting behavior even if an individual is faced with betrayal (Koscik and Tranel, 2011). In the case of altruistic punishment, the role of the amygdala is ambiguous. Two similar impaired twins have shown strongly varying behavior ranging from exaggerated rejections to rejecting only highly unfair and costly offers (Scheele et al., 2012). This difference in behavior might indicate a mediating role of the amygdala in the case of fairness assessment. Gu et al. (2015) have coupled the analysis of the insula and the VMPFC in the ultimatum game. In line with the other mentioned findings, lesions of the insula constrain the ability to adapt to changing norms in the environment. This increased sensitivity to norm violations is surprising. It might indicate that the role of the insula in fairness and trust evaluations deviates. The results regarding the VMPFC are consistent with its functionality outlined above. Restriction of this area results in an acceptance of extremely unfair offers. The dampening of anger and of other negative emotions through the MPFC only affects the decision-making process if the individual's own outcome is affected. Offerings to third parties are rejected at the same rate with or without a lesion. The rejection rate only drops in the case of a lesion and in the case of offers to the self (Civai et al., 2015). The lateral part of the prefrontal cortex has been influenced via tDCS with differing outcomes. Ruff et al. (2013) stimulated the right sphere of this brain region and have reported increased norm compliance

when an individual faces the threat of retaliatory punishment. Nihonsugi et al. (2015) stimulated the DLPFC and so increased the feeling of guilt that leads an individual towards higher cooperation in the trust game. These findings can lend support to the idea that the lateral part of the DLPFC suppresses selfish impulses.

The methodology of neuro-economics has sparked attention in the psychological-medical research community since it entails an experimental character that enables to analyze psychiatric conditions in a comparable setup. Psychopathy does not uniformly alter behavior during the ultimatum game. Osumi et al. (2012) have found that psychopaths, in comparison to healthy controls, accept unfair divisions more often. They have argued that this matches the selfish motives of the pathology. On the neurophysiological level, they have found less activity in the amygdala and thalamus, which, in turn, reduces reactive aggression. Yet, differing degrees of psychopathy permit similar acceptance rates for unfair offers. However, while mostly unaffected individuals employ the DLPFC in the case of acceptance, individuals who rate highly on the psychopathy scale have utilized the VMPFC to a higher degree. While the first group likely rejects an offer because of fairness considerations, the latter group does the same because of frustration (Vieira et al., 2014). These findings can be reflected in a setting in which an individual has the choice to punish in a costly manner unfair offer makers. Unfair offers activate the dorsal ACC, and rejection is linked to ACC and insula activation. Psychopathy modulates only the latter relation and decreases the effect of the activation on the rejection probability (White et al., 2013). These studies have shown that psychopaths seem to feel less negative emotions when receiving unfair offers, but the neurophysiological basis for this effect may deviate. Depression, in contrast, does not have an influence on behavior in the ultimatum game. Controls and depressed individuals have accepted the same rate of unfair and fair offers. Those with depression have shown less effects in the NAcc and the dorsal caudate. This indicates that they gain less perceived rewards from fair offers (Gradin et al., 2015). As trustees in an ultimatum game, depressed individuals tend not to

abuse trust even though the risk of detection and of punishment is low. This deviation from behavior of healthy controls who adapt their behavior and tend to defect is mediated by lower activation levels in the dorsal putamen, insula, and DLPFC. One explanation that integrates the reduced activation pattern has claimed that this behavior is caused by lower perceived rewards, blurred risk perception, and less conscious efforts to cheat and, thereby, to violate a social norm (Shao et al., 2015). Different kinds of fear have a substantial influence on decision-making. Social anxiety induces a higher rejection rate in the ultimatum game. The rate is coupled with signals related to emotional negativity. Therefore, anxious people tend to be more prone to the negative effects of unfair offers (Luo et al., 2014). In the setting of the trust game, social phobia prohibit the inclusion of reputational information over repeated interactions. While anxious individuals activate the striatum when they experience reciprocity, they fail to activate the same region when they face a partner with a good reputation, and, in consequence, they hinder themselves from establishing trust-based, long-term relationships (Sripada et al., 2013). Psychosis often includes states of depression and anxiety. Two studies of Gromann et al. (2013; 2014) have shown the impact of psychosis on trust games. Patients that suffer from this condition have shown less initial trust and have not rewarded reciprocity in comparison to healthy controls. No differences can be found between the two groups when dealing with trust-abusing partners. Affected individuals exhibit less activation in the caudate and the TPJ in the cooperative setting; the difference in TPJ activation is also prevalent in the deceptive setting. Similar to depression patients, psychosis may reduce sensitivity to rewards. Similar results have been found when testing siblings who exhibit psychosis. While they do not differ to controls on the behavioral level, they have reduced activation patterns in the putamen during the initial stage and lower activation in the caudate and insula in the result stage. This may hint toward a genetic antecedent of psychosis. In a comparison between schizophrenic individuals and healthy controls, Billeke et al. (2015) have reported differences on the behavioral and neurobiological

