



Utrecht University

MASTER THESIS

**The Influence of Intolerance of Uncertainty on Decision-Making
in Individuals with Eating Disorders**

Emma Görlich

4248694

Clinical Psychology

Supervisor: Unna Danner

July 2018

American English – APA Style

Word count: 4923

Abstract

Background and aim: Eating disorders are severe and often chronic psychiatric disorders influencing both physical and mental well-being (American Psychiatric Association, 2013). An important factor that has been related to the pathology of eating disorders is intolerance of uncertainty (IU; Sternheim, Startup, & Schmidt, 2015). Elevated IU may have important consequences, including impaired decision-making behavior (Thibodeau, Carleton, Gómez-Pérez, & Asmundson, 2013). Studies have found that individuals with eating disorders show impaired decision-making in uncertain situations (Bodell et al., 2014; Danner et al., 2012; Galimberti et al., 2013). The present study therefore examined whether IU influences decision-making in individuals with an eating disorder.

Method: 202 patients with eating disorders (including anorexia nervosa restrictive type, anorexia nervosa binge-eating/purging type and bulimia nervosa) and 91 healthy control individuals completed the IUS-12 and the IGT.

Results and discussion: Results showed that IU is higher in eating disorder patients than in healthy control individuals and that decision-making did not differ between both groups. Moreover, individuals with higher IU demonstrated more advantageous decision-making than individuals with lower IU. These findings suggest that IU is indeed an important factor influencing eating disorder pathology and has important consequences for decision-making. Patients may benefit from (adjunct) interventions targeting IU. More research is needed into the exact workings of the relation between IU and decision-making and how this affects eating disorder pathology.

Introduction

Eating disorders are severe and often chronic psychiatric disorders with serious health consequences, such as amenorrhea and vital sign abnormalities, and may ultimately result in starvation (American Psychiatric Association, 2013; Litmanen, Fröjd, Marttunen, Isomaa & Kaltiala-Heino, 2016). Moreover, related psychological difficulties include symptoms of depression and elevated anxiety (APA, 2013). An important factor influencing eating disorder pathology is intolerance of uncertainty (IU; Frank et al., 2012; Kesby, Maguire, Brownlow, & Grisham, 2017; Sternheim, Startup, & Schmidt, 2011, 2015), which entails the inclination to respond negatively to uncertain events and situations (Heimberg, Turk, & Mennin, 2004). Individuals with eating disorders often experience high anxiety levels and frequently have comorbid anxiety disorders (Kesby et al., 2017). This heightened anxiety is reflected in high levels of IU. Studies have indicated that elevated IU may have important consequences, including impaired decision-making behavior (Thibodeau, Carleton, Gómez-Pérez, & Asmundson, 2013). Highly anxious individuals (who often suffer from high IU) are inclined to make less advantageous choices in an uncertain situation by disregarding long-term consequences (Miu, Heilman, & Houser, 2008; de Visser et al., 2010; Zhang, Wang, Zhu, Yu, & Chen, 2015). Studies have found that individuals with eating disorders show a similar tendency (Adoue et al., 2015; Cavedini et al., 2004; Cavedini et al., 2006; Boeka & Lokken, 2006; Bodell et al., 2014; Danner et al., 2012; Galimberti et al., 2013; Liao et al., 2009; Tchanturia et al., 2007). Since individuals with eating disorders often suffer from IU and demonstrate impaired decision-making in uncertain situations, the purpose of this research is to examine whether IU influences decision-making in individuals with an eating disorder.

Eating disorders

Eating disorders represent a persistent disturbance in eating and eating related behavior, which may significantly harm physical and mental health (APA, 2013). Amongst others, the DSM-5 specifies the eating disorders anorexia and bulimia nervosa (APA, 2013). Anorexia nervosa is characterized by “an intense fear of gaining weight or becoming fat

combined with behaviors that result in a significantly low body weight” (Butcher, Hooley, & Mineka, 2015, p.354). It consists of two subtypes defining the method of maintaining a low body weight, which are the restrictive type and binge-eating/purging type (Butcher et al., 2015). Bulimia nervosa refers to “uncontrollable binge eating and efforts to prevent resulting weight gain by using inappropriate behaviors such as self-induced vomiting and excessive exercise” (Butcher et al., 2015, p.356). Eating disorders are associated with a higher mortality risk, particularly anorexia nervosa (Smink, van Hoeken, & Hoek, 2012).

Intolerance of Uncertainty

Eating disorders frequently co-occur with other disorders, including anxiety and depressive disorders (APA, 2013). An important underlying factor that has been related to the pathology of anxiety, depressive, and eating disorders, is IU (Sternheim et al., 2015). IU is defined as the inclination to respond negatively to uncertain events and situations on a cognitive, emotional, and behavioral level (Heimberg et al., 2004). When faced with an unforeseen or ambiguous situation, in which they are unable to predict the consequences of their own or others’ behavior, individuals with high IU may experience this uncertainty as threatening and distressing. Because of this, they may react negatively to the situation and try to avoid uncertain events as much as possible (Buhr & Dugas, 2002). As everyday life is filled with such uncertain situations where one has to make decisions based on ambiguous or limited information, intolerance of uncertainty can have a problematic effect on these individuals’ responses to life events (Carleton, 2012). For example, when a socially anxious person finds herself standing alone at a party surrounded by strangers, she may experience this uncertain and unpredictable situation as threatening. As a result, she may experience anxiety due to her inability to tolerate the uncertainty and may avoid similar situations in the future.

IU and Eating Disorders

Due to the high comorbidity of anxiety and eating disorders, patients with eating disorders often experience anxiety-related symptoms (APA, 2013). These anxiety-related

difficulties are reflected in high levels of IU, since IU is connected to heightened anxiety (Carleton, 2012; Sternheim et al., 2015). Evidence indicates that individuals with an eating disorder show higher levels of IU as compared to healthy control individuals (Frank et al., 2012; Kesby et al., 2017; Sternheim, Startup et al., 2011; Sternheim et al., 2015). Most studies on the role of IU in eating disorders have been done in patients with anorexia and bulimia nervosa and have confirmed a relationship between elevated IU and both eating disorders (Frank et al., 2012; Kesby et al., 2017; Sternheim et al., 2015).

