The Effects of Negative Urgency and Audio-Visual Feedback on Decision-Making as Assessed by the Iowa Gambling Task

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Master's Thesis in the Programme Clinical Psychology

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June 7, 2020

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Word count: 4941

Abstract

Negative Urgency (NU), a facet of impulsivity, refers to the tendency to act rashly when distressed. Impulsive traits are generally believed to impair decision-making, yet the relationship between NU and decision-making in situations of uncertainty remains underspecified. Therefore, this study examined the potential influence of NU on decision-making abilities as measured by the Iowa Gambling Task (IGT). It was further investigated whether additional audio-visual feedback leads to a superior performance in this task and whether this feedback alleviates the possible impairing effect of NU on decision-making. While no association between NU and decision-making was found, only individuals with low NU showed a learning effect during the IGT, suggesting a non-linear relationship between those two constructs. Feedback did not improve IGT performance. Desirable approaches for further research are standardisation of NU scores, establishment of clinical cut-points and monitoring or induction of emotions during the IGT.

Making decisions is an important task that we face daily, and the consequences can range from marginal to life-changing. Therefore, it is crucial to consider possible outcomes that a certain choice of alternatives holds and to evaluate them. However, some individuals show less premeditation before deciding than others; they tend to behave impulsively. Research has shown that those people make more risky choices and are more influenced by immediate, rather than long-term consequences (Martin & Potts, 2009). Impulsivity is mentioned in the ICD-10 as a symptom involving cognition, perception, emotional state, and behaviour (World Health Organization, 1992). It is associated with various psychiatric disorders (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001), forms of eating pathologies (Tuschen-Caffier, 2007), and decision-making deficits (Franken, van Strien, Nijs & Muris, 2008).

One problem with the concept of impulsivity is its very broad definition which in some cases leads to inconsistent findings (Lynam & Miller, 2004; Anestis, Smith, Fink & Joiner, 2009). Also, different measures show only little correlation (Cyders & Coskunpinar, 2011; Sharma, Markon & Clark, 2014). For these reasons, this study focusses solely on Negative Urgency (NU), a facet of trait impulsivity according to Lynam, Whiteside and Cyders (2006). NU is the disposition to act rashly when experiencing negative affect. A person with high levels of NU would be more prone to behave impulsively than a person with low levels subsequent to an event that elicits negative emotions. For example, this person might be more likely to use drugs when he/she is feeling angry and sad, despite knowing about the long-term negative consequences. Findings suggest that higher levels of NU are associated with less tolerance of uncertainty (Pawluk & Koerner, 2016), which in turn leads to a preference of immediate prospects at the expense of more valuable long-term rewards (Luhmann, Ishida & Hajcak, 2011). Accordingly, this study's first hypothesis is that people with higher levels of NU display impaired decision-making behaviour.

There appears to be some link between NU and cognitive processing that manifests itself in behavioural decision making (Bayard, Raffard & Gely-Nargeot, 2011). A possible explanation for the underlying mechanism is provided by the *Somatic Marker Hypothesis* (SMH; Damasio, 1996). The SMH postulates that the combination of a decision and the consequence triggers an emotional response ('somatic state') to the outcome which is linked to the choice. The valence of the somatic state depends on the perceived valence of the consequence and determines if the choice will be more likely to be initiated again or inhibited. In a simplifying example, person A makes the decision to start a conversation with person B. If the consequence (the conversation) leads to positive emotions, this results in the choice being marked as 'positive', and A will be more likely to engage in a conversation with B again. Person A might or might not be aware of the emotional response. Note that this only holds true in situations where outcomes are uncertain, namely in social and personal matters (Damasio, 1996). In these contexts, somatic markers are believed to facilitate reasoning and to allow more efficient decision-making through a biasing mechanism (Bechara, Damasio, Damasio & Anderson, 1994).

According to the SMH, we make many decisions based on the anticipated emotional feedback in situations where potential gains or losses are uncertain. However, critics of the SMH state that the somatic marker mechanism remains underspecified and lacks sound empirical support (Dunn, Dalgleish & Lawrence, 2006). Namely, the process of how somatic states are transformed into a marker and the magnitude of their effect continues to be a subject of controversy. In order to further examine how somatic markers operate exactly, this study examined potential effects of audio-visual feedback that is added to outcome information. The reasoning behind this assumption is in line with the postulates of Bechara and colleagues (1994) and Damasio (1996) who argue that decision-making deficits can be explained by the impaired ability to generate somatic markers resulting in an insensitivity to future outcomes. The extra audio-visual feedback is believed to counteract this insensitivity by heightening the

emotional response to choice-outcomes. This might facilitate the creation of somatic markers which, in turn, leads to more adaptive decision-making. Therefore, the second hypothesis of this study states that added audio-visual feedback leads to more advantageous decision-making, regardless of the individual NU levels.

