



**Utrecht University**

MASTER THESIS

**The Influence of Sensitivity to Punishment on  
Obsessive-Compulsive Disorder Symptoms in Individuals with  
Anorexia Nervosa**

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### **Abstract**

*Introduction:* Individuals with anorexia nervosa (AN) with either anorexia nervosa-restrictive or anorexia nervosa-binge purge subtype are underweight because they restrict the food intake since they have a strong fear to gain weight (American Psychiatric Association, 2013).

Obsessive compulsive disorder (OCD) is often a comorbid disorder in individuals with AN (Levinson et al., 2018). This comorbidity impairs the possibility to fully benefit from treatment (Pallister & Waller, 2008). Sensitivity to punishment is both very common in OCD and in AN (e.g. Alonso et al., 2008; Ceschi, Hearn, Billieux, & Van der Linden, 2011), which makes it a mutual underlying factor. This study therefore examines if sensitivity to punishment influences OCD-symptoms in individuals with anorexia nervosa restrictive and binge purge subtype and healthy controls.

*Method:* 95 individuals diagnosed with ANR, 77 individuals diagnosed with ANBP, and 82 healthy control participants were included in this study and completed the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) and the Obsessive Compulsive Inventory-Revised (OCI-R) questionnaire.

*Results and discussion:* Individuals with AN were more sensitive to punishment than healthy controls and individuals with ANBP were more sensitive to punishment than individuals with ANR. Furthermore, results showed that sensitivity to punishment influences OCD-symptoms in individuals with AN, independently of the AN-subtype. However, this study did not include other factors which may explain the difference between sensitivity to punishment in the AN-subtypes, like symptom severity which Glashouwer and colleagues (2014) included. Future research should take this into account.

*Keywords:* Obsessive compulsive disorder, anorexia nervosa subtypes, sensitivity to punishment, SPSRQ, OCI-R

## **Introduction**

Anorexia nervosa (AN) is a severe eating disorder. Many individuals suffering from AN relapse and are chronically ill (Fox & Diab, 2015). People with AN have a strong fear to gain weight and therefore restrict their food intake which results in underweight (American Psychiatric Association, 2013). As a consequence they often experience medical complications like osteoporosis, cardiovascular problems, or amenorrhea (Mehler & Brown, 2015). There are two subtypes of AN. Individuals with anorexia nervosa restrictive (ANR) restrict the food intake and can excessively move to burn calories, while individuals with anorexia nervosa binge purge (ANBP) binge and/or purge in addition to a restrictive eating pattern (American Psychiatric Association, 2014). Individuals with AN often suffer from comorbidity with obsessive compulsive disorder (OCD) (Levinson et al., 2018), which impacts negatively the possibility to benefit fully from treatment (Pallister & Waller, 2008). Sensitivity to punishment is an underlying factor of both AN and OCD (e.g. Alonso et al., 2008; Monteleone et al., 2018). Individuals with AN differ in the degree of sensitivity to punishment (e.g. Keating et al., 2016; Shott et al., 2012), which suggests that individuals who are more sensitive to punishment will show more OCD-symptomatology, since sensitivity to punishment is a mutual characteristic of AN and OCD. This study examines therefore whether individuals with AN who are more sensitive to punishment will show more OCD-symptoms and if this differs between the subtypes. More insight in the relation between AN (subtypes), OCD-symptoms and sensitivity to punishment may have important treatment implications.

