

The Role of Ambiguity and Anxiety in Intertemporal Choices

Master Thesis

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Abstract

This study focused on the role of anxiety and ambiguity in intertemporal choices. For that, 104 people took part in a study by filling in some questionnaires, such as the State-Trait Anxiety Inventory, and completing an intertemporal choice computer task, where they had to choose between a fixed smaller-sooner reward today (5€), or a variable larger reward later. In half of the trials the delivery time of the larger-later reward had a certain range of days so participants did not know the exact waiting time for the reward (ambiguous trials). The data of 100 participants ($M = 22$ years) were included in the analysis. The results showed no significant main effect of anxiety on intertemporal choices. Furthermore, the interaction-hypothesis was falsified: there is no interaction between anxiety and ambiguity on intertemporal choices. Several explanations with regard to e.g. the participation sample and suggestions for further research are given. It is concluded that there is no relation between anxiety and ambiguity in intertemporal choices and that further research is needed.

Keywords: Intertemporal Choice, ambiguity, anxiety

Everyone does it up to 100.000 times each day: making decisions. Whether it is about simple decisions, such as deciding to drink a Coke or Sprite, or about more complex ones, such as buying a car, decision making is an essential part of everyday life (Berndt, 2010). There are several types of decision making and one of them is called intertemporal choice. In intertemporal choices one has to make a tradeoff between costs and benefits that occur at different points in time (Wittmann & Paulus, 2009). For instance, one could buy something small in order to satisfy one's instant need (e.g. shoes), or save the money and spend it on something even more satisfactory sometime later (e.g. a car). There are some factors that influence the intertemporal choices someone makes. Research has shown that anxiety is one of these factors (Steinglass et al., 2016).

Anxiety can be seen as a negative mood state and is defined by feelings of bodily tension, such as an increased heartbeat, and worries about the future (Barlow & Durand, 2015). Steinglass et al. (2016) studied the relation between anxiety and intertemporal choices. Therefore, as done in most intertemporal choice tasks, participants were asked to choose between a smaller-sooner (SS) monetary reward (e.g. 15€ now) and a larger-later (LL) reward (e.g. 50€ in four weeks). Steinglass and colleagues found that greater anxiety was associated with a greater tendency to prefer the larger-later reward rather than the smaller-sooner one, so choosing the larger-later reward more often. This might be the case because choosing instant rewards has been shown to be associated with risky behaviors (Steinglass et al., 2016) and

anxious people prefer to avoid those behaviors (Giorgetta et al., 2012). Since anxiety has an impact on making decisions, especially intertemporal choices, the question comes up if other factors are associated with decision making and anxiety as well.

A lot of research has focused on the role of ambiguity when it comes to anxiety and decision making, especially in risk-taking behaviors. Ambiguity can be defined as a decision context in which several outcomes are possible with unknown probabilities (Hartley & Phelps, 2012). An example of an often-used decision making task with ambiguity is that someone has to make a choice between a payoff of five euro (safe option) and a lottery with a probability of winning 20€ that is not exactly known (ambiguous option; Tymula et al., 2012). A study by Hartley and Phelps (2012) focused on anxiety and ambiguity and found that, compared to non-anxious people, anxious participants were ambiguity averse, meaning that they interpret ambiguous decision contexts negatively and therefore prefer the safe option. This relation is also supported by other literature (e.g. Smith, Ebert, Broman-Fulks, 2016; Zhang, Wang, Zhu, Yu, & Chen, 2015).

Summarized it can be said that there is a relation between anxiety and intertemporal choices (Steinglass et al., 2016), as well as a relation between anxiety and ambiguity in risk-taking behaviors (e.g. Hartley & Phelps, 2012). Up to now no research has focused on the role of ambiguity when it comes to anxiety and intertemporal choices. Therefore, this study aims to answer the following question: What is the role of ambiguity and anxiety in intertemporal choices? In the current study ambiguity is not about unknown probabilities (chance of getting monetary reward is always 100%), but about time: The delivery time of the reward has a certain range of days, so participants do not know the exact waiting time for the reward (Ikink, Engelmann, van den Bos, Roelofs, & Figner, 2017). Conducting research in this field could broaden the knowledge of different scientific areas, such as decision making, especially when it comes to intertemporal choices and anxiety and could give new insights, since the intertemporal choice task used in this study is newly developed and the first one to include ambiguity, meaning that only a few studies have been done with it until now. Furthermore, knowledge about this relation could point out the significance of treating e.g. anxiety disorders in order to reduce ambiguity aversion that comes along with anxiety and therefore make it possible for them to choose more delayed/ future-oriented rewards.