level when participants acted as proposers in an ultimatum game. In general, such patients choose safer, sometimes hyper-fair, offers and show a higher variance in the amount that is offered than controls. Additionally, controls update their expectations and offers when they play with an algorithm but apply strategic reasoning and intention estimation in the case of human opponents. This difference in behavior is linked to the adjustment of offers only in the computer scenario and oscillatory brain activity in the human setting. Schizophrenic individuals show a reversed pattern that implies that they may have trouble updating their expectations in social-exchange situations. Research about other conditions such as, for example, autism has recognized the potential of neuro-economic methods as well. Kishida et al. (2012) have identified the medial cingulate cortex as an important region that differentiates individuals with autism and those without, and they have proposed two computational models from the literature to measure these differences. The article of McAdams et al. (2015) have gone a step further. They have not only found behavioral differences between women with anorexia nervosa (or recovering from anorexia nervosa) and controls but also shown potential neural roots in a trust game. On top of that, they have deducted psychological antecedents for the illness. The last two papers of this review have combined the two research fields, psychological conditions, and aging. Adolescents with disruptive behavior disorder (DBD) often show antisocial behavior. The studies of Klapwijk et al. (2016) and Stuart et al. (2016) have analyzed the ramifications of this condition in socio-economic exchanges, in particular, in the dictator and ultimatum game. Affected adolescents show little discrimination dependent on emotional cues as a dictator. The control group lowers their offerings towards happy receivers. This contrast is accompanied by a lower activation level in the TPJ for DBD individuals. These individuals have trouble taking the perspective of others on an emotional dimension (Klapwijk et al., 2016). Surprisingly, no behavioral difference can be found in the case of altruistic punishment. DBD patients only

exhibit less neural activity in the connection between VMPFC and amygdala. This may point to a less distinct ability to dampen feelings of threat of these individuals (White et al., 2016).

4.6 Conclusion

A metaphor that describes the current state of neuro-economic research might be that of an unfinished puzzle. In the earlier days of the field, the main task was to identify the relevant puzzle pieces that resemble the brain areas utilized in economic tasks. From the descriptive analysis, I identified seven cortices that play a major role during different settings: namely, the cingulate cortex, the insula, the striatum, the VMPF, the DLPFC, the DMPFC, and the VLPFC. In relation to the four games, the brain areas have been of varying interest since researchers have ascribed them various functionalities in decision-making processes.

Before 2011, the focus had been on the discovery of distinctive functions of individual cortices. Through the metaphor of the puzzle, the research community managed to paint some colors on the puzzle pieces so as to get a first glimpse in which way they might connect to each other. Several research approaches and directions have evolved since 2011 to identify the connections: (1) reward and punishment, (2) aging, (3) social context, affect, and emotions, (4) learning, (5) drugs and hormones, and (6) impairments and disorders. The research has utilized guiding frameworks from economics and psychology to construe its findings. These frameworks are utility maximization, altruism, empathy, guilt, utilitarianism, inequity aversion, social norms, fairness, trust, reciprocity, reputation, and reinforcement learning. Just as in completing a puzzle it is advisable to set corner and edge pieces first, so these guiding ideas made it simpler to obtain a more meaningful, fuller picture.

While these frameworks had their advantages, and were backed up by the results presented in this review, one issue is that most of the work is carried out in small theoretical bubbles. This means most researchers have placed their work in one or two particular frameworks and have interpreted their findings against the backdrop of those. Literature that

compares the explanatory power of different concepts based on brain activation is currently missing. To some degree, the frameworks and the included ideas have overlapped, but they also have some distinctive attributes that should enable research to differentiate their impacts across several settings. In terms of connecting the pieces of the puzzle, the literature has made some substantial advancements. Reflecting back on the initial question, if some brain areas have conflictive or supportive relationships, I can state this is only partly true and leaves out a substantial portion of the overall picture. The seemingly opposing influences of the insula cortex and the DLPFC are moderated by the ACC and the VMPFC. This kind of relationship is exemplary for several instances of moderation effects that are present in social decision-making in a variety of contexts. The magnitude of the moderation effects is linked to context. This opens up new research opportunities linked to psychology that implement contextual settings in experimental setups. Additionally, there have been few studies that have implemented the public good game, and this needs to be increased. There have also only been a few studies that have analyzed more than one game. Here I see potential to carve out more information about the adaptive functionality of brain regions.

In conclusion, I would like to point out that this current review comes with some limitations that future research might address. First, the selection of studies might be rather restrictive in terms of the dimension of quality. I needed to leave out some fascinating research that, in some cases, also extended and qualified the studies included in the review. Second, while I mentioned all relevant brain areas, I had to focus on those that seemed most relevant in the decision-making process of the chosen economic games. Last, the level of detail in the reported findings was reduced to a certain degree owing to the relatively high number of included studies and the complexity of the field. In coming back to the initial metaphor, the puzzle is already taking shape but still needs more research to be solved.

5 Summary

This chapter gives an overview of the findings of the three studies that constitute this dissertation and lays out their individual contributions to the relevant literature streams. Subsequently, concluding thoughts on the impact of the dissertation and on future research are presented.

5.1 Results and contributions

The three studies included in this work are not interconnected with each other, and each represents an individual contribution to a particular research stream. They do, however, constitute discrete perspectives on the same subject. By utilizing a psychological framework, the study in Chapter Two aims to identify the antecedents of sustainable entrepreneurship. The first contribution of this study is the application and the enhancement of Ajzen's (1991) theory of planned behavior in the setting of sustainable venturing. The created model includes attitudes and norms of the entrepreneurial and sustainability realm and links them at the element of perceived behavioral control. This enables a simultaneous consideration of all factors in the intention creation process. The empirical analysis yields direct positive effects on the dependent variable of sustainable venturing intention for the elements of entrepreneurial orientation, sustainability orientation, and entrepreneurial norms. Additionally, the moderation between entrepreneurial and sustainability orientation is positively linked to the dependent variable. This result enables the study to contribute to the discussion as to whether those factors are rather contradictory to each other when it comes to sustainable venturing or whether the individual is able to combine the positive orientations. In fact, the overall positive linkage of attitudes to the sustainable venturing intention speaks for a coupling ability of identities as it has been proposed by York et al. (2016). Besides these significant relationships, the non-findings contribute to the understanding of the phenomenon of sustainable entrepreneurship as well. Sustainability

norms are strongly correlated with other elements of the proposed model and wield a rather passive influence on the dependent variable. Yet, this relationship to the rest of the parts does strengthen the notion of a reasonable application of the theory of planned behavior. The variable for perceived behavioral control, unfortunately, does not show a direct link to sustainable venturing intention. Through the literature research, a double-edged relationship of perceived behavioral control with social and ecological means could be revealed. While the variable has a positive impact on social purposes in the venturing intention, it does negatively affect ecological intents. Besides the insight into the mechanism of intention forming and the identification of relevant antecedents for sustainable venturing intentions, the study also contributes to the field on a methodological level. Even though choice-based conjoint analysis is not a novel method, its application in the entrepreneurial field is rare and is unique in the setting of sustainable entrepreneurship. The proposed research design directly answers Muñoz and Cohen's (2017b) call for new measures of dependent variables in the space of sustainable entrepeneurship.