Studies on the role of IU in eating disorders have indicated that IU can have important consequences for the individual (Kesby et al., 2017). The anxiety that IU induces in uncertain situations may elicit maladaptive eating disorder behaviors, aimed to reduce uncertainty (Kesby et al., 2017). A qualitative study by Sternheim, Konstantellou, Startup, and Schmidt (2011) indicated that these behaviors, in bulimia nervosa patients, may be actions such as bingeing and purging and, in anorexia nervosa patients, these may concern rigid routines and rituals, such as repetitive body weighing and checking. Moreover, anorexia nervosa patients reported using certain eating disorder-related behaviors, such as restrictive actions, to counter uncertainty, because these behaviors provide them with feelings of familiarity and safety (Sternheim, Konstantellou, et al., 2011).

IU and Decision-Making

Next to eating-disorder specific actions, such as bingeing and checking, IU may also induce other problematic behaviors in eating disorder patients. Studies suggest that IU influences important cognitive functions, such as decision-making (Carleton et al., 2016, de Visser et al., 2010; Miu et al., 2008; Zhang et al., 2015). It has been indicated that highly anxious individuals (who often suffer from IU) show a tendency to disregard long-term consequences and focus only on the immediate future in their decisions (Miu et al., 2008; de Visser et al., 2010; Zhang et al., 2015). Numerous studies examined this phenomenon with the Iowa Gambling Task (IGT), which simulates a real-life uncertain situation where the outcome of choice behavior is unknown (Bechara, Damasio, Damasio, & Anderson, 1994).

This task measures decision-making by looking at choice behavior in relation to short-term gains versus long-term consequences (Bechara et al., 1994). Evidence indicated that individuals with elevated anxiety are inclined to make less advantageous choices by preferring high immediate rewards at the consequence of even higher long-term losses (de Visser et al., 2010; Miu et al., 2008; Zhang et al., 2015). This decision-making impairment when faced with uncertainty can be very problematic, as vital future outcomes are often disregarded (Bechara, Damasio, Damasio, & Anderson, 1994) and thus may lead to problems in the long-term. For example, a patient with bulimia nervosa may engage in purging behavior to lower (uncertainty-related) anxiety in the immediate future, however, thereby may disregard serious health consequences, such as heart arrhythmia (APA, 2013), in the long-term future.

One explanation for this decision-making impairment entails, that anxiety stands in the way of cognitive functions regulating attention highly anxious individuals (Zhang et al., 2015). Thereby, anxiety impairs the ability to ignore task-irrelevant information is impaired in highly anxious individuals, which deteriorates their performance on a cognitive task (Zhang et al., 2015). In this way, the anxiety induced by IU may impair decision-making on a cognitive task such as the IGT.

Decision-Making Under Uncertainty in Eating Disorders

Studies have indicated that, on the IGT, eating disorder patients are also inclined to opt for high immediate gains in spite of disadvantageous long-term consequences in comparison to healthy control individuals (Adoue et al., 2015; Cavedini et al., 2004; Cavedini et al., 2006; Boeka & Lokken, 2006; Bodell et al., 2014; Danner et al., 2012; Galimberti et al., 2013; Liao et al., 2009; Tchanturia et al., 2007). Since eating disorder patients often suffer from IU and show decision-making impairments when faced with uncertainty, it is worth investigating how IU relates to decision-making behavior in eating disorders.

Aim and Hypotheses of this Study

Building on the previous findings, the purpose of this study is to investigate whether IU influences decision-making in uncertain situations in individuals with an eating disorder. Predicted is that participants with high IU will show less advantageous decision-making. More specifically, it was hypothesized that 1) individuals with an eating disorder will show a higher intolerance of uncertainty than healthy controls, 2) individuals with an eating disorder will demonstrate less advantageous decision-making, and 3) in both groups, individuals with higher IU will show less advantageous decision-making than those individuals with lower IU. Moreover, 4) no differences were expected between different eating disorder diagnoses (anorexia nervosa restrictive type, anorexia nervosa binge-eating/purging type and bulimia nervosa) in IU, decision-making and the relation between IU and decision-making.

Method

Participants

This study included a total of 293 adult participants divided into two groups: one eating disorder group (95.0% women; age, 26.0, SD = 9.0; years of education, 13.6, SD = 2.5) and one group consisting of healthy control individuals (93.4% women, age, 26.3 years, SD = 9.5; years of education, 15.1, SD = 1.9).

The eating disorder group entailed 202 participants, out of which 151 with anorexia nervosa (83 restrictive and 68 binge-eating/purging subtype), and 51 with bulimia nervosa, according to DSM-5 criteria. The diagnoses were established by certified professionals and also confirmed by the Eating Disorders Examination (EDE; Cooper & Fairburn, 1987). Participants were currently undergoing treatment at a specialized center for eating disorders, Altrecht Eating Disorders Rintveld, located in Zeist, the Netherlands.

The healthy control group consisted out of 91 participants with no history of eating disorders or other mental illnesses. To ensure this, potential participants were screened via the phone before participating with the Mini International Neuropsychiatric Interview (MINI; Cockrell & Folstein, 2002). Consequently, 21 out of 137 participants were not included in the study. The healthy control participants were matched with the eating disorder patients in age

and gender to ensure that both participant groups were comparable. Out of the 116 remaining participants, 23 male participants and one female participant were excluded from the study for matching purposes. One participant dropped out of the study due to illness. Demographically, the control group consisted of students of different educational levels and members of the community.