Based on the literature (Steinglass et al., 2016), I expect that there will be a relation between anxiety and intertemporal choices, i.e., more anxious individuals will choose the larger-later reward more often than less anxious individuals. Moreover, based on the literature (e.g. Hartley & Phelps, 2012) I further expect that ambiguity will moderate the relation

between anxiety and the intertemporal choices. The association between anxiety and intertemporal choices (Steinglass et. al, 2016) will be weaker in ambiguous trials than in non-ambiguous trials. When there is ambiguity, more anxious individuals will choose the larger-later reward less often than less anxious individuals, due to greater ambiguity aversion in more anxious individuals (e.g. Hartley & Phelps, 2012), whereas when there is no ambiguity, more anxious individuals will choose the larger-later reward more often than less anxious individuals.

Method

Participants

In total, 104 participants took part in this study. The data of four participants had to be excluded, because they had too many missing values, were outliers or did the catch trials wrong (described below). After cleaning, 100 participants were suitable for the analysis. The participants were students of the Radboud University in Nijmegen, who were recruited via the SONA-system, as well as students from other universities (e.g. Ruhr Universität Bochum), who were recruited via advertisement on social media (e.g. Facebook). The 100 participants were 70 (70%) females and 30 (30%) males between 18 and 29 years of age ($M = 22.61$, $SD = 2.59$). Participation was on a voluntary basis and the participants were reimbursed with credit points (0.5 credits). In addition, participants could choose between receiving a snack and a drink or taking part in a lottery with a 20% chance of winning a cinema voucher with a value of 10€.

Materials

State-Trait Anxiety Inventory for Adults. Anxiety was assessed using the German and Dutch version of the trait scale of the State-Trait Anxiety Inventory for Adults (STAI-T; Laux, Glanzmann, Schaffner, & Spielberger, 1981; Van der Ploeg, Defares, & Spielberger, 1980). This questionnaire consists of 20 statements like “I feel nervous and restless” and “I feel like a failure”. Participants have to indicate how anxious they feel in general on a four-point Likert scale ranging from “almost never” to “almost always”. Total scores were computed, by summing up the scores per participant, with higher scores indicating greater anxiety.

Intertemporal Choice Task. Intertemporal choice and ambiguity were operationalized as the proportion of exact and ambiguous LL choices (number of times the LL is chosen out of the total number of exact or ambiguous trials, respectively). The proportion of the exact LL choices as well as the proportion of the ambiguous LL choices were computed

by summing up all the exact/ambiguous trials where the LL was chosen and dividing them by the total number of exact/ambiguous trials, with a higher proportion indicating more exact/ambiguous LL choices. This was measured using a German and Dutch version of a newly developed intertemporal choice task by Ikink et al. (2017). This task involves exact and ambiguous trials, where participants have to choose between receiving a fixed smaller-sooner reward (5€ today; always the same), or a variable larger reward later. All these questions are hypothetical, i.e., no real money can be made. The larger-later reward can be either 8.30€, 16.80€ or 24.10€ and can be received in either 30, 60 or 90 days from today. The delivery time of the larger-later reward is either exactly specified (e.g. in 30 days; exact trials), or with a certain range of days (e.g. in 20 to 40 days; ambiguous trials). There are four ambiguity ranges (0, 20, 40, 58 days). The midpoints of the ranges are always either 30, 60, or 90 days, in order to compare both types of trials. For instance an exact trial would be: What would you prefer: 5€ today or 16.80€ in 30 days? An ambiguous trial would be: What would you prefer: 5€ today or 16.80€ sometime between 20 to 40 days from now? An example of the trials can be seen in Figure 1. The LL reward is presented on a timeline ranging from today to 120 days from today. There is an exact delivery time for each trial (e.g. 30 days). The exact delivery time is indicated by a red stripe on the timeline, which is visible in half of the trials (exact trials). However, in the other half of the trials (ambiguous trials) the exact position of the red stripe is covered by a box (e.g. box covers timeline from 20 to 40 days). Here, participants do not know the exact waiting time for the LL reward, and the delivery time is specified by a range of days. If the ambiguity equals zero, it is an exact trial and if it is higher than zero it is an ambiguous trial. Each trial is repeated twice, once with the SS presented on top of the screen (and the LL at the bottom) and once with the LL on top of the screen (and the SS at the bottom). The exact trials are repeated four times instead of two times, since there are only nine unique exact trials. So, in total, this task consists of 96 trials, 36 exact trials, 54 ambiguous trials, plus six “catch” trials. In these “catch” trials the larger reward is today and not later, so participants should always choose this larger-sooner reward. Thus, those trials serve as a control: if the larger-sooner reward is not chosen more than 2 times, it can be an indication that participants did either not understand the task or did not pay attention, therefore those participants can be excluded. Additionally, there are three practice trials in the beginning.