For the reasons outlined above, it seems possible that the impairing effect of NU on decision-making is influenced by added audio-visual feedback. For the reasons outlined above, the feedback might mitigate this effect. Therefore, the third hypothesis is that the association between NU and decision-making abilities is smaller when adding audio-visual feedback than without feedback.

Methods

Participants

A convenience sample of 98 adults out of the general population who were all fluent in Dutch participated in this study. The recruitment occurred in person or online, participants were offered either course credit or the chance to win one out of three vouchers (10,00€) for a web shop. Knowledge about the goal of the test assessing behavioural decision-making (Iowa Gambling Task; IGT) led to the exclusion of the participant's data in the analysis.

Design and Procedure

A 2x2 between-subjects design was used, with *position of the IGT within the test battery* and the *audio-visual feedback* as the two factors. The place of the IGT within the test battery (beginning or end) was randomized between participants. This was also true for the audio-visual feedback that half of the participants received and the other half did not. The allocation of the participants to a condition was done randomly through www.random.org. NU scores were assessed as the third independent variable on an interval scale. The dependent variable for all analyses was the learning effect in the IGT from one block to another.

The experiment lasted about 30 minutes. All participants used a customary computer with a mouse and on-ear headphones and completed the experiment in a quiet room. They were asked to fill out the questionnaires after being informed about the procedure and broad goals of the study and signing the informed consent. The experiment concluded with a debriefing about the aim of this study. This study was approved by the faculty's ethics committee.

Instruments

Short Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking, Positive Urgency Impulsive Behaviour Scale (SUPPS-P)

In order to measure the level of NU in participants, the Dutch version of the SUPPS-P (Lynam, 2013) was used. In this case, the short version was more suitable because it only takes one third of the time compared to using the standard version with minimal loss of shared variance (5.4% for NU; Cyders, Littlefield, Coffey & Karyadi, 2014). This questionnaire is widely used to assess trait impulsivity (Zsila, Bőthe, Demetrovics, Billieux & Orosz, 2020) and consists of the five subscales Negative and Positive Urgency, Lack of Premeditation and Perseverance, and Sensation seeking. NU was assessed on a Likert-scale ranging from 1 (strongly agree) to 4 (strongly disagree). The subscale contains four items (e.g. "When I am upset, I often act without thinking") and its scores are highly correlated with alcohol use, binge eating and gambling behaviour (Cyders et al., 2014). A confirmatory factor analysis found that the five-factor model provides a good fit to the data, thus indicating that the UPPS-P possesses a satisfactory construct validity (Cyders et al., 2014). To assess reliability of the NU-subscale of the SUPPS-P in this sample, a Cronbach's Alpha test was administered. The test yielded an internal consistency of $\alpha = .71$ across the four items, which is acceptable (Tavakol & Dennick, 2011).

Iowa Gambling Task (IGT)

The IGT (Bechara, et al., 1994) is a commonly used instrument to measure real-life decision making under uncertainty in a context of reward and punishment (Bechara, Damasio, Tranel & Damasio, 2005; Bowman, Evans & Turnbull, 2005). Participants were instructed to make the most profit of their starting capital of 2000€ by choosing cards from four different decks. They were told to repeat choosing one out of the four decks 100 times and that every choice holds monetary wins but can also bring losses. The probability of wins and losses and their magnitude was unequally distributed over the decks, so that repeatedly choosing deck A and B resulted in an overall loss and repeatedly choosing deck C and D led to an overall win of money. Therefore, decks A and B are considered disadvantageous, whereas decks C and D are considered advantageous. The *immediate* rewards, however, are larger in the disadvantageous decks (Bechara et al., 2005). Accordingly, poor performance in this task is associated with the preference for short-term gains over larger long-term gains (Brevers, Bechara, Cleeremans & Noël, 2013).