Instruments

Intolerance of Uncertainty Scale Short Form (IUS-12). IU was measured with the Intolerance of Uncertainty Scale Short Form (IUS-12; Carleton, Norton, & Asmundson, 2007). The IUS-12 is a shortened version of the original 27-item scale (Freeston et al., 1994), which measures reactions to uncertainty, ambiguous situations, and the future. The IUS-12 has two factors, prospective anxiety (7 items) and inhibitory anxiety (5 items), and consists of items that are scored on a 5-point Likert scale (ranging from 1 to 5). The IUS-12 was found to have a strong correlation with the original scale ($r .96$) and acceptable internal consistency (Carleton, Collimore, & Asmundson, 2010). In this particular study, the Cronbach's alpha for the IUS-12 was $.91$.

Iowa Gambling Task (IGT). Decision-making was assessed with a computerized version of the original Iowa Gambling Task (IGT; Bechara et al, 1994). The IGT is a widely used decision-making task that contains 100 trials in which individuals need to choose one card out of four decks of cards. Participants are instructed to try to gain as much money as possible. Two decks (A, B) produce large immediate rewards but also large longer-term losses (with a net value of -250 euro per 10 cards), making them less advantageous in the long run. The other two decks (C, D) give smaller wins, but also smaller long-term losses (with a net value of 250 euro per 10 cards), making them more advantageous in the long run (Bechara et al, 1994). Decision-making is assessed by looking at performance on the IGT over time. To facilitate this, the 100 trials are divided into five blocks of 20 trials, from which the net score for each block is calculated by looking at the difference in number of choices between de

advantageous and disadvantageous decks $[(C + D) - (A + B)]$. More disadvantageous than advantageous card choices indicate a decision-making impairment.

Procedure

The data of this research were derived from a larger study on the genetic background of eating disorders, conducted by the Utrecht Research Group for Eating disorders (URGE). The instruments utilized in the current study were part of an extended phenotype battery from the larger study. The study protocol was approved by the Medical Ethical Committee of the University Medical Center Utrecht and by the Committee Scientific Research of Altrecht Mental Health Institute.

Participants from the eating disorder group were recruited from a specialized center for eating disorders, Altrecht Eating Disorders Rintveld, located in Zeist, the Netherlands, where these patients were currently undergoing treatment. Healthy control participants were recruited from the Utrecht University student population and from the community via flyers. Before taking part in the study, participants were thoroughly informed on the procedure and goals of the research. Additionally, they were given sufficient time to ask questions, which were answered subsequently. Afterwards participants gave their written informed consent.

Upon arrival, participants were asked to sit down in front of a computer, on which the questionnaire and cognitive task were ready to start. Participants were instructed to take their time, read instructions well, and complete the tasks according to their own perception and how they felt that day. It was noted that there are no wrong answers in this process. Afterwards participants were asked if they recognized the IGT, to rule out any previous learning effects.

Statistical Analyses

The data were analyzed with Statistical Package for the Social Sciences version 25. To compare demographic information between the two groups, Analyses of Variance (ANOVA) were used. To test the hypotheses, (repeated measures) ANOVA were conducted.

The assumption of normality was violated for the analysis on decision-making and the analysis on the relation between IU and decision-making. However, ANOVA appear to be robust to non-normality (Blanca, Alarcon, Arnau, Bono, & Bendayan, 2017). The assumption of homogeneity of variance was violated for the analysis on IU and for IGT block 3 in the analysis on the relation between IU and decision-making. The assumption of sphericity was violated for the analysis on decision-making and for the analysis on the relation between IU and decision-making. Degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .96$).

Results

Sample characteristics

Demographic and clinical characteristics were compared between groups and are displayed in Table 1. There were no differences between the groups regarding gender, $F(1, 291) = .33, p = .57, \eta_p^2 = .001$, and age, $F(1, 289) = .07, p = .79, \eta_p^2 < .001$. However, the healthy control participants had had significantly more years of education than the patient group, $F(1, 291) = 23.61, p < .001, \eta_p^2 = .08$ (see also Table 1). As expected, BMI was significantly lower in the eating disorder group, $F(1, 289) = 60.45, p < .001, \eta_p^2 = .17$ (see also Table 1).

Intolerance of Uncertainty

To test the difference between individuals with an eating disorder and healthy control participants with regards to intolerance of uncertainty, a between groups analysis of variance (ANOVA) was conducted. Results showed a significant main effect of group, $F(1, 291) = 117.49, p < .001, \eta_p^2 = .29$: patients showed significantly higher IU than the healthy control participants (see also Table 1).

Table 1.

Mean and SD of descriptive variables: demographic (age and years of education) and clinical characteristics (BMI) per group (eating disorder patients and healthy control participants), as well as the mean and SD of Intolerance of Uncertainty (IU), decision-making on the Iowa Gambling Task (IGT) per block, and overall decision-making (IGT total).

	Patient (n = 202)		Control (n = 91)	
	Mean	SD	Mean	SD
Age	25.95	8.92	26.25	9.50
Years of education	13.63	2.54	15.08	1.90
BMI	18.60	3.81	22.22	3.26
IU	40.72	8.94	29.24	7.01
<i>IGT</i>				
Block 1	-3.80	6.77	-2.97	7.22
Block 2	-3.27	8.59	-2.64	9.96
Block 3	-2.40	8.73	-2.75	10.30
Block 4	-1.53	9.34	-1.69	10.13
Block 5	-1.00	10.33	-.26	10.18
IGT total	-12.00	32.09	-10.31	35.27

Decision-Making

In order to assess the learning differences in decision-making between individuals with an eating disorder and healthy control participants, a repeated measures ANOVA was conducted. A significant main effect was found of time, $F(3.82, 1112.80) = 6.36, p < .001, \eta_p^2 = .02$ (see also Table 1), demonstrating that participants generally chose more advantageously over time. Results did not show a time \times group interaction effect: eating disorder patients and healthy control participants did not differ significantly in their decision-making over time $F(3.82, 1112.80) = .39, p = .81, \eta_p^2 = .001$ (see also Figure 1). No main effect of group was found on the total scores of decision-making: patients and healthy control participants did not differ significantly in their decision-making $F(1, 291) = .16, p = .69, \eta_p^2$

= .001. Moreover, as Figure 1 shows, participants continued to make more disadvantageous choices than advantageous ones, even though they learned to choose more advantageously over time.