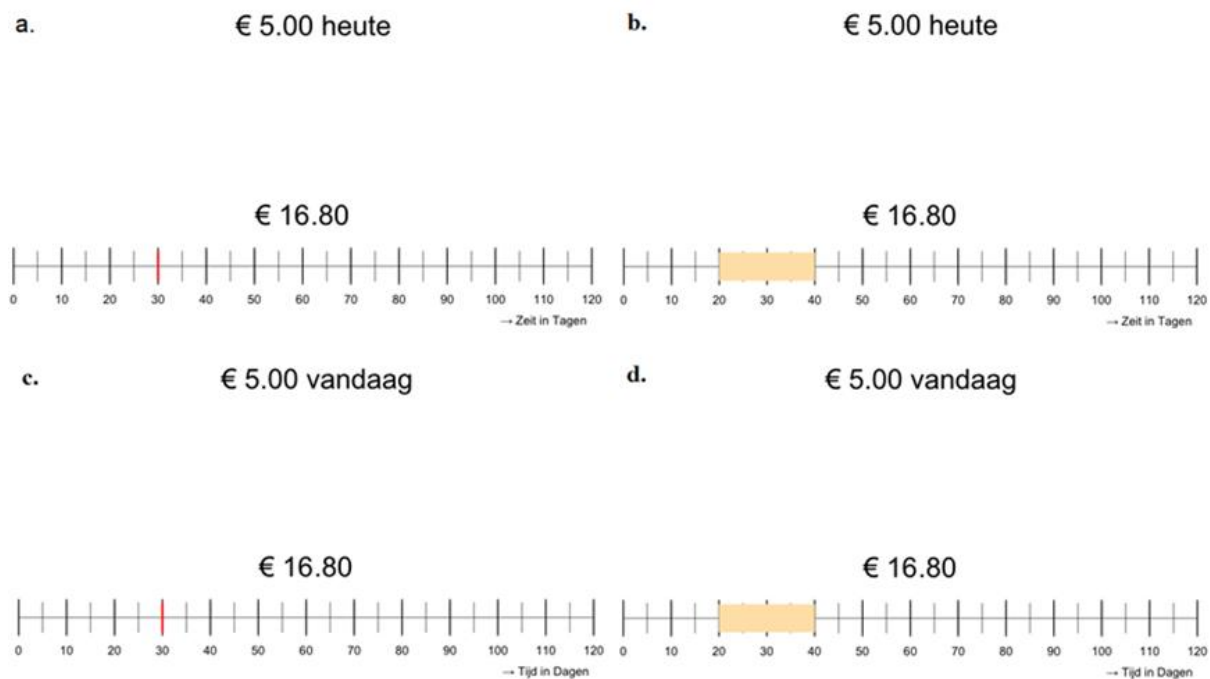


Figure 1. Example of stimuli as shown in the intertemporal choice task with (a.) an exact trial, (b.) an ambiguous trial of the German version, (c.) an exact trial and (d.) an ambiguous trial of the Dutch version. “Heute” and “vandaag” mean today, “Zeit in Tagen” and “Tijd in Dagen” mean time in days.