The task consisted of 100 trials divided into five blocks à 20 trials. The overall score of the IGT was defined as the learning effect, meaning the total increase of choices of advantageous decks (C and D) from one block to another. For the purpose of this study, the learning effect is a more adequate outcome-measure than the overall score since individuals start choosing advantageous more often only after having completed about half of the trials (Damasio, 1996). As participants who adopt an advantageous strategy might do so only halfway through the test, the learning effect over the course of the five blocks is more meaningful than the net score. The reliability of the IGT is yet to be examined (Buelow & Suhr, 2009; Lin, Song, Chen, Lee & Chiu, 2013), but this test has shown to be a valid measure for implicit decision making (Bechara et al., 2005) and it has been extensively used in a broad range of clinical and some non-clinical samples (see Dunn, et al., 2006; Overman & Peirce, 2013). Prior to the IGT, participants indicated their current level of motivation for

completing the task on a visual analogue scale ranging from 1 (not motivated at all) to 100 (extremely motivated).

IGT with audio-visual feedback

In the feedback condition, participants received additional stimuli after every trial of the IGT, consisting of an auditory and a visual component. For the auditory feedback, classic casino slot machine sounds were used. There were a variety of sounds indicating monetary win and multiple sounds indicating budgetary loss. Studies have shown that in games similar to the IGT, sound has a notable influence on player's arousal and stress response (Dixon et al., 2014) and might increase emotional responses to wins and losses (Bramley & Gainsbury, 2015). The feedback's visual component consisted of green smiley (indicating a win) and red frowny faces (indicating a loss) that were displayed together with the auditory stimuli. Visual feedback about wins and losses has been identified as a key feature in reward processing in gambling experiments (Oberg, Christie & Tata, 2011).

Analyses

All statistical analyses were carried out using the IBM Statistical Package for Social Sciences version 25.00. In order to examine whether participants displayed a learning effect over the course of the five blocks of the IGT, one-way repeated measure analyses of variance were carried out. The blocks were used as a five-level within-subjects factor. To test the first hypothesis, that people with higher levels of NU display impaired decision-making behaviour, NU scores were used as a between-subjects factor. To examine the second hypothesis stating that audio-visual feedback leads to more advantageous decision-making, the same analysis was conducted but with *feedback* as a dichotomous between-subjects factor. The third hypothesis postulated that the association between NU and decision-making abilities is smaller when adding audio-visual feedback than without feedback. The two-level factor *feedback* as a covariate and the term of interaction between NU and feedback was added to

the model used in the first analysis to test the third hypothesis. For all analyses, a significance level of $\alpha < .05$ was assumed.

Results

Sample characteristics

Two participants were excluded from the analyses due to a total lack of variation in their responses in the IGT. About two thirds (64) of the remaining $N = 98$ participants were men, one third (34) were women. The participant's age ranged from 19 to 66 with a mean age of 26.48 ($SD = 8.98$). Two thirds (65) of the participants were students. It was tested whether NU and IGT total scores differed in the variables condition, sex, age, and current employment (ANOVA). No significant differences were found, indicating a successful randomization. Table 1 displays product-moment and point-biserial Pearson correlation coefficients between the study variables along with descriptive statistics. Note that for the purpose of simplification, the IGT total score instead of the learning effect is shown in this overview.

Negative Urgency and IGT performance

To test this hypothesis, a one-way repeated measure ANOVA was conducted with the five-level within-subjects factor *Blocks* and the between-subjects factor *NU scores*. Prior analyses have shown that a normal distribution of data in each of the five blocks cannot be assumed. However, simulation studies suggest that a rANOVA is relatively robust to violations of the assumption of normality (Vasey & Thayer, 1987). Furthermore, according to the Central Limit Theorem, the sample means approximate a normal distribution even if the data is non-normally distributed, if the sample size is large enough ($N \geq 40$; Wilcox, 2011). The Mauchly's test indicated a slight violation of the assumption of sphericity in the data ($\varepsilon = .88$). Therefore, the Huynh-Feldt correction of degrees of freedom was used in all analyses to avoid a type I error inflation (Huynh & Feldt, 1976; Field, 2013).