### **AN, OCD and Sensitivity to Punishment**

Individuals with AN often show comorbidity with OCD but the degree differs strongly as the range differs from 5% to 54.6% (e.g. Carrot et al., 2017; Swinbourne et al., 2012; Ulfvebrand, Birgegård, Norring, Högdahl, and von Hausswolff-Juhlin, 2015). Individuals with OCD feel forced to compulsive behaviour to neutralize obsessions, which are recurrent and persistent

thoughts, urges or images (American Psychiatric Association, 2014). Individuals with AN also experience a lot of obsessions and compulsions. Halmi and colleagues (2003) investigated to what extent the obsessions and compulsions of individuals with AN and with OCD corresponded. Both individuals with AN and with OCD showed obsessions related to somatic obsessions and symmetry to the same extent, and showed equal compulsions related to hoarding, ordering and checking. In addition, individuals with OCD showed more and different obsessions and compulsions than individuals with AN (e.g. sexual obsessions) (Halmi et al., 2003). Furthermore, individuals with AN often experience obsessions and compulsions related to the eating disorder (Levinson et al., 2018). For example, an individual with AN may try to neutralize or control the obsessive thought of gaining weight by eating disorder related compulsions, like frequently weighing and rules or rituals for food intake.

The comorbidity between AN and OCD may be explained by a mutual underlying factor: sensitivity to punishment (e.g., Alonso et al., 2008; Ceschi, Hearn, Billieux, & Van der Linden, 2011; Danner et al., 2012; Danner et al., 2016; Fullana, Mataix-Cols, Caseras et al., 2004; Fullana, Mataix-Cols, Trujillo et al., 2004; Monteleone et al., 2018). Sensitivity to punishment alludes to the extent to which an individual perceives future stimuli or events as threatening and avoids these (Kim, Yoon, Kim, & Hamann, 2015). For example, an individual who is highly sensitive to punishment, is afraid of being embarrassed (threat) if speaking in public and restrains therefore from expressing an opinion (avoidance).

Individuals with AN in general report more sensitivity to punishment than healthy controls (Danner et al., 2012; Glashouwer et al., 2014; Jappe et al., 2011; Keating et al., 2016; Shott et al., 2012), it often predates AN and persists after recovery to a certain degree (Danner et al., 2012; Kaye et al., 2015). Ceschi and colleagues (2011) considered that sensitivity to punishment is a vulnerability factor for developing obsessive compulsive symptoms in general, from which both individuals with AN and with OCD suffer (e.g. Carrot et al., 2017,

Pauls, Abramovitch, Rauch, & Geller, 2014). Individuals who are sensitive to punishment show a heightened awareness of possible threats in their environment (Inzlicht, Barhalow, & Hirsch, 2015) and perform compulsions to avoid or reduce anxiety and distress, caused by these threats (perceived as punishment) (Salkovskis, 1999; Kaufmann et al., 2013). Therefore, possibly individuals with AN who are more sensitive to punishment will also develop more OCD-symptoms. For example, an individual with AN who is very sensitive to punishment counts calories (compulsion) to lower the anxiety of gaining weight (threat/punishment). Thus, sensitivity to punishment seems an underlying factor of OCD-symptomatology in individuals with AN. Studying this relationship can contribute to better treatment for individuals with AN. According to Kaye and colleagues (2015) treatment of AN should focus on the awareness of underlying personality characteristics (like sensitivity to punishment) and on learning how to use and manage these as an advantage to treat AN. By targeting sensitivity to punishment in individuals with AN, OCD-symptomatology should also diminish.

### **Subtypes of AN**

Furthermore, it might be relevant to investigate if the subtypes of AN differ in the degree of sensitivity to punishment and therefore in the level of OCD-symptoms, because this allows even more personalized and more effective treatment options. When individuals with ANR differ from individuals with ANBP regarding sensitivity to punishment, treatment can focus more intensive on sensitivity to punishment when treating individuals with the subtype high on sensitivity to punishment. Unfortunately, most studies did not investigate the subtypes of AN in relation to sensitivity to punishment and to OCD, but only examined SP in AN more generally (e.g. Danner et al., 2012; Keating et al., 2016; Monteleone et al., 2018; Shott et al., 2012). A few studies did investigate the subtypes. Matton and colleagues (2015) specifically studied the relationship between the subtypes and sensitivity to punishment, because they suggested that a personality feature like sensitivity to punishment could explain why