In Chapter Three, the perspective on sustainable entrepreneurship moves away from the decision about entry into entrepreneurship. Rather, the balance between the demands for the pursuit of sustainable goals and the economic profit is analyzed through the lens of behavioral economics. Based on two papers by Holmstrom and Milgrom (1991) and Bénabou and Tirole (2005), I built a principal-agent two-task model that takes into consideration factors such as reputation, substitutability of tasks, risk preferences, and importance perception. By utilizing backward induction, the optimal effort levels for the tasks in the economic and sustainable space can be derived. While the findings of Bénabou and Tirole regarding the crowding-out effects of external incentives hold true in a two-task setting for the task attached to reputation (in this case, the pursuit of sustainable goals), the opposite is true for the economic task. That means that if the entrepreneur faces a setup in which he or she receives a remuneration for a sustainable task that would normally build a

positive reputation, he or she feels that the positive signal of his or her effort is distorted due to the extrinsic incentive. In consequence, he or she puts less effort into the sustainable task and concentrates on the purely economic task. This effect is moderated by the importance for the entrepreneur to appear pro-social and not greedy. As the crowding-out effect, therefore, affects not only the reputational task but also the other task, I label it a "reputational spillover effect" in the two-task setting.

The optimal effort levels enable the calculation of optimal incentive structures for maximizing society's surplus. Given the relatively high complexity of the equations that describe the relationship of incentives to other parameters, numerical solutions for a given set of parameter manifestations are determined. As expected, the two tasks have a mirrored relationship for numeration for most variables included in the model, but the reputational impact is similar. On top of that, there are cases in which positive incentives for both tasks seem reasonable. Overall, the study contributes to the research stream of behavioral economics since the setting of two tasks with reputational inputs allows multiple applications in real-life contexts. Embedding the model in a context of sustainable venturing provides a new approach for the research field of sustainable entrepreneurship. This also enables to analyze issues that this kind of entrepreneur faces from an analytical perspective.

The last study included in this dissertation approaches the topic of sustainable entrepreneurship from an uncommon direction. The object of research in this case is not the entrepreneur but pro-social, altruistic, and cooperative behavior in social exchange situations. Making use of the PRISMA framework, I identify 98 studies in the period between 2011 and 2016 that investigate the neurophysiological roots of such behavior in four economic games: the dictator game, the ultimatum game, the trust game, and the public good game. In the descriptive part of the chapter, the importance of different brain regions in the games is determined, and I define six research directions in which the identified studies can be categorized. Starting from the early work of Sanfey et. al (2003) that has described the

functionality of the anterior cingulate cortex to studies that have addressed the abilities of the tempo-parietal junction and dorsomedial prefrontal cortex, I collect findings about particular brain regions so as to give an overview of their capabilities and roles in decision-making processes.

Building on this summary, I review the more current findings of the 98 studies and place them in relation to each other so as to gain a better understanding of functional linkages. Generally speaking, the research from the period 2011–2016 has focused more on coherences between different cortices during decision-making than articles before this time frame. On the one hand, the literature review is aimed at researchers in the economics sphere who have strived to add physiological backing to their theories, and this review has, accordingly, provided them with an overview of the field of neuro-economics. On the other hand, the literature review offers neuro-economists a current insight into different research directions and enables them to find gaps in the literature that need to be addressed.

5.2 Concluding thoughts and implications for future research

Similar to the *triple bottom line* that is represented in sustainable development (Elkington, 1997) and that establishes connections between the realms of economy, ecology, and society, this work tries to entangle different perspective on the topic of sustainable entrepreneurship. Its purpose is to promote interdisciplinary research, which is applied by utilizing different theoretical and methodological approaches from the fields of economics, psychology, and neurophysiology. The reasoning behind this approach is twofold. On the one hand, while the research stream of sustainable entrepreneurship has moved past its infancy, it may still be in its adolescence. The groundwork has been done with regard to defining sustainability and drawing lines between ecological, social, and sustainable entrepreneurship. Yet, the majority of work in the field is still explorative, and quantitative studies have been relatively rare (Muñoz and Cohen, 2017b). The rigidness of the methods applied in other fields may

add substance to the research in entrepreneurship and may enable it to gain recognition from other scholars. In particular, experimental setups that allow for the comparison of results and the repeatability of executions may enable scholars to combine inputs from all fields.

On the other hand, each of the aforementioned disciplines has some limitations when it comes to explaining human behavior in socio-economic decision situations. The most obvious gap between the theoretical framework and empirical tests can be seen in classical economics. While the idea of a utility-maximizing protagonists may serve well as an approximation for simple choice decisions (Camerer, 2008a) it does not consider all potential influencing factors within the decision-making process. A well-established advancement has been the research field of behavioral economics that tries to implement psychological concepts and to build mathematical models that account for particular instances of deviations from the standard case. While this may be one piece of the puzzle, so to speak, neuro-economics can add even further insights into the neurological roots of behavior. This might enable scholars to generalize particular findings from selected instances to a greater set of situations. Psychological approaches can add contextual information to decision-making situations and, in consequence, make them more realistic than the abstract settings of economic experiments. As a counterpart to economics, psychology is able to add details to situations and can provide an abundance of empirical evidence of behavior, but it lacks a unified theory to explain human behavior. Neuro-economics in turn provides explanation for behavior on an exceedingly detailed dimension, but the models that are used in studies are rather simplistic due to the complexity of the brain and to the early state of the research field. Economics and psychology can add to this approach by supplying frameworks that are more complex and closer to reality.