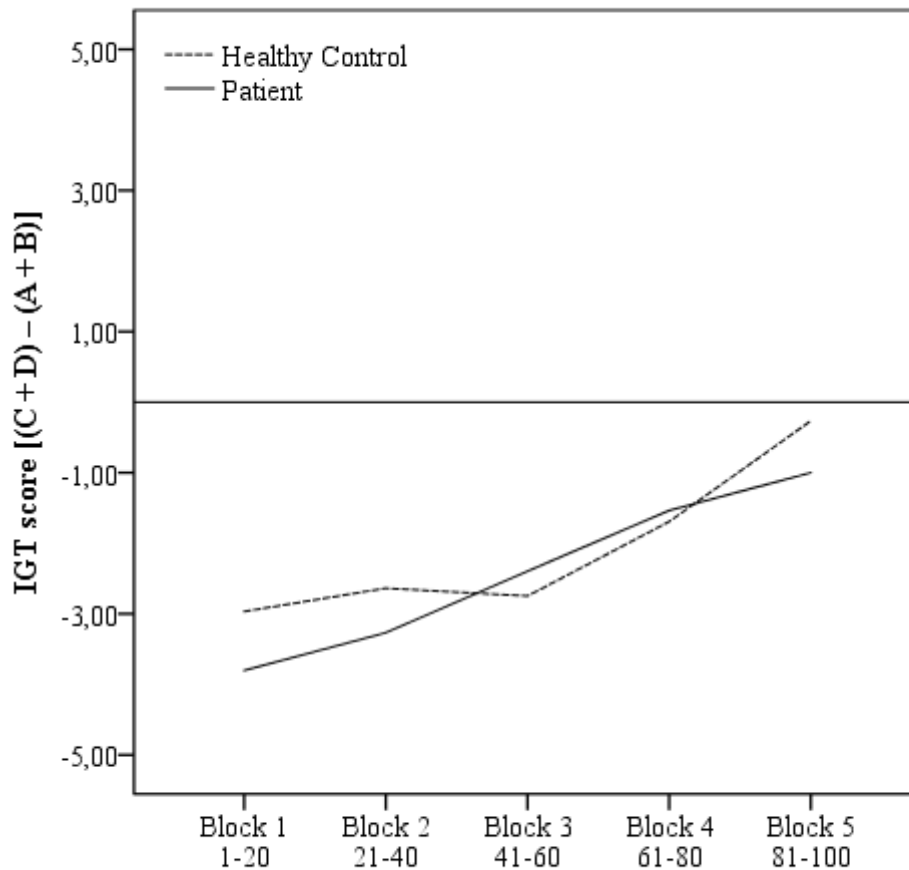


Figure 1. The mean net number of chosen cards {i.e. $[(C + D) - (A + B)]$ } by eating disorder patients and healthy control participants across five blocks (consisting of 20 trials each). Positive net scores reflect advantageous performance, whereas negative net scores reflect disadvantageous performance.

Influence of Intolerance of Uncertainty on Decision-Making

To examine whether IU influences decision-making for participants from both groups, a repeated measures ANOVA was conducted with IU as moderator variable. No main effects of time and group were found, all F 's < 1.07, all p 's > .36, η_p^2 < .004. This shows that individuals with higher levels of IU did not make more advantageous choices over time than those individuals with lower levels of IU, or vice versa. Additionally, it shows that patients and control participants did not differ in how IU influenced their (overall) decision-making.

A significant main effect of IU on overall decision-making was found, $F(1, 289) = 4.42, p = .04, \eta_p^2 = .02$, which shows that IU influenced the number of (dis)advantageous choices participants made in general. Figure 2 displays the overall IGT score across different levels of IU: participants with higher levels of IU chose more advantageously in general, as compared to participants with medium IU levels, who scored better than participants with lower levels of IU.