Other questionnaires. There were also other questionnaires included in the study, namely the “10-Item Self-Scoring Self-Control Scale” (Tangney, Baumeister, & Boone, 2004), the “Intolerance of Uncertainty Scale” (Carleton, Norton, & Asmundson, 2007) and the “Future Self-Continuity Scale” (Ersner-Hershfield, Garton, Ballard, Samanez-Larkin, & Knutson, 2009). However, these questionnaires were not pertinent for this research question.

Procedure

After making an appointment with the experimenter via E-Mail or signing up for a time-slot on the SONA-system, the participants had a meeting at the BSI lab or at a silent place of their choice to complete the survey. There, participants had to sign an informed consent and received instructions by the experimenter. Afterwards, the participants filled in the questionnaires online on a website called qualtrics. After completing the questionnaires, the experimenter gave some final instructions and started the computer task. The completion of the survey took approximately 30 minutes. After taking part in the study, participants had the opportunity to choose if they wanted to receive a soda can (Coke, Coke Zero, Fanta, Sprite, Iced Tea) and a chocolate bar (Snickers, Mars, Twix, cereal bar) of their choice or if they wanted to take part in a lottery where they had a 20% chance to win a cinema voucher (10€ value). To win the cinema voucher, a box containing five numbered slips was used

(numbers from 1 to 5). Participants had to choose a number between one and five and draw the slip with that exact number in order to win. If they won the cinema voucher or decided on the snack and drink, they had to sign an acknowledgement of receipt. In the end the experimenter asked if they had any questions and/or comments and thanked them for their participation.

Data-analysis

Preprocessing. In order to start the analysis the data had to be prepared. First of all, the datasets of the German and Dutch version of the STAI-T had to be merged into one. In order to do that, the total scores were computed in each dataset at first. For that, some items of both versions had to be mirrored beforehand. After computing the total scores in each version, the two datasets were merged into one and the total scores of the STAI-T were centered. Then, the dataset of the computer task and the dataset of the STAI-T had to be cleaned. Participants with more than 15% missing values (reaction time <400ms or >12s) or who did more than two of the catch trials wrong were excluded. Cases that were three standard deviations above or below the mean of the STAI-T were assessed and identified as outliers. Ultimately, the two datasets were merged into one. The assumptions of normality and linearity were checked graphically, before starting the analysis.

Main analysis. In order to analyze the main effect of anxiety on intertemporal choices and the interaction between anxiety and ambiguity on intertemporal choices, a repeated measures ANCOVA was conducted using IBM SPSS Statistics 21. The design was a within-subjects design, with anxiety (quantitative) serving as the covariate and ambiguity (qualitative: ambiguous/exact) as the independent variable (within-subjects). The proportion of LL choices (quantitative) served as the dependent variable.

Results

In order to investigate the main effect of anxiety as well as the interaction between anxiety and ambiguity on intertemporal choices, a repeated measures ANCOVA was conducted. The assumptions of linearity and normality were met. Table 1 shows an overview of the descriptives and correlations between all variables.

Table 1

Descriptives and Pearson's Correlation Coefficients of all Variables (N=100)

	<i>M</i>	<i>SD</i>	<i>1</i>	<i>2</i>	<i>3</i>
1. Proportion of exact LL choices	0.63	0.26	1	.76**	-.20
2. Proportion of ambiguous LL choices	0.60	0.25		1	-.09

Main Analysis

The results showed that there was no significant main effect of anxiety on intertemporal choices ($F(1, 98) = .31, p = .58$), meaning that greater anxiety was not associated with choosing the larger-later reward more often than less anxiety. The mean total score of the STAI-T was 38.51 with a standard deviation of 8.42.

The interaction between anxiety and ambiguity on intertemporal choices was not significant ($F(1, 98) = .85, p = .36$), meaning that greater anxiety was not associated with choosing the larger-later reward more or less often than less anxiety, when ambiguity was present or not present, respectively.

Discussion

This study examined the role of anxiety and ambiguity in intertemporal choices. Looking at the results it can be said that, unexpectedly, the relation between anxiety and intertemporal choices was not significant, thus the first hypothesis can be discarded. Furthermore, no significant interaction effect was found between anxiety and ambiguity on intertemporal choices, therefore the interaction hypothesis can also be discarded.