While there was a general improvement in scores over the five blocks of the IGT ($F(3.65,350.11) = 4.24$, $p = .003$, $\eta_p^2 = .04$), no significant influence of NU scores on the learning effect in the IGT was found ($F(3.65,350.11) = 1.89$, $p = .12$). This led to the rejection of the first hypothesis stating that higher NU scores lead to a smaller IGT learning effect. However, when plotting the means of individuals with a lower NU score against those with a higher score, only for the low scoring group, a significant learning effect was found ($F(4,93) = 3.24$, $p = .016$, $\eta_p^2 = .12$), while the high scoring group did not improve their performance over time ($F(4,93) = 1.34$, $p = .26$). A lower NU score was defined as one standard deviation (*SD*) below the mean (*M*), higher NU scores as one *SD* above the *M*.

To further investigate this, the sample was median-split into a group of low ($n = 44$) and high ($n = 54$) NU scores and the group membership was used as a between-subject factor. After applying the Huynh-Feldt correction of degrees of freedom, the rANOVA indicated a significant interaction between the factors *Blocks* and *NU group* ($F(3.70,354.84) = 6.02$, $p < .001$, $\eta_p^2 = .06$) indicating a difference in the learning effect across the blocks in the high versus low NU group. Considering the mean block scores in the two NU groups, it seems that low NU traits are associated with a steeper learning curve. Figure 1 shows the learning effect in IGT performances for individuals in the group with low and high NU traits, respectively.

Feedback and IGT Performance

The second hypothesis stated that audio-visual feedback leads to more advantageous decision-making as measured by the IGT. Again, a one-way repeated measure ANOVA with the Huynh-Feldt correction was conducted, showing no significant main effect of *feedback* on block scores ($F(3.68,352.76) = 1.57$, $p = .19$). When looking at the IGT total score, the feedback group had a non-significantly lower mean score than the non-feedback group ($F(1,96) = 0.26$, $p = .61$).

Moderator analysis

Due to a lacking effect of NU scores on the IGT learning effect, a moderation of this association through feedback was not investigated.

Position of the IGT

A rANOVA with *position of the IGT within the test battery* as a between-subjects factor showed no influence of position on both the IGT learning effect ($F(3.64,349.57) = 0.89$, $p = .57$) and the IGT total score ($F(1,96) = 0.25$, $p = .62$).

Discussion

The first aim of this study was to investigate whether more NU is related to worse decision-making as measured by the IGT. The second purpose was to examine the effect of added audio-visual feedback on decision-making performance. Overall, participants showed a learning effect over the course of the five blocks in the IGT, which confirms the finding that healthy individuals adopt an advantageous strategy at some point and then maintain it (Damasio, 1996). No significant association between NU and decision-making abilities was found. However, when plotting individuals with higher levels of NU against those with lower levels, only the participants with low NU showed a meaningful learning effect indicating better decision making ability. Both the provision of audio-visual feedback during the task and the position of the IGT within the test battery did not influence the learning effect.

Negative Urgency

Past studies have linked NU to problematic behaviour in adolescents (Smith & Cyders, 2016) and food addiction (Wolz et al., 2016) and have identified the inability to focus on long-term goals as an important mechanism (Bechara, 2004; Wolz et al., 2016). This process is pertinent to the IGT, considering that poor performance in this task is linked to insensitivity to future consequences (Bechara, Damasio & Damasio, 2001).

However, NU does not significantly affect IGT performance, according to our results. This shows that caution is needed when assuming a linear association between NU and decision-making abilities Nonetheless, when using NU as a dichotomous variable, only individuals in the low NU group showed learning effects over the trials. This difference between high and low NU levels indicates an impaired learning effect in individuals with high NU levels. The mechanism behind this could be that those individuals act more rashly subsequent to unsuccessful trials that might elicit negative emotions. These unpremeditated choices may account for the lack of learning effects and are in line with findings of Danner and colleagues (2013) who suggest that disadvantageous behaviour in individuals who are more likely to have higher levels of NU increases after negative affect. Still, it is surprising that a meaningful influence of NU levels on the IGT learning effect was found only after a sample split, considering the loss of statistical power that a dichotomisation implies (Royston, Altman & Sauerbrei, 2006). The most plausible explanation for this is that there is a non-linear association between NU and IGT performance, as a dichotomisation discards the need for a linearity assumption (Baneshi & Talei, 2011).