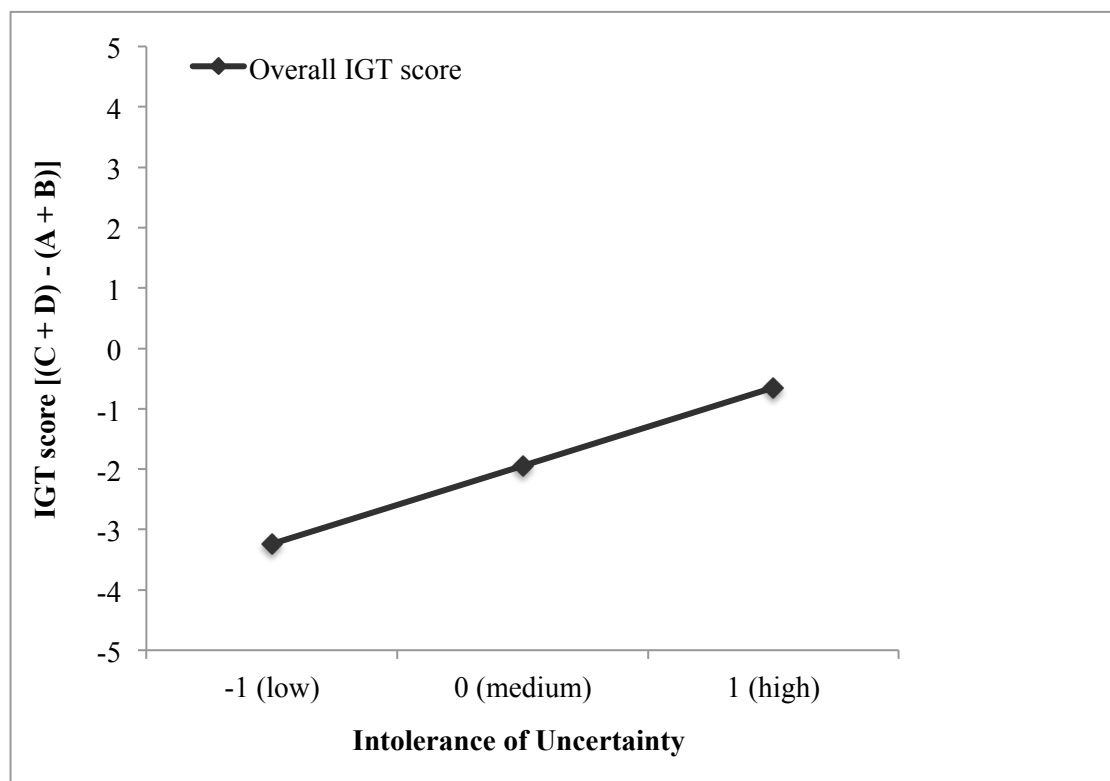


Figure 2. The mean net number of chosen cards {i.e. $[(C + D) - (A + B)]$ } of all participants across three levels of IU (for which z-scores of the IU variable were computed). A low level of IU represents a mean z-score of -1, a medium level a mean z-score of 0, and a high level a mean z-score of 1. Positive IGT scores reflect advantageous performance, whereas negative scores reflect disadvantageous performance.

Eating disorder subtypes

The patient groups consisted of individuals with different types of eating disorder diagnoses (anorexia restrictive subtype (ANR), anorexia binge-eating/purging subtype (ANBP), and bulimia nervosa (BN)). To assess whether there were any differences between

these eating disorder subtypes in IU, decision-making, and the relation between IU and decision-making, a between groups ANOVA and two repeated measures ANOVA (one with IU as moderator) were conducted. For IU, a main effect of subgroup was reported, $F(3, 289) = 44.22, p < .001, \eta_p^2 = .32$. Patients with the anorexia binge-eating/purging subtype showed significantly higher IU scores than patients with the anorexia restrictive subtype, $p < .01$ (see also Table 2). Patients with bulimia nervosa did not differ significantly from either patients with anorexia binge-eating/purging subtype, $p < .07$, or patients with anorexia restrictive subtype, $p < .30$ (see also Table 2).

No significant differences for subgroup were found for decision-making, all F 's $< 0.84, p$'s $> .47$. This shows that patients from the varying subtypes did not differ in their (overall) decision-making. A main effect of time was found (similar to the previous findings), $F(3.84, 1110.80) = 8.21, p < .001, \eta_p^2 = .03$, which shows that patients of all eating disorder subtypes learned to make more advantageous choices over time (see also Table 2). Lastly,

Table 2.

Mean and SD of Intolerance of Uncertainty (IU), decision-making on the IGT per block, and overall decision-making (IGT total) per eating disorder subtype (anorexia restrictive subtype (ANR), anorexia binge-purge subtype (ANBP), and bulimia nervosa (BN)).

	ANR (n = 83)		ANBP (n = 68)		BN (n = 51)	
	Mean	SD	Mean	SD	Mean	SD
IU	38.78	8.47	43.32	8.26	40.41	9.83
<i>IGT</i>						
Block 1	-4.22	6.88	-2.88	7.21	-4.35	5.93
Block 2	-4.24	8.87	-2.91	8.77	-2.16	7.85
Block 3	-2.92	8.30	-1.50	9.06	-2.75	9.06
Block 4	-2.65	9.11	-1.62	9.41	.39	9.48
Block 5	-2.22	9.78	-.62	10.53	.47	10.91
IGT total	-16.24	30.24	-9.53	34.79	-8.39	31.10

no significant differences for subgroup were found for the relation between IU and decision-making, all F 's < 0.64 , p 's $> .53$. This shows that patients with different types of eating disorder diagnoses did not differ in the way IU influenced their decision-making. A significant main effect of IU on overall decision-making was found, $F(1, 196) = 7.10$, $p < .01$, $\eta_p^2 = .04$, which shows that IU influenced the number of (dis)advantageous choices patients generally made.

Discussion

This study assessed the influence of IU on decision-making in individuals with an eating disorder, compared with healthy individuals. The findings supported the hypothesis that IU is higher in eating disorder patients. The results did not provide support for the hypothesis that individuals with an eating disorder demonstrate less advantageous decision-making than healthy controls. The present findings supported the hypothesis that a relationship exists between IU and decision-making, however, the expected relationship was not found. Results also provided support for the hypothesis that this relationship did not differ between the groups.

Intolerance of Uncertainty

The present study found that IU was higher in patients with eating disorders than in healthy control individuals. This is in line with previous studies, which also found higher IU levels in patients with eating disorders (Frank et al., 2012; Kesby et al., 2017; Sternheim, Startup, et al., 2011; Sternheim et al., 2015). These findings suggest that IU plays a role in eating disorder pathology. Specifically in eating disorders, IU has been related to feelings of anxiety and problematic eating disorder behaviors, such as bingeing and restrictive behaviors (Sternheim, Konstantellou, et al., 2011). The present findings suggest that IU may also play a broader role in the decision-making behavior of patients with eating disorders. Therefore IU may be an important factor to consider in eating disorder treatments. To facilitate this, it may be beneficial to examine cognitive anxiety processes and also anxiety maintenance processes in (highly anxious) patients with eating disorders (Sternheim et al., 2015). Moreover, treatment could be enhanced with (additional) interventions specifically tailored to assessing

IU-related anxiety perceptions and behavior in the context of eating disorders. In a recent pilot study, Sternheim and Harrison (2018) examined the effects of a novel IU group intervention for adolescent patients with anorexia nervosa, which was adapted from a CBT-based treatment for generalized anxiety disorder. The treatment aimed to enhance awareness of IU and beliefs about worry, and improve problem solving under uncertainty. Results indicated potential treatment benefits for patients (Sternheim & Harrison, 2018). Further research is needed to develop and test the effectiveness of IU-based (adjunct) interventions for eating disorders.