Besides the individual suggestions for further research made in the three chapters, the above-mentioned symbiotic relationship between the research directions provides the

potential for further research avenues. Possible new approaches could include the creation and renewal of economic models. These could try to define utility gained from acting sustainable based on neuro-economic findings. Psychological studies could be gathered to identify feasible explanations for non-rational behavior in the setting of sustainable entrepreneurship, similar to the study of Shepherd et al. (2013). Additionally, I see great potential in the combination of more complex economic models and neuro-economic methods to carve out the neuro-physiological wirings of sustainable behavior. In general, there is an abundance of possible combinations of either two or all three of the fields of economics, psychology, and neuro-economics.

While there might be potential for more profound insights into human behavior and, in particular, into sustainable entrepreneurship when applying interdisciplinary research, I should like to conclude my work with an appeal to the academic ecosystem in management and economics. In its current state, it provides too little incentives to carry out such research. Think tanks that combine researchers of different fields or grants that foster interdisciplinary studies in the management faculty are rare, and journals that explicitly promote the submission of such articles are not well established in the traditional management field. This work has taken a step in the direction of interdisciplinary research that mainly is motivated intrinsically, a similarity it shares with sustainable entrepreneurship. My hope is that, in both cases, the amount of extrinsic incentives will increase.

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Appendix

A.1 Online survey slides of chapter 2

Willkommen bei der Alumni Umfrage der Universität Würzburg

Sehr geehrte/r Teilnehmer/in,

zunächst möchten wir uns herzlich bei Ihnen für das Interesse an unserer Befragung bedanken. Wir sichern Ihnen zu, dass jegliche Antworten Ihrerseits anonym erhoben werden und kein Bezug zwischen Ihren Angaben und Ihrer Person hergestellt werden kann. Unsere Bitte an Sie wäre, den Fragebogen so vollständig wie möglich auszufüllen. Durch eine große Anzahl abgeschlossener Umfragen wird die Möglichkeit verlässlicher Erkenntnisse stark verbessert.

Wir, der Lehrstuhl für Unternehmensgründung und -führung, möchten Ihnen uns und unsere Forschung vorstellen. Im Jahr 2009 wurde der Lehrstuhl von der Universität Würzburg zur verstärkten Profilierung der wirtschaftswissenschaftlichen Fakultät ins Leben gerufen und wird seitdem von Prof. Dr. Marcus Wagner geleitet. Im Zentrum der Forschungstätigkeit stehen die Themen Unternehmensgründung, Innovationsmanagement und nachhaltige Unternehmensführung.

Wir würden uns freuen, wenn Sie sich 15 Minuten Zeit nehmen den folgenden Fragebogen auszufüllen. Sie unterstützen damit unsere Forschung und helfen dabei den Service des Alumnibüros für Sie und andere Alumni zu verbessern. Um Ihnen einen weiteren Anreiz zu bieten, an unserer Umfrage teilzunehmen, haben Sie am Ende des Fragebogens die Möglichkeit an einer Verlosung von 10 Amazon-Gutscheinen im Wert von 20€ Euro teilzunehmen. Zusätzlich werden wir 30 Exemplare des Buches "Entrepreneurship, Innovation and Sustainability" von Prof. Dr. Marcus Wagner, sowie 60 Jahrespackete aus 2013 der Zeitschrift "StartingUp" an zufällig ausgewählte Teilnehmer unserer Studie verschicken.

Sollten Sie Fragen, Anregungen oder Kritik zur Umfrage haben, melden Sie sich gerne bei David Hirschfeld (david.hirschfeld@uni-wuerzburg.de).

Mit freundlichem Gruß
Ihr Lehrstuhl Unternehmensgründung und –führung der Universität Würzburg

0% 100%

Ausbildung & Ausland

Welcher ist der höchste von Ihnen erworbene akademische Abschluss?

- Keiner
- Bachelor
- Diplom
- 1. Staatsexamen
- Master/Magister
- 2. Staatsexamen
- Promotion
- Habilitation
- Sonstiger

In welchem Jahr haben Sie diesen Abschluss erworben?

Bitte schreiben Sie Ihre Antwort hier

In welchem Bereich haben Sie diesen Abschluss erlangt?

- MINT
- Humanwissenschaften
- Philosophische Wissenschaften
- Wirtschafts-/ Sozialwissenschaften
- Rechtswissenschaften
- Medizin
- Sonstiger

Haben Sie vor Ihrem Erststudium eine Ausbildung abgeschlossen?

- Nein
- Ja

0% 100%

Ausbildung & Ausland

Inwieweit stand dieser berufliche Abschluss in einem fachlichen Zusammenhang mit Ihrem Studium?

- gar nicht
- wenig
- mittelmäßig
- überwiegend
- völlig

0% 100%

Ausbildung & Ausland

Wie viele Praktika / studienbezogene Nebenjobs (auch mehrere bei einem Arbeitgeber) haben Sie während Ihres Studiums absolviert?

Haben Sie sich im Rahmen Ihres Studiums im Ausland aufgehalten? (mehrere Optionen möglich)

- [ ] Ja, für ein Auslandsstudium
- [ ] Ja, für ein Praktikum
- [ ] Ja, für einen Sprachkurs
- [ ] Nein

0% 100%

Ausbildung & Ausland

Wie viele Monate haben Sie sich während Ihres Studiums insgesamt im Ausland aufgehalten?