individuals with ANR are able to restrict the food intake, while individuals with ANBP are not able to fully restrict the food intake and engage in binge eating behaviour. They suggested that both individuals with ANBP and ANR consider food as punishment and would therefore be equally high on sensitivity to punishment and that they would differ on sensitivity to reward (which is not investigated in this study). Indeed, most studies did not find any differences between the subtypes in relation to sensitivity to punishment (Danner et al., 2016; Jappe et al., 2011; Matton et al., 2015), but these studies consisted of relatively small sample sizes. In contrast, the study of Glashouwer and colleagues (2014) consisted of a relatively large sample size and found that individuals with ANBP were more sensitive to punishment than individuals with ANR. The authors suggested that individuals with ANBP in their study might display more severe eating disorder symptoms and would therefore be more sensitive to punishment than individuals with ANR, since they found that the measurement of sensitivity to punishment (SPSRQ-SP) correlated positively with symptom severity.

Since the evidence is inconsistent, this study will also examine the subtypes of AN in relation to sensitivity to punishment and OCD-symptoms, in addition to AN in general. This study distinguishes itself by a large sample size in contrast to all studies, but one (Glashouwer et al., 2014). Furthermore, it is the first study examining the relationship between AN (and subtypes), sensitivity to punishment and OCD-symptoms.

### **Hypotheses**

First, it is expected that individuals with AN are more sensitive to punishment than healthy controls and that within the AN group the two subtypes of AN differ: individuals with ANBP are more sensitive to punishment than individuals with ANR. Second, it is expected that individuals with AN who are more sensitive to punishment will show more OCD-

symptomatology and that this relation will be stronger for individuals with ANBP than for individuals with ANR.

## **Methods**

### **Participants**

In total 254 individuals participated in the study: 95 individuals (age 24.93 years; SD = 8.77) diagnosed with ANR, 77 individuals (age 27.35 years; SD = 10.11) diagnosed with ANBP, and 82 healthy control participants (age 26.26 years; SD = 9.40). The diagnosis of AN was ascertained by certified professionals (psychiatrists and psychologists) according to the DSM-5 criteria (American Psychiatric Association, 2013) and confirmed by (questions from) the Eating Disorder Examination (Cooper, & Fairburn, 1987). This study is part of a larger study into the genetic background and relations with phenotypes in people with AN, conducted by Altrecht Eating Disorders Rintveld in Zeist, a Dutch highly specialized treatment facility for people with eating disorders. The individuals with AN agreed to partake in the study during their first appointment at the Altrecht Eating Disorders Rintveld in Zeist. These individuals were compared to healthy individuals, who were recruited by advertisements, which contained information about the study. The control participants were matched with the AN patients on gender and age.

All participants who took part in the study did receive information about the study and signed the informed consent before they enrolled in the study. This study is part of a larger study that is performed by the Utrecht Research Group for Eating disorders (URGE). The instruments which are used in the current study were integrated in an extended phenotype battery from the larger study. The research protocol is authorized by the Committee Scientific Research of Altrecht Mental Health Institute and the Medical Ethical Committee of the University Medical Center Utrecht.

**Inclusion and exclusion criteria.** The participants included in this study had to be at least 18 years old. The healthy individuals were screened for mental disorders in the past and currently in the first part of the study using the MINI interview (see Instruments section). When the participant scored on the MINI, the participant was informed that he/she could not take part in the second part of the study. This led to the exclusion of 22 of the 137 individuals who were screened. In addition to this, one female and 23 male participants were excluded for matching purposes. One male participant dropped out of the study due to illness during the research period. Lastly, 8 control participants and one individual with ANBP and one with ANR were excluded since they were outliers on the OCI-R.