The heterogeneity of our findings reflect some of the ambiguity in literature about impulsive personality traits and IGT scores. Some studies claim that NU plays an important role in disorders that often come with strong decision-making deficiencies such as eating and substance abuse disorders (Fischer, Settles, Collins, Gunn & Smith, 2012) and that these disorders are associated with poor IGT performance (Chan et al., 2014; Verdejo-Garcia, Bechara, Recknor & Perez-Garcia, 2006). Others found no association between NU and decision-making (Bayard et al., 2011) and concluded that behavioural decision-making cannot be predicted by impulsive personality traits (Franken & Muris, 2005). Interestingly, most studies using clinical samples found a relationship between NU and decision-making, whereas most of those using non-clinical samples did not. This suggests that sampling methods might be an important aspect to consider when designing these kind of experiments. In our sample,

we found a significant negative correlation between NU score and education level, stressing the need for diverse samples with individuals coming from different educational backgrounds. The potential sampling effects also call for a standardisation NU scores in order to establish clinical cut-points. This would allow juxtapositions of clinical versus non-clinical levels of NU and thereby more in-depth analyses of potential effects on decision-making (Franken et al., 2008). For example, it could be investigated whether only clinically relevant levels of NU impair decision-making. Differentiating between clinical and non-clinical levels of NU seems even more essential considering the possibly non-linear relationship between NU and decision-making abilities. Likewise, this would allow identification of individuals at risk for certain disorders such as problem drinking and disordered eating (Fischer, Settles, Collins, Gunn, & Smith, 2012).

Audio-visual feedback

To our knowledge, this study was the first to examine the effect of audio-visual feedback on performance in the IGT. In line with the SMH (Damasio, 1996), we assumed that the ability to develop advantageous decision-making in situations of uncertainty is based on generating emotional responses (somatic markers) that 'mark' every choice-outcome combination as either positive or negative. These somatic markers are believed to guide decision-making by assisting the logical mental operations needed to choose a response (Damasio, Everitt & Bishop, 1996), as their valence indicates the quality of a choice. The IGT offers the perfect framework for the examination of these markers because there is a context of uncertainty of outcomes and logical thinking does not aid the decision-making process (Damasio, Adolphs & Damasio, 2003). It can therefore be argued that the IGT is an adequate measure for the functionality of somatic markers (Bechara, Damasio & Damasio, 2000). Previous studies on gambling behaviour have shown that auditory feedback influences a player's arousal and stress response (Dixon et al., 2014) and might lead to heightened

emotional responses (Bramley & Gainsbury, 2015). Similarly, visual stimuli appear to play an important role in reward processing in gambling situations (Oberg et al., 2011). It was therefore hypothesized that adding audio-visual feedback to trial outcomes enhances the emotional response, thereby supporting the formation of somatic markers. This was expected to manifest itself in more advantageous decision-making as measured by the IGT.

However, audio-visual feedback did not have an effect on task performance in this study. There are several explanations for this finding. First, audio-visual cues could be less arousing than expected and therefore could have failed to influence emotional responses to choice-outcome combinations. This could have happened, for instance, as a result of an incongruence between the external feedback and the individual's actual state of affect. Second, feedback did induce or reinforce emotional states, but it failed to guide advantageous decision-making in some way. This could have occurred because audio-visual feedback induced 'too much' affect, leading to feelings of frustration which might impair IGT performance because they uses up emotional resources that are needed for advantageous decision-making (Cella, Dymond, Cooper & Turnbull, 2007; Turnbull, Evans, Bunce, Carzolio & O'Connor, 2005). This would suggest that the emotional states postulated by Damsio (1996) might not necessarily contribute to a higher performance in the IGT. In line with that, some authors argue that it is possible to complete the IGT not by relying on markers (Dunn et al., 2006), but by using explicit knowledge (Maia & McClelland, 2004). Therefore, processes underlying decision-making in the IGT need more examination in order to shed more light on which cognitive and somatic processes are involved in this task and to what extent. A third explanation for the lack of effect regarding the feedback is that it solely depended on the valence of choice outcomes and was unaffected by the magnitude of gains/losses. More specifically, this means that the feedback for a win is always the same regardless of whether it implied a great gain or a rather small one. However, the magnitude of losses are an important aspect of the IGT, since it is the main task to develop an (implicit)

idea of what choices yield bigger wins in the long term rather than discriminating between win and loss from trial to trial. In that sense, it is not surprising that adding feedback did not result in a better performance because the given stimuli emphasised trial-to-trial rewards instead of long-term gains.