Haben Sie während Ihres Auslandaufenthaltes Produkte/Dienstleistungen wahrgenommen, welche Sie in Deutschland vermissen?

- ( ) Nein
- ( ) Ja

0% 100%

Ausbildung & Ausland

Waren/sind Sie an einer Hochschule und/oder einer sonstigen Forschungseinrichtung beschäftigt?

- ( ) Nein
- ( ) Ja

Haben Sie während Ihres Studiums über eine Gründung nachgedacht?

- [ ] Ja, während meines Studiums
- [ ] Ja, während meiner Promotion
- [ ] Nein

0% 100%

Berufliche Tätigkeit

Arbeiten Sie aktuell als Selbstständige/r bzw. sind Sie freiberuflich tätig?

- ○ Nein
- ○ Ja

In welcher Branche sind Sie momentan tätig?

Bitte alle Möglichkeiten auswählen, die zutreffen.

- ☐ Ingenieurwesen, Architektur, Bauwesen
- ☐ Beratung, Recht, Training
- ☐ Sprachdienstleistungen (z.B. Übersetzung, Lektorat, Journalismus)
- ☐ IT/Telekommunikation (inkl. Programmierung)
- ☐ Handel, Einzelhandel
- ☐ Produzierendes Gewerbe
- ☐ Medizin, Gesundheit, Fitness, Schönheit
- ☐ Marketing, Werbung, Medien, Grafik & Design, Event-Management, Kunst
- ☐ Kaufmännische Dienstleistungen
- ☐ Gastronomie, Hotel
- ☐ Vertrieb (z.B. Finanzvertrieb, Makler)
- ☐ Service (z.B. Reparatur, Reinigung, Transport, Haushalt, Garten)
- ☐ Erziehung, Unterricht
- ☐ Handwerk
- ☐ Sonstiges

0% 100%

Unternehmertum

Bitte wählen Sie die zutreffende Antwort aus.

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
Ich beabsichtige, mich in den nächsten 5 Jahren selbstständig zu machen bzw. selbstständig zu bleiben	○	○	○	○	○

Bitte wählen Sie die zutreffende Antwort aus.

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
Die Atmosphäre an der Universität Würzburg inspirierte zur Entwicklung einer Geschäftsidee.	○	○	○	○	○
Wenn die Dinge gut für mich laufen, so denke ich, dies sei größtenteils Glück.	○	○	○	○	○
Eine Unternehmensgründung reizt mich mehr als die Leitung eines bereits bestehenden Betriebs.	○	○	○	○	○
Es gibt genügend qualifizierte Beratungs- und Serviceangebote für Existenzgründer.	○	○	○	○	○
Ich denke oft: "So ist es eben, und da gibt es nichts, was man daran ändern könnte.".	○	○	○	○	○
Als Gründer ist es schwierig, Kredite von Banken zu erhalten.	○	○	○	○	○
Existenzgründer haben ein positives Image in der Bevölkerung.	○	○	○	○	○
Es ist schwer, eine Geschäftsidee zu finden, die nicht bereits realisiert wurde.	○	○	○	○	○
Ein festes Gehalt und geregelte Arbeitszeiten sind für mich wichtig.	○	○	○	○	○
Wenn ich reise, dann wähle ich eher Routen, die ich kenne.	○	○	○	○	○
In den letzten 6 Monaten habe ich mich einer riskanten Situation ausgesetzt.	○	○	○	○	○
Richtig gut verdienen kann man auf Dauer nur, wenn man als Selbstständiger arbeitet.	○	○	○	○	○
Ich möchte immer wieder etwas Neues ausprobieren (z.B. exotische Gerichte, fremde Länder, ...).	○	○	○	○	○
Die staatlichen Reglementierungen (Gesetze, Genehmigungsverfahren, Verordnungen, etc.) sind unternehmerfeindlich.	○	○	○	○	○
Mir ist es wichtiger, mein eigener Chef zu sein, als eine besonders sichere Stelle zu haben.	○	○	○	○	○

0% 100%

Unternehmertum

Bitte wählen Sie die zutreffende Antwort aus.

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
Ich bin fähig, die meisten meiner Probleme zu bewältigen.	○	○	○	○	○
Manchmal habe ich nicht das Gefühl, meine Arbeit im Griff zu haben.	○	○	○	○	○
Wenn ich mir Mühe gebe, habe ich normalerweise Erfolg.	○	○	○	○	○
Ich schließe Aufgaben erfolgreich ab.	○	○	○	○	○
Ich bin zuversichtlich, im Leben den Erfolg zu erzielen, den ich verdiene.	○	○	○	○	○
Gründungsrisiko ist vergleichbar mit dem Risiko eines Glücksspiels.	○	○	○	○	○
Ich bestimme, was in meinem Leben passieren wird.	○	○	○	○	○
Insgesamt bin ich mit mir selbst zufrieden.	○	○	○	○	○
Gründungsrisiko ist vergleichbar mit dem Risiko von Investitionen in finanzielle Geldanlagen.	○	○	○	○	○
Wenn ich scheitere fühle ich mich manchmal wertlos.	○	○	○	○	○
Es gibt Zeiten, da erscheinen mir die Dinge ziemlich trostlos und hoffnungslos.	○	○	○	○	○
Ich höre mir Probleme meiner Mitmenschen an, um Lösungen für diese zu finden.	○	○	○	○	○
Wenn ich Fehler an Produkten/Dienstleistungen erkenne, fällt mir sofort etwas ein, um diese zu verbessern.	○	○	○	○	○
Ich bin dauerhaft auf der Suche nach neuen Geschäftsideen, um diese umsetzen zu können.	○	○	○	○	○
Ich habe nicht das Gefühl, die Kontrolle über meinen Erfolg in meiner beruflichen Entwicklung zu haben.	○	○	○	○	○
Ich bin voller Zweifel über meine Fähigkeiten.	○	○	○	○	○
Manchmal fühle ich mich niedergeschlagen.	○	○	○	○	○