## **Instruments**

**Mini International Neuropsychiatric Interview (MINI).** The Dutch translation of the abbreviated version 5.0.0 of the MINI (Overbeek, Schruers, & Griez, 1999) was used to control for psychological illnesses before participants enrolled in the study. The MINI version 5.0.0 is based on DSM-IV and can be deployed for interrogation about current and lifetime psychological illnesses. The MINI consists of questions for depression (with melancholic characteristics), dysthymia, suicidal risk, (hypo)mania, panic disorder, agoraphobia, social phobia, obsessive compulsive disorder, posttraumatic stress disorder, alcohol abuse/dependency, drug abuse/dependency, psychotic disorder, anorexia nervosa, bulimia nervosa, generalized anxiety disorder and antisocial personality disorder. Each subject started with a few screening questions. The researcher moved on to the next disorder if the screening questions on a disorder were answered with 'no'. If the answer was 'yes' to the screening questions, the researcher moved on to more specific questions about that particular disorder. Dependent on how many times the answer was 'yes' to the specific questions about one

disorder, the disorder was marked as present. If the participant scored on a mental disorder, he or she was excluded from further study participation.

**Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ).** The SPSRQ consists of two subscales: the sensitivity to punishment scale and the sensitivity to reward scale (Torrubia, Avila, Moltó, & Caseras, 2001). Both subscales consist of 24 items, the questions are answered with 'yes' or 'no'. This study only uses the sensitivity to punishment scale. The score can be obtained by adding up all the 'yes' answers ranging from 0 to 24. A higher score means that an individual is more sensitive to punishment. The sensitivity to punishment scale contains a good reliability and construct validity (Torrubia et al., 2001). The psychometric measures of the Dutch SPSRQ are largely unknown, but Franken and Muris (2006) reported a Cronbach's  $\alpha = .84$ . The reliability of the sensitivity to punishment scale of the SPSRQ in this study was good, Cronbach's  $\alpha = .90$ .

**Obsessive Compulsive Inventory – Revised (OCI-R).** The OCI-R (Foa et al., 2002) is a shorter version of the OCI (Foa, Kozak, Salkovskis, Coles, & Amir, 1998). The OCI-R measures obsessions and a variety of compulsions. The OCI-R consists of 18 items, divided over six subscales with each three items on a five-point Likert Scale (0 – 4): Washing, checking, ordering, obsessing, hoarding, and neutralizing. A score of each subscale can be obtained by adding up the scores of each item of the subscale. The subscale score can range from 0 to 12. The total score ranges from 0 to 72 and can be obtained by adding up the scores of all the items. Foa et al. (2002) suggested that a cut-off score of 21 on the total OCI-R is best to differentiate between individuals with obsessive-compulsive disorder and non-anxious controls. The OCI-R has excellent psychometric properties (Foa et al., 2002). The reliability of the OCI-R in this study was Cronbach's  $\alpha = .90$ .

## **Procedure**

The participants were informed about the procedure and were able to ask questions about the study before signing the informed consent. The procedure was the same for both AN groups and the control group, except for the MINI interview prior to the actual participation.

The participants were asked to take place behind a computer. The entire study was programmed using Inquisit software (version 4; Millisecond, 2016). Participants were told in advance to read the instructions of each test carefully. The tests took approximately 45-60 minutes. The researcher was nearby, in case there were any questions. Afterwards, the participant was debriefed and provided with the opportunity to indicate whether or not he or she would like to be informed about the results of the study. Furthermore, control participants were able to receive one study credit for engaging in the study or could compete in the draw for a bol.com voucher.

## **Analyses**

The analyses were performed using SPSS statistics (version 23.0; IBM, 2015). A between-subjects design was used to examine the differences between ANR, ANBP and healthy controls in terms of SP and OCD. ANOVA analyses were used to test group differences related to demographic characteristics and to test hypothesis one. The second hypothesis consisted of two moderation analysis using hierarchical multiple regression analyses: the first moderation analysis was used to compare HC and AN in general and the second moderation analysis was used to test whether the subgroups differed regarding the interaction effect. The assumption of normality was violated for the analyses of demographic characteristics and hypothesis one. However, ANOVA is found to be robust even when non-normality occurs (Blanca, Alarcón, Arnau, Bono, Bendayan, 2017). The assumption of homogeneity of

variance was violated for the analyses of years of education and OCI-R. All assumptions for hierarchical multiple regression analyses were met except for the Mahalanobis distance.