Furthermore, analyses with the eating disorder subtypes indicated that patients with anorexia nervosa binge-eating/purging type experienced higher IU than patients with anorexia nervosa restrictive type. These findings suggest that the level of IU and potentially the severity of its related effects may not be generalizable to eating disorders as a general group. This may imply that patients with one diagnosis suffer more from IU than patients with another diagnosis, which could mean that the severity of their IU-related problems may differ as well. To optimize (adjunct) interventions targeting IU, it may therefore be recommendable to consider the specific diagnosis of patients and how this relates to IU. Future studies should further investigate the distinctions between the various eating disorders in light of IU and how this may affect interventions targeting IU.

Decision-making

In the present study, individuals with eating disorders did not exhibit less advantageous decision-making than healthy controls. Instead, both groups learned to make better decisions over time. These findings contrast with various previous studies, which did not report a learning effect amongst patients with eating disorders using the same task (Adoue et al., 2015; Cavedini et al., 2004; Cavedini et al., 2006; Bodell et al., 2014; Boeka & Lokken, 2006; Danner et al., 2012; Galimberti et al., 2013; Liao et al., 2009; Tchanturia et al., 2007). The present results are, however, in line with a study by Guillaume and colleagues (2010), who also found no differences in decision-making between patients with eating disorders and healthy control individuals utilizing the same task. These findings suggest that not all eating

disorder patients approach decision-making the same way and therefore not all may be unable to show learning capacity. A reason for this could be that patients may show differences in their 'cognitive profiles', which means that one eating disorder patient may exhibit different thought-action processes than another (Schilder, Danner, van Elburg & Snellen, 2015). For example, one patient may exhibit problems with central coherence, whereas another may display cognitive flexibility difficulties (Schilder et al., 2015). Since these cognitive differences exist between individual patients, it may be difficult to infer a general learning deficit in decision-making amongst eating disorder patients. One patient may show difficulties in learning to make better decisions over time, whereas another may not. Therefore, individual differences in cognitive functioning should be taken into account in treatment to optimize its effectiveness for the individual. This could, for example, be facilitated by carrying out an assessment of different areas of cognitive functioning, such as decision-making (Schilder et al., 2015). The results can be used in treatment to help patients understand their (weaknesses in) thinking style and how this influences their views on subjects such as body weight and food and thereby impacts their daily life (Schilder et al., 2015).

A remarkable finding is that both the patients with eating disorders and the healthy control individuals overall made more disadvantageous choices than advantageous ones. The healthy control individuals therefore performed worse compared to the healthy control participants on both the study of Guillaume and colleagues (2010) and various other studies (Cavedini et al., 2004; Danner et al., 2012; Galimberti et al., 2013; Tchanturia et al., 2007). One reason for this could be that the IGT was completed last as part of a series of questionnaires and tasks, which could have led to a lack of interest or motivation for the task. Another explanation could be that various participants were influenced by their mood. A negative mood at the time of assessment has been previously connected to more disadvantageous card deck selections (Buelow & Suhr, 2012). The present study did not screen for participants' affective or motivational state at the time of assessment, which may be of interest for further study.

Relation Between Intolerance of Uncertainty and Decision-making

The present findings supported the hypothesis that IU is related to decision-making in both groups, however, this relationship was opposite to the expectation: generally, participants with high IU demonstrated more advantageous decision-making than those with low IU. Since high IU has been related to heightened anxiety (Sternheim, et al., 2015), and studies have found that individuals with high levels of anxiety tend to make less advantageous choices (Miu et al., 2008; de Visser et al., 2010; Zhang et al., 2015), the present results were unexpected. It was instead hypothesized that individuals with low IU would suffer less from anxiety and therefore show more advantageous choice behavior. Studies have outlined the idea that heightened anxiety stands in the way of attention regulation, which therefore deteriorates performance on a cognitive task (Eysenck, Derakshan, Santos, & Calvo, 2007; Zhang et al, 2015). The present results, however, suggest that IU does not stand in the way of attention regulation and may therefore not deteriorate or even enhance decision-making.

Various studies have also found that highly anxious individuals do show a focus on avoiding long-term losses (Hartley & Phelps, 2012; Mueller, Nguyen, Ray & Borkovec, 2010; Luhmann, Ishida, & Hajcak, 2011). IU as a concept includes anxiety about the (unknown) future, prospective anxiety, which may lead to an increased focus on long-term consequences. This could imply that IU is not of negative influence, but instead helpful in decision-making. Consequently, this would imply that patients with eating disorders who have a high IU are more focused on future consequences, which could, for example, aid in realizing the negative long-term consequences of their eating disorder behaviors. Realizing these consequences is vital to be able to benefit from treatment and recover from the eating disorder (Cavedini et al., 2006). However, IU has also been connected to maladaptive eating disorder behaviors to reduce uncertainty (Sternheim, Konstantellou, et al., 2011).

One explanation for these contrasting findings could be that there may be more awareness of future consequences due to IU, however, the anxiety that uncertainty brings on may lead to maladaptive (eating disorder) behaviors. In an uncertain situation, patients with eating disorders might want to reduce feelings of uncertainty by engaging in their familiar and

predictable eating disorder behaviors (Kesby et al., 2017; Sternheim, Konstantellou, et al., 2011). Potentially, on the one hand, they may realize the long-term consequences of these behaviors due to IU, whereas on the other hand, the desire to reduce uncertainty and the anxiety it brings on may outweigh this realization. Therefore they may still engage in maladaptive eating disorder behaviors, as these feel predictable and familiar. Further research is needed on the relationship between IU, the anxiety it brings on and decision-making, in order to examine how exactly IU influences decision-making. Additionally, future studies should examine possible benefits of IU, such as an enhanced focus on long-term consequences, and how these may influence eating disorder pathology.