0% 100%

Unternehmertum

Wie würden Sie Ihre Risikobereitschaft in Bezug auf folgende Bereiche einschätzen?
Wie schätzen Sie Ihre Risikobereitschaft ein...

	gar nicht risikobereit										Sehr risikobereit
...beim Geldanlegen?	○	○	○	○	○	○	○	○	○	○	○
...bei Freizeit und Sport?	○	○	○	○	○	○	○	○	○	○	○
...bei Ihrer beruflichen Karriere?	○	○	○	○	○	○	○	○	○	○	○
...bei Ihrer Gesundheit?	○	○	○	○	○	○	○	○	○	○	○
...beim Vertrauen in fremde Menschen?	○	○	○	○	○	○	○	○	○	○	○
...im Allgemeinen?	○	○	○	○	○	○	○	○	○	○	○

Geben Sie für folgende Aussagen bitte an, wie wahrscheinlich es ist, dass Sie die Aktivität oder das Verhalten ausüben.

	sehr unwahrscheinlich	unwahrscheinlich	unentschieden	wahrscheinlich	sehr wahrscheinlich
Investition von 10% Ihres Jahreseinkommens in einen Investmentfond mit mittlerem Wachstum	○	○	○	○	○
Investition von 5% Ihres Jahreseinkommens in eine konservative Aktie	○	○	○	○	○
Mit einem Tageseinkommen in einem Casino spielen	○	○	○	○	○
Setzen eines Tageseinkommens bei einem Pokerspiel mit hohen Einsätzen	○	○	○	○	○
Wetten eines Tageseinkommens auf den Ausgang eines Sportereignisses (z.B. Fußball, Tennis oder Basketball)	○	○	○	○	○
Wetten eines Tageseinkommens auf ein Pferderennen	○	○	○	○	○
Investition von 10 % Ihres Jahreseinkommens in eine Regierungsanleihe	○	○	○	○	○
Investition von 5% Ihres Jahreseinkommens in eine hoch spekulative Aktie	○	○	○	○	○

0% 100%

Unternehmertum

Wie sehen Sie sich selbst?
Ich bin jemand, der...

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
... verzeihen kann	○	○	○	○	○
... sich oft Sorgen macht	○	○	○	○	○
... rücksichtsvoll und freundlich mit anderen umgeht	○	○	○	○	○
... zurückhaltend ist	○	○	○	○	○
... eine lebhafte Phantasie, Vorstellung hat	○	○	○	○	○
... wissbegierig ist	○	○	○	○	○
... gründlich arbeitet	○	○	○	○	○
... künstlerische, ästhetische Erfahrungen schätzt	○	○	○	○	○
... originell ist, neue Ideen einbringt	○	○	○	○	○
... manchmal etwas grob zu anderen ist	○	○	○	○	○
... Aufgaben wirksam und effizient erledigt	○	○	○	○	○
... entspannt ist, mit Stress gut umgehen kann	○	○	○	○	○
... kommunikativ, gesprächig ist	○	○	○	○	○
... leicht nervös wird	○	○	○	○	○
... eher faul ist	○	○	○	○	○
... aus sich herausgehen kann, gesellig ist	○	○	○	○	○

Wie bewerten Sie folgende Aussagen?
Die sozialen Normen und Kultur in meinem persönlichen Umfeld...

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
...fördern das Eingehen von unternehmerischen Risiken.	○	○	○	○	○
...unterstützen stark Erfolge, die durch eigene Leistung erreicht wurden.	○	○	○	○	○
...betonen den Wert von Selbstständigkeit, Autonomie und Eigeninitiative.	○	○	○	○	○
...betonen den Wert der Verantwortung des Einzelnen über das eigene Leben.	○	○	○	○	○
...fördern Kreativität und Originalität.	○	○	○	○	○

0% 100%

Einstellungen

Bitte überlegen Sie bei jeder Aussage, in welchem Ausmaß diese auf Sie persönlich zutrifft oder nicht zutrifft.

	Trifft überhaut nicht zu	Trifft überwiegend nicht zu	Trifft eher nicht zu	Trifft eher zu	Trifft überwiegend zu	Trifft vollständig zu
Eigentlich gebe ich mir keine Mühe, mich umweltbewusst zu verhalten.	○	○	○	○	○	○
Die Rolle des Autos als Umweltverschmutzer wird übertrieben.	○	○	○	○	○	○
Ich bin froh, dass ich für Reisen, Wanderungen oder fürs Picknick Erfrischungsgetränke in leichten Dosen oder Plastikflaschen kaufen kann.	○	○	○	○	○	○
Mit einem Tempolimit ist der Umwelt auch nicht geholfen.	○	○	○	○	○	○
Die Umweltprobleme werden heutzutage künstlich hochgespielt.	○	○	○	○	○	○
Ich rege mich über die Leute auf, die Berge von Konservendosen aus den Supermärkten schleppen.	○	○	○	○	○	○
Ich mache mir beim Einkaufen keine unnötigen Sorgen darüber, ob ein Produkt die Umwelt in irgendeiner Weise schädigen könnte.	○	○	○	○	○	○
Ich bin dafür, dass man von Firmen, die sich nachweislich umweltschädigend verhalten, keine Produkte mehr kauft, auch wenn man dann in Zukunft auf einige Dinge verzichten müsste.	○	○	○	○	○	○
Als Einzelner kann ich wenig für den Umweltschutz tun.	○	○	○	○	○	○
Beim Einkaufen lasse ich mir lieber eine Plastiktüte geben, als dass ich eine Einkaufstasche mitnehme.	○	○	○	○	○	○
Ich bin nicht so ohne weiteres bereit, mein bewährtes Wasch- oder Reinigungsmittel zu wechseln, nur weil ein anderes Produkt umweltfreundlicher ist.	○	○	○	○	○	○
Ich würde einen höheren Strompreis in Kauf nehmen, wenn ich wüsste, dass zur Stromerzeugung alternative Energien eingesetzt werden.	○	○	○	○	○	○
Ich habe mich informiert, welche Wasch- und Reinigungsmittel wirklich umweltverträglich sind, und kaufe bevorzugt diese Produkte.	○	○	○	○	○	○