Strengths

As researchers of previous studies pointed out, examining multiple indices of impulsive characteristics and their relation to behavioural decision-making is of great importance because different impulsivity questionnaires might assess different aspects of that trait (Franken et al., 2008). This study shed more light on the relation between NU and decision-making abilities in that it showed that we should consider a non-linear relationship between those two constructs. It also underlines the importance of discrimination between different aspects of impulsivity, a multifactorial construct with little agreement among researchers on what those factors are (Evenden, 1999; Dawe & Loxton, 2004). Therefore, future studies should consider assessing and comparing components of impulsivity rather than impulsivity as a whole.

This research project was the first to examine the effects of adding audio-visual feedback to the IGT, a task widely used in clinical, cognitive, and neurological research (Bechara, Tranel & Damasio, 2000; Bowman, Evans & Turnbull, 2005). As outlined above, added feedback is a promising aspect in behavioural decision-making tasks, especially in regard to the SMH. Further studies who use feedback in their designs should include a measure for the experienced affect in order to control for the level of emotional arousal which might have been too low or too high in this study.

Another strength of the present design is the outcome measure. The IGT score is calculated in very different manners across literature. Some studies used the IGT total score as an outcome measure (e.g. van den Bos, Houx & Spruijt, 2006), others used the difference

between the amount of advantageous and disadvantageous choices (e.g. Bechara, Damasio, Tranel & Anderson, 1998) and still others looked at the net scores of the last 40 trials only (e.g. Sevy et al., 2007). Excluding early IGT trials surely is a superior approach compared to the conventional method (i.e. using the total score) because early choices might tap a different kind of decision making (Buelow & Suhr, 2009; Dunn et al., 2006) and they do not correlate with test performance (Gansler, Jerram, Vannorsdall & Schretlen, 2011). Damasio (1996) proposed that high performers improve their performance gradually and start playing better about halfway through the test. However, this exclusion procedure implies an undesirable loss of data. This is why the most adequate approach for the present research question is measuring the learning effect over the course of the five blocks (e.g. Danner, Ouwehand, van Haastert, Hornsveld & de Ridder, 2012), acknowledging the fact that net scores neglect the need for initial learning (Gansler et al., 2011) and avoiding a large data loss. Additionally, with non-clinical samples, big differences in total scores are not to be expected, which underlines the need for a sensitive measure and the inclusion of all data.

Limitations & future perspectives

The assumptions of normality and sphericity of data were not met. Regardless of the relative robustness of the analyses towards minor violations of assumptions (Berkovits, Hancock & Nevitt, 2000), interpretations of analyses with more than one violated assumption should always be done with caution.

The assessment or induction of negative affect during the IGT might have been promising, as currently experienced negative emotions guide subsequent choices in individuals with high levels of NU (Cyders & Smith, 2008). Assessing negative affect could reveal whether poor choices really increase after ‘losing’ trials in individuals with higher NU. Likewise, inducing negative affect before the task (see Danner et al., 2013) affords the

opportunity to test whether this indeed impairs decision-making abilities to a greater extend in individuals with high NU than in those with lower levels (Cyders & Smith, 2008).

Some methodological aspects of this study warrant discussion. First, the cut-off for the median-split in this sample is specific to our sample. Therefore, comparisons with other studies might be difficult due to different medians (Baneshi & Talei, 2011). Second, instead of the present cross-sectional design, longitudinal designs might be more promising in determining the mechanism that might connect NU and decision-making because the early indicators of high NU levels could be timely separated from the behavioural consequences that this trait has (Bilieux et al., 2010). This would also be an opportunity to examine a potential causal relationship between those two constructs. Third, the unknown reliability of the IGT may be open to doubt, although this is problematic for longitudinal rather than cross sectional designs (Buelow & Suhr, 2009).

Conclusion

It is somewhat intuitive to assume that people who act rashly when experiencing negative affect make worse decisions than others in a situation that might give rise to negative feelings. For choices in contexts that demand a lot of cognitive elaboration (for example in a game of chess), it seems plausible that the mechanism behind this is simply a lack of consideration. However, when it comes to more ambiguous situations where outcomes are uncertain (such as in social matters) it is less clear whether and how NU impairs decision-making and more data from laboratory settings is needed (Cyders & Smith, 2008).