Strengths and Limitations

The following strengths and limitations should be noted about the present study. One strength is that healthy control participants were successfully matched with the patient group regarding age and gender. Another positive aspect is the relatively large clinical sample. These aspects add to the generalizability of the sample and strength of the comparison between the two participant groups. One limitation is that the present findings point to existing differences in IU amongst the eating disorder subtypes, which may affect the validity of drawing conclusions about the role of IU in eating disorders as a general group. Moreover, the present study indicates that IU influences decision-making. However, decision-making is a broad concept and in this study mostly one type of decision-making was examined. Future studies may investigate whether IU is also related to other types of decision-making as these may provide further insight into the consequences of IU. The Beads Task (Ladouceur, Talbot, & Dugas, 1997), for example, which measures how much information individuals request before making a decision (Ladouceur et al., 1997), has been studied in the context of anxiety and eating disorders and may give important additional insight into the outcomes of IU.

In conclusion, this study shows that IU plays a role in eating disorders and influences choice behavior in both eating disorder patients and healthy individuals. Moreover, it confirms the importance of considering IU as a factor of clinical significance and suggests several implications for treatment. Further research is recommended on the exact workings of

the relationship between IU and decision-making and the role of this relation in eating disorder pathology. It is of great importance for future studies to develop methods to give IU and its consequences the necessary attention in the treatment for individuals with eating disorders.

References

- Adoue, C., Jaussent, I., Olié, E., Beziat, S., Van den Eynde, F., Courtet, P., & Guillaume, S. (2015). A further assessment of decision-making in anorexia nervosa. *European Psychiatry, 30*, 121-127. doi:10.1016/j.eurpsy.2014.08.004
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50*, 7-15. doi:10.1016/0010-0277(94)90018-3
- Blanca, M.J., Alarcon, R. Arnau, J., Bono, R., Bendayan, R. (2016). Non-normal data: Is ANOVA still a valid option? *Psicothema, 29*, 552-557. doi:10.7334/psicothema2016.383
- Bodell, L. P., Keel, P. K., Brumm, M. C., Akubuiro, A., Caballero, J., Tranel, D., Hodis, B. & McCormick, L. M. (2014). Longitudinal examination of decision-making performance in anorexia nervosa: Before and after weight restoration. *Journal of Psychiatric Research, 56*, 150-157. doi:10.1016/j.jpsychires.2014.05.015
- Boeka, A. G., & Lokken, K. L. (2006). The Iowa gambling task as a measure of decision making in women with bulimia nervosa. *Journal of the International Neuropsychological Society, 12*, 741-745. doi:10.1017/S1355617706060887
- Buelow, M. T., & Suhr, J. A. (2013). Personality characteristics and state mood influence individual deck selections on the Iowa Gambling Task. *Personality and Individual Differences, 54*, 593-597. doi:10.1016/j.paid.2012.11.019
- Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty scale: Psychometric properties of the English version. *Behaviour Research and Therapy, 40*, 931-945. doi:10.1016/S0005-7967(01)00092-4
- Butcher, J. N., Hooley, J. M., Mineka, S. (2015). *Abnormal Psychology* (16th ed.). Harlow: Pearson Education Limited.

- Carleton, R. N. (2012). The intolerance of uncertainty construct in the context of anxiety disorders: theoretical and practical perspectives. *Expert Review of Neurotherapeutics*, *12*, 937-947. doi:10.1586/ern.12.82
- Carleton, R. N., Collimore, K. C., & Asmundson, G. J. (2010). "It's not just the judgements - It's that I don't know": Intolerance of uncertainty as a predictor of social anxiety. *Journal of Anxiety Disorders*, *24*, 189-195. doi:10.1016/j.janxdis.2009.10.007
- Carleton, R. N., Duranceau, S., Shulman, E. P., Zerff, M., Gonzales, J., & Mishra, S. (2016). Self-reported intolerance of uncertainty and behavioural decisions. *Journal of Behavior Therapy and Experimental Psychiatry*, *51*, 58-65. doi:10.1016/j.jbtep.2015.12.004
- Carleton, R. N., Norton, M. P. J., & Asmundson, G. J. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders*, *21*, 105-117. doi:10.1016/j.janxdis.2006.03.014
- Cavedini, P., Bassi, T., Ubbiali, A., Casolari, A., Giordani, S., Zorzi, C., & Bellodi, L. (2004). Neuropsychological investigation of decision-making in anorexia nervosa. *Psychiatry Research*, *127*, 259-266. doi:10.1016/j.psychres.2004.03.012
- Cavedini, P., Zorzi, C., Bassi, T., Gorini, A., Baraldi, C., Ubbiali, A., & Bellodi, L. (2006). Decision-making functioning as a predictor of treatment outcome in anorexia nervosa. *Psychiatry Research*, *145*, 179-187. doi:10.1016/j.psychres.2004.12.014
- Cockrell, J. R., & Folstein, M. F. (2002). Mini-mental state examination. *Principles and practice of geriatric psychiatry*, 140-141.
- Cooper, Z., & Fairburn, C. (1987). The eating disorder examination: A semi-structured interview for the assessment of the specific psychopathology of eating disorders. *International Journal of Eating Disorders*, *6*, 1-8.
- Danner, U. N., Sanders, N., Smeets, P. A., van Meer, F., Adan, R. A., Hoek, H. W., & van Elburg, A. A. (2012). Neuropsychological weaknesses in anorexia nervosa: Set shifting, central coherence, and decision making in currently ill and recovered women. *International Journal of Eating Disorders*, *45*, 685-694. doi:10.1002/eat.22007