	Bitte kreuzen Sie auf nachstehender Skala an, ob Sie mehr dem Statement auf der linken oder auf der rechten Seite zustimmen:							
Manchmal müssen manche natürlichen Ressourcen für wichtige Entwicklungen geopfert werden.	○	○	○	○	○	○	○	Alle Vorsicht muss gewahrt werden um die natürlichen Ressourcen in unserem Streben nach Entwicklung zu schützen.
Gegenwärtige Produktionsmuster müssen nur wenig angepasst werden um das Wohlergehen der Natur zu schützen.	○	○	○	○	○	○	○	Gegenwärtige Produktionsmuster müssen wesentlich geändert werden um das Wohlergehen der Natur zu schützen.
Die Menschen müssen aus Respekt vor der Natur nur kleine Veränderungen ihres gegenwärtigen Konsums vornehmen.	○	○	○	○	○	○	○	Die Menschen müssen aus Respekt vor der Natur wesentliche Veränderungen ihres gegenwärtigen Konsums vornehmen.
In einem gewissen Umfang wird sich die Natur um sich selbst kümmern zum Wohle zukünftiger Generationen.	○	○	○	○	○	○	○	Es ist eine Verpflichtung einer Gesellschaft die Natur rigoros zu schützen zum Wohle zukünftigen Generationen.

0% 100%

Einstellungen

Bitte überlegen Sie bei jeder Aussage, in welchem Ausmaß diese auf Sie persönlich zutrifft oder nicht zutrifft.

	Trifft überhaut nicht zu	Trifft überwiegend nicht zu	Trifft eher nicht zu	Trifft eher zu	Trifft überwiegend zu	Trifft vollständig zu
Es lohnt im Grunde nicht, sich mit Problemen Anderer zu belasten. Man kann sowieso nichts dagegen tun.	○	○	○	○	○	○
Ich glaube, dass man auch als Einzelner eine Menge bewegen kann, um anderen Menschen zu helfen.	○	○	○	○	○	○
Ich habe einfach keine Zeit, mich um Andere zu kümmern.	○	○	○	○	○	○
Wenn man sich um Andere kümmert, wird dies doch meist als Einmischung in die Privatsphäre verstanden. Am besten, man hält sich da heraus.	○	○	○	○	○	○
Wenn ich sehe, dass Andere in Schwierigkeiten sind, biete ich spontan meine Hilfe an.	○	○	○	○	○	○
In meiner Freizeit möchte ich mich erholen und Spaß haben und mich nicht auch noch mit Problemen Anderer belasten.	○	○	○	○	○	○
Bei meiner Arbeit ist mir vor allem wichtig, dass ich anderen Menschen helfen kann.	○	○	○	○	○	○
Ich kümmere mich regelmäßig um "Außenseiter" der Gesellschaft (z.B. Ausländer, Asylanten, Behinderte, Alte, Kranke).	○	○	○	○	○	○
Als Einzelner kann man an sozialen Missständen doch nichts ändern.	○	○	○	○	○	○
Ich kann mich nicht mit den Problemen Anderer belasten; ich habe genug mit mir selbst zu tun.	○	○	○	○	○	○

Wie bewerten Sie folgende Aussagen?

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
Ich glaube, dass Umweltprobleme zu den größten Herausforderungen in unserer Gesellschaft gehören.	○	○	○	○	○
Ich bin der Meinung, dass Unternehmer und Unternehmen eine breitere gesellschaftliche Verantwortung übernehmen müssen.	○	○	○	○	○
Unternehmen sollten im Bereich Umweltschutz eine Vorreiterrolle einnehmen.	○	○	○	○	○
Firmen, die als umweltfreundlich gelten, haben es leichter qualifizierte Mitarbeiter zu rekrutieren und zu halten.	○	○	○	○	○
Die Umweltleistungen eines Unternehmens werden in Zukunft zunehmend von Finanzinstituten berücksichtigt (z.B. in der Kreditvergabe oder bei Aktienempfehlungen).	○	○	○	○	○
Corporate Social Responsibility sollte in den Firmengrundsätzen jedes Unternehmens verankert sein.	○	○	○	○	○

0% 100%

Einstellungen

Wie sehen Sie sich selbst?
Ich bin jemand, der...

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
...sich fügt und anpasst	○	○	○	○	○
...detailgenaues Arbeiten gerne mag	○	○	○	○	○
...bedacht im Umgang mit Autorität agiert	○	○	○	○	○
...niemals ohne die nötige Befugnis handelt	○	○	○	○	○
...der neue Blickwinkel auf alte Probleme eröffnet	○	○	○	○	○
...gründlich ist	○	○	○	○	○
...sich mit vielen Ideen gleichzeitig befassen kann	○	○	○	○	○
...belebend wirkt	○	○	○	○	○
...originelle Ideen hat	○	○	○	○	○
...sich mit allen Details sorgfältig befasst	○	○	○	○	○
...viele neue Ideen hervorbringt	○	○	○	○	○
...der methodisch und systematisch ist	○	○	○	○	○
...sich gut in „das System" einfügt	○	○	○	○	○

Wie bewerten Sie folgende Aussagen.
Die sozialen Normen und Kultur in meinem persönlichen Umfeld...