Nevertheless, this study continues since all the other assumptions were met including the assumptions for standardized residuals and Cook's distance.

## Results

### Sample Characteristics

Healthy controls, individuals with ANBP and with ANR were compared on age, BMI, years of education and OCI-R total score (see Table 1). No group differences were found regarding age,  $F(2, 251) = 1.44, p = .24, \eta_p^2 = .01$ . As to be expected, individuals with ANBP and ANR were lower in BMI than the healthy control group,  $F(2, 249) = 110.58, p < .001, \eta_p^2 = .47$ .

Individuals with ANBP and ANR had less years of education than the healthy control group,  $F(2, 251) = 10.79, p < .001, \eta_p^2 = .08$ . Lastly, individuals with ANBP and ANR scored higher on the OCI-R than healthy controls,  $F(2, 251) = 39.35, p < .001, \eta_p^2 = .24$ . Individuals with ANR and ANBP did not differ regarding BMI, years of education and OCI-R score.

### Sensitivity to Punishment

ANOVA analyses were used to analyse if individuals with AN differed from healthy controls (see also Table 1). Individuals with AN were more sensitive to punishment than healthy controls,  $F(1, 252) = 105.34, p < .001, \eta_p^2 = .30$ . Furthermore, all groups differed in terms of sensitivity to punishment,  $F(2, 251) = 57.71, p < .001, \eta_p^2 = .32$ . Post hoc analyses revealed that individuals with ANBP were more sensitive to punishment than individuals with ANR (see Table 1).

Table 1

*Group characteristics (Mean, SD) for healthy controls and individuals with anorexia nervosa*

	ANR (n = 95)		ANBP (n = 77)		HC (n = 82)		<i>F</i>	<i>p</i>	$\eta_p^2$
	Mean	SD	Mean	SD	Mean	SD			
Age	<b>24.93</b>	8.77	<b>27.35</b>	10.11	<b>26.26</b>	9.40	1.44	ns	
BMI	<b>16.57<sup>a</sup></b>	2.05	<b>17.35<sup>a</sup></b>	2.27	<b>22.04<sup>b,c</sup></b>	3.30	110.58	<.001	.47
Years of education	<b>13.88<sup>a</sup></b>	2.69	<b>13.43<sup>a</sup></b>	2.56	<b>15.13<sup>b,c</sup></b>	1.90	10.79	<.001	.08
OCI-R	<b>18.01<sup>a</sup></b>	10.58	<b>20.45<sup>a</sup></b>	13.34	<b>6.89<sup>b,c</sup></b>	6.28	39.35	<.001	.24
SPSRQ-SP	<b>14.24<sup>a,c</sup></b>	5.68	<b>16.40<sup>a,b</sup></b>	4.98	<b>7.99<sup>b,c</sup></b>	4.73	57.71	<.001	.32

*Note:* <sup>a</sup> Different from control group, <sup>b</sup> Different from ANR group, <sup>c</sup> Different from ANBP group. ANR = Anorexia Nervosa Restrictive, ANBP = Anorexia Nervosa Binge Purge, HC = Healthy controls, SPSRQ-SP = Sensitivity to Reward and Sensitivity to Punishment Questionnaire – Sensitivity to Punishment subscale (Torrubia et al., 2001), OCI-R = Obsessive Compulsive Inventory-Revised (Foa et al., 2002).

