

Effects of entrepreneurship and sustainability orientation in three behavioral economic paradigms

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Abstract

Innovation is suggested to be key to sustainable development. Since innovation results from entrepreneurship, a key question is about the relationship of entrepreneurship and individuals' sustainability orientation. Risk, as a variable potentially affecting both, is involved in our exploratory study using three different behavioral economic paradigms. Our sample consists of twenty individuals and includes self-reported data on psychometric scales, behavioral data, and EEG and fMRI data. For the offer game, analysis of reaction time data reveals a significant main effect of ambiguity indicating longer reaction times in ambiguous trials. For the decision-making data, sustainability orientation was found to interact significantly with ambiguity indicating that participants with a high sustainability orientation were relatively more cautious under ambiguity and riskier without. In the stock trading game, analysis of the reaction time data did reveal a significant effect of risk, which indicated fastest reaction for mixed as compared to both low and high risk. Furthermore, a significant interaction of risk with sustainability orientation was found in this paradigm, revealing relatively slower reaction times in mixed trials for participants with a high sustainability orientation as compared to faster reaction times of participants with a high sustainability orientation for both low and high risk trials. For the public goods game, the mixed model of the latency data revealed a significant effect of the trial with a decline in reaction time from trial 1 to trial 14 and an increase from trial 15 to 21. There was a significant interaction of the trial with sustainability orientation revealing a significant positive relationship with reaction time in trial 1. Finally, the mixed model of the decision-making data revealed a significant effect of the trial indicating an increase in offer size from trial 1 to trial 16 (trial 16 being significantly higher than trial 14), and a subsequent decrease to 21. These findings indicate complex interactions of especially sustainability orientation and to a lesser degree entrepreneurship when it comes to content and speed of economic choices in decision situations differing in terms of risk conditions and social context that are to be related further to fMRI and EEG data.

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1. Principal Topic

In the context of sustainable development, innovation has often been proposed as a panacea for solving fundamental challenges to humankind, such as climate change. Since innovations often result from entrepreneurship, a key question is what the relationship of entrepreneurship and the sustainability orientation of individuals is. The literature is equivocal in terms of these two being mutually supporting or rather mutually exclusive (Shepherd et al., 2013; York et al., 2016). One possible answer to this question lies in the role of risk as a third variable, potentially affecting both sustainability orientation and entrepreneurship. In the field of entrepreneurship, risk is a central concept, even though empirical studies are challenged with distinguishing different forms of risk, ambiguity or uncertainty. In order to do so, our exploratory study comprehensively models different forms and levels of risk beyond simple risk gambles in different behavioral economic paradigms. In order to at the same time account for effects of sustainability orientation we also vary these in terms of social interaction levels, in order to ultimately gain a better and more fundamental understanding of the role of individual sustainability orientation for entrepreneurship aimed at realizing innovations supporting sustainable development.

2. Data and Methods

Our sample consisted of ten entrepreneurs (mean age: 40.1, 7 male, 2 female, demographic data of one entrepreneur missing) and ten employees (mean age: 38.0, 9 male, 1 female). Data from the entrepreneurship group were collected first and participants for the paid employment group were subsequently selected based on screening data, using a matching algorithm to result in a controlled sample. The participants have been matched on the variables age, number of children, and level of education.

The collected data include self-reported data on a number of psychometric scales, behavioral data in three behavioral economic paradigms, as well as data from electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). Except for the questionnaires employed to collect self-reported data, all data were collected in a single session. Participants first gave demographic information and filled in questionnaires on sustainability and risk taking. Next, the simultaneous EEG- and fMRI-recording was prepared. During the recording of the physiological data, participants completed an offer game (Albrecht, 2016) and a stock trading game (while the first can be seen as a variant of the ultimatum game, the latter is a more abstract exchange game. They differ in conditions of risk, uncertainty, and social involvement) as well as a public goods game (which includes includes several human interaction partners). Data from personality questionnaires was gathered using online or pen-and-paper versions, both of which were filled out after the experimental session, and returned later by the participants to the research team.

In the offer game, participants read fictitious requests of customers and had to choose between two proposals to offer in response to these. Proposals varied in terms of risk (i.e. the probability of the customer accepting the proposal) and ambiguity (i.e. whether information on the probability of acceptance was available or whether participants faced a situation of uncertainty). In the stock trading game, participants repeatedly made the decision which of two amounts of money to invest in a given fictitious stock. The amounts of the two options indicated the risk associated with them. There were three different types of trials: trials with two high risk options, trials with two low risk options, and

trials with one high risk and one low risk option. In the public goods game, participants had to decide how much money to invest in a public good shared with other players, with the total average investment of all other players increasing monotonously from 100€ to 1500€ in increments of 100€ over all trials. The information about the other players' investment and their amount invested varied between trials. In all three games, we extracted data and information on decision behavior and reaction times and are in process of preparing the EEG and fMRI data for additional analyses.