- De Visser, L., van der Knaap, L. J., van de Loo, A. J. A. E., van der Weerd, C. M. M., Ohl, F., & van Den Bos, R. (2010). Trait anxiety affects decision-making differently in healthy men and women: towards gender-specific endophenotypes of anxiety. *Neuropsychologia*, *48*, 1598-1606. doi:10.1016/j.neuropsychologia.2010.01.027
- Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. *Emotion*, *7*, 336-353. doi:10.1037/1528-3542.7.2.336
- Frank, G. K., Roblek, T., Shott, M. E., Jappe, L. M., Rollin, M. D., Hagman, J. O., & Pryor, T. (2012). Heightened fear of uncertainty in anorexia and bulimia nervosa. *International Journal of Eating Disorders*, *45*, 227-232. doi:10.1002/eat.20929
- Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry?. *Personality and Individual Differences*, *17*, 791-802. doi:10.1016/0191-8869(94)90048-5
- Galimberti, E., Fadda, E., Cavallini, M. C., Martoni, R. M., Erzegovesi, S., & Bellodi, L. (2013). Executive functioning in anorexia nervosa patients and their unaffected relatives. *Psychiatry Research*, *208*(3), 238-244. doi:10.1016/j.psychres.2012.10.001
- Guillaume, S., Sang, C. N. T., Jaussent, I., Raingeard, I., Bringer, J., Jollant, F., & Courtet, P. (2010). Is decision making really impaired in eating disorders?. *Neuropsychology*, *24*, 808-812. doi:10.1037/a0019806
- Hartley, C. A., & Phelps, E. A. (2012). Anxiety and decision-making. *Biological Psychiatry*, *72*, 113-118. doi:10.1016/j.biopsych.2011.12.027
- Heimberg, R. G., Turk, C. L., & Mennin, D. S. (2004). *Generalized anxiety disorder: advances in research and practice*. New York: Guilford Press
- Kesby, A., Maguire, S., Brownlow, R., & Grisham, J. R. (2017). Intolerance of Uncertainty in eating disorders: An update on the field. *Clinical Psychology Review*, *56*, 94-105. doi:10.1016/j.cpr.2017.07.002

- Ladouceur, R., Talbot, F., & Dugas, M. J. (1997). Behavioral expressions of intolerance of uncertainty in worry: Experimental findings. *Behavior Modification, 21*, 355-371.
doi:10.1177/01454455970213006
- Liao, P. C., Uher, R., Lawrence, N., Treasure, J., Schmidt, U., Campbell, I. C., Collier, D. A., & Tchanturia, K. (2009). An examination of decision making in bulimia nervosa. *Journal of Clinical and Experimental Neuropsychology, 31*, 455-461.
doi:10.1080/13803390802251378
- Litmanen, J., Fröjd, S., Marttunen, M., Isomaa, R., & Kaltiala-Heino, R. (2017). Are eating disorders and their symptoms increasing in prevalence among adolescent population?. *Nordic Journal of Psychiatry, 71*, 61-66. doi:10.1080/08039488.2016.1224272
- Luhmann, C. C., Ishida, K., & Hajcak, G. (2011). Intolerance of uncertainty and decisions about delayed, probabilistic rewards. *Behavior Therapy, 42*, 378-386.
doi:10.1016/j.beth.2010.09.002
- Miu, A. C., Heilman, R. M., & Houser, D. (2008). Anxiety impairs decision-making: psychophysiological evidence from an Iowa Gambling Task. *Biological Psychology, 77*, 353-358. doi:10.1016/j.biopsycho.2007.11.010
- Mueller, E. M., Nguyen, J., Ray, W. J., & Borkovec, T. D. (2010). Future-oriented decision making in Generalized Anxiety Disorder is evident across different versions of the Iowa Gambling Task. *Journal of Behavior Therapy and Experimental Psychiatry, 41*, 165-171. doi:10.1016/j.jbtep.2009.12.002
- Schilder, C. M. T., Danner, U. N., van Elburg, A. A., & Snellen, W. (2015). Neuropsychologische diagnostiek bij patiënten met eetstoornissen: Toepassingen in de klinische praktijk en voor wetenschappelijk onderzoek. *Tijdschrift voor Neuropsychologie, 10*, 27-38. Retrieved from:
https://www.researchgate.net/publication/309428217_Neuropsychologische_diagnostiek_bij_patiënten_met_eetstoornissen_Toepassingen_in_de_klinische_praktijk_en_voor_wetenschappelijk_onderzoek

- Smink, F. R., Van Hoeken, D., & Hoek, H. W. (2012). Epidemiology of eating disorders: incidence, prevalence and mortality rates. *Current Psychiatry Reports, 14*, 406-414. doi:10.1007/s11920-012-0282-y
- Sternheim, L., & Harrison, A. (2018). The acceptability, feasibility and possible benefits of a group-based intervention targeting intolerance of uncertainty in adolescent inpatients with anorexia nervosa. *Cogent Psychology, 5*, 1-11. doi:10.1080/23311908.2018.1441594
- Sternheim, L., Konstantellou, A., Startup, H., & Schmidt, U. (2011). What does uncertainty mean to women with anorexia nervosa? An interpretative phenomenological analysis. *European Eating Disorders Review, 19*, 12-24. doi:10.1002/erv.1029
- Sternheim, L., Startup, H., & Schmidt, U. (2011). An experimental exploration of behavioral and cognitive–emotional aspects of intolerance of uncertainty in eating disorder patients. *Journal of Anxiety Disorders, 25*, 806-812. doi:10.1016/j.janxdis.2011.03.020
- Sternheim, L., Startup, H., & Schmidt, U. (2015). Anxiety-related processes in anorexia nervosa and their relation to eating disorder pathology, depression and anxiety. *Advances in Eating Disorders: Theory, Research and Practice, 3*, 13-19. doi:10.1080/21662630.2014.948469
- Tchanturia, K., Liao, P. C., Uher, R., Lawrence, N., Treasure, J., & Campbell, I. C. (2007). An investigation of decision making in anorexia nervosa using the Iowa Gambling Task and skin conductance measurements. *Journal of the International Neuropsychological Society, 13*, 635-641. doi:10.1017/S1355617707070798
- Thibodeau, M. A., Carleton, R. N., Gómez-Pérez, L., & Asmundson, G. J. (2013). “What if I make a mistake?”: Intolerance of uncertainty is associated with poor behavioral performance. *The Journal of nervous and mental disease, 201*, 760-766. doi:10.1097/NMD.0b013e3182a21298

Zhang, L., Wang, K., Zhu, C., Yu, F., & Chen, X. (2015). Trait anxiety has effect on decision making under ambiguity but not decision making under risk. *PloS One*, *10*, 1-21.

doi:10.1371/journal.pone.0127189