Regarding anxiety it can be concluded that there was no significant relation with intertemporal choices. This result is not in line with the findings of Steinglass et al. (2016), who stated that people with greater anxiety prefer and choose the larger-later reward more often. A possible explanation for the absence of the relation might be that the scores of the STAI-T did not have a high range. The range from the STAI-T goes from one to 80, but the participants in the current study scored between 22 and 59, indicating that the scores did not vary that much. Looking at the study of Steinglass et al. (2016) it can be seen that they included clinically anxious participants as well as healthy participants, so participants who scored on both extremes (high and low) of the scale. It is thus possible that more participants with scores on both extremes of the range are needed to find a significant relation, so that the variance increases, meaning that there would be more participants who score high as well as low on the scale. Another possible reason for the absent relation might be that more anxious participants are needed in general. When looking at the mean score of the STAI-T in the present study and the above mentioned literature (Steinglass et al., 2016), it can be seen that the mean score in the study at hand was 38.51, while the mean score in the research of

Steinglass et al. (2016) was 48.34, indicating that their study included more participants who were more anxious. Thus, it is possible that more anxious participants are needed in order to find a significant relation.

Concerning the interaction hypothesis it can be concluded that there was no significant interaction between anxiety and ambiguity on intertemporal choices, thus there is no moderation of ambiguity on the relation between anxiety and intertemporal choices. So when ambiguity is present, more anxious individuals do not choose the LL reward less often than less anxious individuals and when the trials are exact, they do not choose the LL reward more often than less anxious individuals.

There are some limitations in the current study that might have had an impact on the results. Several participants mentioned that their current amount of money impacted their decision in the computer task. Some of them said that they have a low income in general, which is why they preferred to choose the LL reward less often, because they are in need of instant money. Others on the other hand said that they have a good income in general, which is why they preferred to choose the LL more often, because they are not in financial need and therefore, do not mind waiting. Indeed researches have shown that a lower income is associated with making less larger-later choices (Green, Myerson, Lichtman, Rosen, & Fry, 1996; Reimers, Maylor, Stewart, & Chater, 2009). Furthermore, some participants mentioned and found that the cap of the timeline of the rewards (120 days) was too low and that they would have chosen differently if the cap of the timeline was higher (e.g. 350 days).

Based on the above mentioned limitations it would be interesting if future research included income as a control variable, in order to control for its effect on intertemporal choices. Moreover, following research should include a greater amount of anxious participants and/or more participants who score on both extremes of the scale, as well as increase the cap of the timeline to see if an interaction between anxiety and ambiguity on intertemporal choices can be found then. Furthermore, it might also be interesting to include the state scale of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) to see if this plays a role when it comes to ambiguity and intertemporal choices, since the study at hand as well as the above mentioned literature (Steinglass et al., 2016) only used the trait scale. Research has shown that people in anxious moods (who are anxious in that very moment; experimentally manipulated) prefer low-risk options when making decisions (Raghunathan & Pham, 1999). Due to this and the fact that anxious individuals are ambiguity aversive (Hartley & Phelps, 2012), it might be possible that there is a role between state anxiety and ambiguity in intertemporal choices, in a way that people with an instant present

anxiety choose the LL rewards more often, since the LL reward is not associated with risky behaviors (Steinglass et al., 2016), but choose the LL reward less often under ambiguity (Hartley & Phelps, 2012). Also, when manipulating someone's mood by inducing anxiety, one can be saver to actually get enough anxious participants, which is why it would be interesting to include state anxiety.

Taking the relevance of this study into consideration it can be said that at this point, the current study contributed little to the significance of treating anxiety disorders. Still, this study contributed to the scientific field of decision making, in a way that this study did not find the same results as existing literature did, automatically increasing one's interest to see who is in fact right. Therefore, this study suggests that further research is necessary in order to get a clearer picture when it comes to anxiety and intertemporal choices. Also, since the computer task was newly developed and therefore few studies have been done with it until now, this study gave some suggestions of what to focus on in future studies.

To conclude, this research focused on the role of anxiety and ambiguity in intertemporal choices. Taking the above mentioned literature and the conducted study into consideration it can be concluded that no interaction was found between anxiety and ambiguity on intertemporal choices: Ambiguity does not moderate the relation between anxiety and intertemporal choices. This study showed that further research is necessary and several suggestions are mentioned for future research.

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