	Ich stimme überhaupt nicht zu	Ich stimme eher nicht zu	Neutral	Ich stimme eher zu	Ich stimme voll zu
...unterstützen den Wert von Freiheit der Person.	○	○	○	○	○
fördern die Solidarität in einer Gemeinschaft.	○	○	○	○	○
...fördern die Toleranz gegenüber Unbekanntem.	○	○	○	○	○
...betonen den guten Umgang mit der Natur.	○	○	○	○	○
...stellen geteilte Verantwortung in den Mittelpunkt aller Handlungen.	○	○	○	○	○
...betonen die Gleichheit aller Personen.	○	○	○	○	○

0% 100%

Unternehmerische Erfahrung

Sind/Waren Ihre Eltern selbstständig tätig?

○ Nein

○ Ja

Wie viele Unternehmen haben Sie bereits selbst gegründet? ☐

0% 100%

Unternehmerische Erfahrung

Wann haben Sie ihr (erstes) Unternehmen gegründet?

In welcher Branche fand diese Gründung statt?

Bitte alle Möglichkeiten auswählen, die zutreffen.

- [ ] Ingenieurwesen, Architektur, Bauwesen
- [ ] Beratung, Recht, Training
- [ ] Sprachdienstleistungen (z.B. Übersetzung, Lektorat, Journalismus)
- [ ] IT/Telekommunikation (inkl. Programmierung)
- [ ] Handel, Einzelhandel
- [ ] Produzierendes Gewerbe
- [ ] Medizin, Gesundheit, Fitness, Schönheit
- [ ] Marketing, Werbung, Medien, Grafik & Design, Event-Management, Kunst
- [ ] Kaufmännische Dienstleistungen
- [ ] Gastronomie, Hotel
- [ ] Vertrieb (z.B. Finanzvertrieb, Makler)
- [ ] Service (z.B. Reparatur, Reinigung, Transport, Haushalt, Garten)
- [ ] Erziehung, Unterricht
- [ ] Handwerk
- [ ] Sonstiges

Alles in allem, würden Sie sagen, Sie haben Ihr Unternehmen gegründet...

- ( ) ...um eine konkrete Gelegenheit zu nutzen.
- ( ) ...weil sich keine bessere Erwerbsalternative bot, also aus der Notwendigkeit heraus.
- ( ) ...aus der Notwendigkeit heraus und weil sich gerade eine gute Gelegenheit bot.

Hatten Sie (bzw. ein Teammitglied) Erfahrung in der Branche, in der die Gründung stattfand?

- ( ) Nein
- ( ) Ja

0% 100%

Sozi-demographische Eigenschaften

Welches Geschlecht haben Sie?

- Männlich
- Weiblich

Wie alt sind Sie? ____

In welcher Region leben Sie aktuell?

- Deutschland
- Europa (ohne Deutschland)
- Nord- oder Südamerika
- Asien
- Australien
- Afrika

Waren Sie an der Universität Würzburg im Rahmen eines Austauschprogrammes oder als Gastforscher eingeschrieben?

- Nein
- Ja

Wie viele Kinder haben Sie? ____

0% 100%

Gründungsentscheidung

Die nächsten 17 Fragen sind Entscheidungensituationen in denen Sie 1 Option aus 4 auswählen müssen. Sie benötigen für die Beantwortung der Fragen 3-4 Minuten und gelangen nach 3 abschließenden Fragestellungen des Alumnibüros direkt zum Gewinnspiel.

Stellen Sie sich vor Sie hätten die Möglichkeit sich selbstständig zu machen und ein Unternehmen zu gründen. In dem folgenden Abschnitt stellen wir Ihnen mehrere mögliche Unternehmen mit verschiedenen Eigenschaften vor. Bitte wählen Sie aus den 4 vorgestellten Unternehmen immer dieses aus, welches Sie am ehesten bereit wären selbst zu gründen. Die Eigenschaftsdimensionen sind dabei Folgende (jeweils 3 Ausprägungen):
- Einkommen (prozentualer Vergleich zu Ihrem jetzigen Einkommen),
- Ausfallrisiko (mit welcher Wahrscheinlichkeit Sie mit dem Unternehmen Insolvenz anmelden müssen, gleichbedeutend mit einem Verlust von 30% des Privatvermögens),
- ökologischer Umweltschutz und sozialer Nutzen für die Gesellschaft (welche Bedeutung diese beiden Konzepte bei der Gestaltung des Unternehmens einnehmen).

(1 von 17)

	Unternehmen 1	Unternehmen 2	Unternehmen 3	Unternehmen 4
Insolvenzrisiko	**50% Ausfallrisiko**	**20% Ausfallrisiko**	**80% Ausfallrisiko**	**50% Ausfallrisiko**
Ökologischer Umweltschutz	**ökologischer Nutzen als Kernaufgabe (hoch)**	**ökologischer Nutzen als Zufallsergebnis (niedrig)**	**ökologischer Nutzen als Zufallsergebnis (niedrig)**	**ökologischer Nutzen als Kernaufgabe (hoch)**
Sozialer Nutzen für die Gesellschaft	**sozialer Nutzen als Zufallsergebnis (niedrig)**	**sozialer Nutzen als Ergänzung (mittel)**	**sozialer Nutzen als Zufallsergebnis (niedrig)**	**sozialer Nutzen als Ergänzung (mittel)**
Einkommen	**- 20% Einkommen**	**+/- 0% Einkommen**	**+ 20% Einkommen**	**+/- 0% Einkommen**
	○	○	○	○

A.2 Distributions of main variables of chapter 2