Our findings indicate that there is no linear relationship between NU and decision-making abilities as measured by the IGT. Also, audio-visual feedback has not shown to promote IGT performance. The potential non-linear relationship between NU and decision-making calls for the standardisation and establishment of cut-points for NU. Other than that,

more diverse samples, emotion induction, and longitudinal designs are promising approaches for future studies.

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Appendix

Table 1

Descriptive Statistics and Pearson Correlations for Study Variables

Variable	*n*	*M*	*SD*	1	2	3	4	5	6	7
1. Sex [a]	98	1.35	0.49	-						
2. Age	98	26.48	8.98	-.02	-					
3. Educational Level [b]	98	5.44	1.59	-.19	.03	-				
4. Motivation [c]	98	70.64	23.09	.13	-.06	-.05	-			
5. Feedback [d]	98	0.51	0.52	.03	.05	-.06	.17	-		
6. NU Score [e]	98	8.96	2.74	-.03	.17	-.29**	-.13	-.08	-	
7. IGT (total) [f]	98	-6.08	37.1	.03	.08	.08	-.12	-.05	.01	-

[a] 1 = female, 2 = male.

[b] 1 = Basisschool (primary school), 2 = VMBO (preparatory secondary vocational education), 3 = HAVO (school of higher general secondary education), 4 = VWO (pre-university education), 5 = MBO (senior secondary vocational education), 6 = HBO (higher professional education), 7 = WO (university education).

[c] Range: 1-100, higher values indicate higher motivation.

[d] 0 = no audio-visual feedback, 1 = audio-visual feedback.

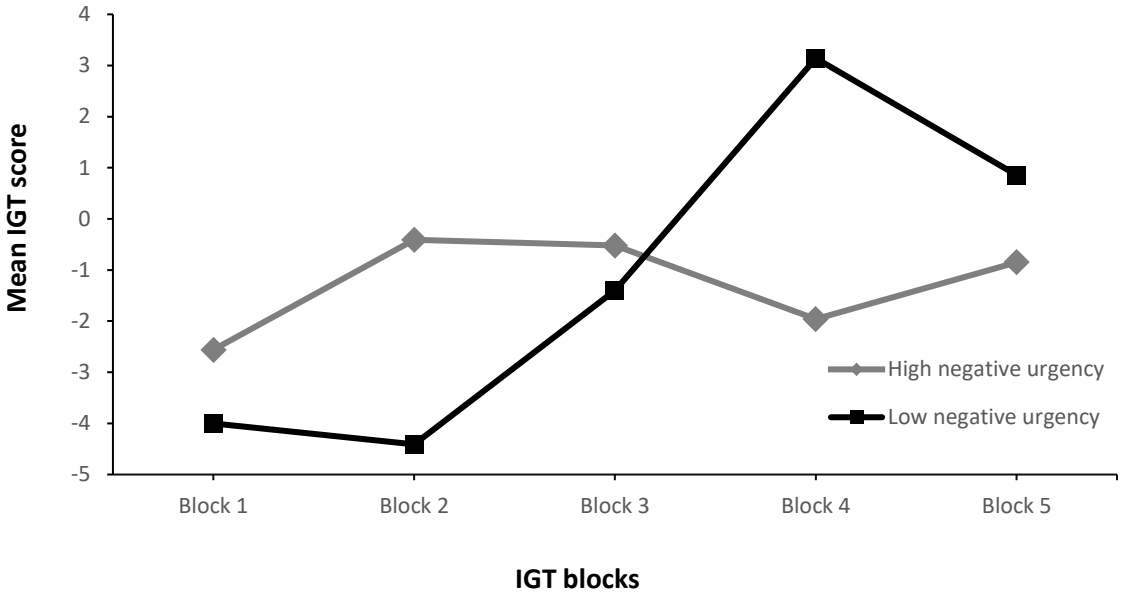
[e] NU, Negative Urgency, as assessed by the SUPPS-P (Short Urgency, Premeditation (lack of), Perseverance (lack of), Sensation Seeking, Positive Urgency Impulsive Behaviour Scale)

[f] IGT, Iowa Gambling Task; number of advantageous choices subtracted by the number of disadvantageous choices [(C + D) – (A + B)].

* $p < .05$. ** $p < .01$.

Figure 1

Mean IGT scores over the five blocks in the high versus low NU group after a median-split



Note. IGT, Iowa Gambling Task; IGT score, number of advantageous choices subtracted by the number of disadvantageous choices [(C + D) – (A + B)].