3. Results

Our preliminary results reported below focus on patterns, associations and differences of decision behavior and reaction times in the three behavioral economic paradigms. In a next step, we will link these to the data from fMRI and EEG to probe deeper into the neurophysiological correlates of our behavioral findings.

The offer game was analyzed using general linear models with the repeated factor ambiguity (high/low) and the between subjects factor group. The Huynh-Feldt correction was used where appropriate. Further, additional models tested sustainability orientation as a covariate on the level of inter-individual differences. The analysis of the decision making data did not reveal any significant main effects or interactions of group and ambiguity (all values of $p > .33$). However, sustainability orientation interacted significantly with ambiguity ($F(1,16)=5.41$, $p=.033$) indicating that participants with a high sustainability orientation were relatively more cautious under ambiguity and riskier without. The analysis of the reaction time data revealed a significant main effect of ambiguity ($F(1, 18)=11.27$, $p=.004$) indicating longer reaction times in ambiguous trials. All other main effects or interactions were not significant (all values of $p > .33$). Sustainability orientation did not moderate any effects significantly ($p > .25$).

The stock trading game was again analyzed using general linear model with the repeated measures factor risk (3 levels: high, mixed and low) and the between subjects factor group. Again, the Huynh-Feldt correction was used where appropriate. As before, additional models included sustainability orientation as a covariate on the level of inter-individual differences. The analysis of the decision making data did not reveal a significant effect of risk, group or their interaction (all values of $p > .13$). Sustainability orientation did not modulate any effects significantly ($p > .35$). The analysis of the reaction time data did reveal a significant effect of risk ($F(2, 34)=4.56$, $p=.036$), which indicated fastest reaction for mixed as compared to both low and high risk. The effects of group or the interaction risk by group were not significant ($p > .25$). There was a significant interaction of risk with sustainability orientation ($F(2, 30)=4.61$, $p=.031$) revealing relatively slower reaction times in mixed trials for participants with a high sustainability orientation as compared to faster reaction times of participants with a high sustainability orientation for both low risk ($p=.031$) and high risk trials ($p=.045$).

The latency and the decision-making data of the public goods game was as before analyzed using linear mixed models. Each model comprised the 21 trials as a repeated measures factor and group (entrepreneurship versus paid employment) as a between subjects factor. Furthermore, additional models included sustainability orientation as a covariate on the level of inter-individual differences. The mixed model of the decision-making data revealed a significant effect of the trial ($F(20, 181,6)=6.40$, $p<.001$) indicating an increase in offer size from trial 1 to trial 16, with trial 16 being significantly higher than trial 14 ($p=.014$), and a subsequent decrease to 21 ($p=0.14$). The main

effect of group and the interaction of group by trial were not significant ($p > .55$). The mixed model of the latency data revealed a significant effect of the trial ($F(20, 134,0) = 2.63$, $p = .001$) indicating a decline in reaction time from trial 1 to trial 14 and an increase from trial 15 to 21. The main effect of group and the interaction of group by trial were not significant ($p > .12$). Thus group was not further analyzed. An additional model tested the influence of the covariate sustainability orientation on the change in reaction time over trials. There was a significant interaction of the trial with sustainability orientation ($F(20, 133,0) = 3.95$, $p < .001$) revealing a significant positive relation between reaction time and sustainability in trial 1 ($r = .50$, $p = .029$) and consistently negative but non-significant negative correlations ranging from $-.13$ to $-.42$ for trials 3 to 20 (except trial 14).

4. Discussion

Our initial findings indicate complex interactions of especially sustainability orientation and to a lesser degree entrepreneurship when it comes to content and speed of economic choices in decision situations differing in terms of risk conditions and social context. Highly sustainability-oriented persons showed relatively more cautiousness under ambiguity and longer reaction times when risk was a critical difference between options, and in a first trial of a public goods game when participants think about their overall strategy. Accordingly, these persons seem overall more reflective in their economic decision-making, potentially taking future consequences into account more than others. Moving forward, in the next step we intend to link our behavioral findings to activation patterns of different brain areas as determined via fMRI as well as to EEG data in order to develop a better understanding of the neurophysiological mechanisms underlying our observed behavioral results. This is crucial to more fully gauge the relationship between sustainability orientation and entrepreneurship (especially in terms of their reaction to different forms and levels of risk, ambiguity and uncertainty).

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