### **The Influence of Sensitivity to Punishment on OCD-symptoms in Individuals with AN**

The first moderation analysis using hierarchical multiple regression analysis examined the relationships between sensitivity to punishment, group (AN vs. HC) and OCD-symptomatology. It revealed that the first model which included the predictors sensitivity to punishment and group was significant,  $F(2, 251) = 55.91, p < .001, R^2 = .31$ . A main effect of sensitivity to punishment was found,  $b = 3.92, t(251) = 5.27, p < .001$ . Individuals who are more sensitive to punishment have higher OCI-R scores than individuals lower on sensitivity to punishment. In addition, there was a main effect of group,  $b = 3.59, t(251) = 4.84, p < .001$ , showing that individuals with AN have higher OCI-R scores than healthy individuals. The second model where the interaction was added was significant as well,  $F(3, 250) = 41.04, p < .001, R^2 = .33$ . Furthermore, the second model added significant value to the first model, with  $\Delta R^2 = .022$ . There was an interaction effect of sensitivity to punishment on the relation between group (AN vs. HC) on OCD-symptoms,  $b = .762, t(251) = 2.85, p < .05$  (see Figure 1).

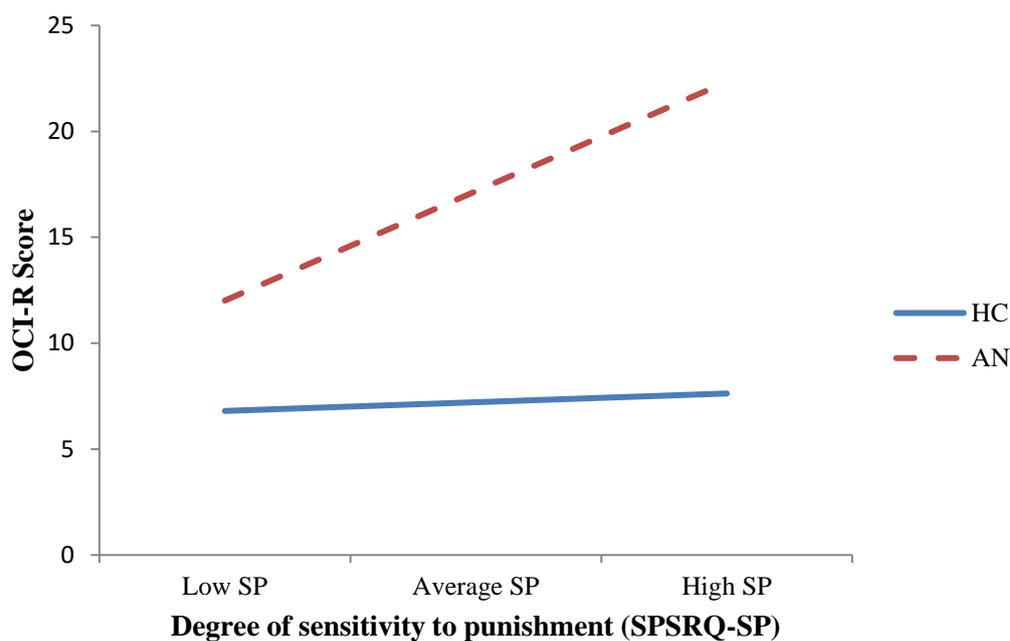


Figure 1. Interaction effect and main effects of sensitivity to punishment and group.

Note. AN = Anorexia Nervosa, HC = Healthy controls, SPSRQ-SP = Sensitivity to Reward and Sensitivity to Punishment Questionnaire – Sensitivity to Punishment subscale (Torrubia et al., 2001), OCI-R = Obsessive Compulsive Inventory-Revised (Foa et al., 2002).

The second moderation analysis also using hierarchical multiple regression examined the relationships between sensitivity to punishment, subgroups (ANR and ANBP) and OCD-symptoms. The first model containing the predictors subgroups and sensitivity to punishment was significant,  $F(2,169) = 14.36, p < .001, \Delta R^2 = .15$ . There was a main effect of sensitivity to punishment as well,  $b = 5.09, t(169) = 5.43, p < .001$ . There was no main effect of subgroups,  $b = .339, t(268) = .39, p = .70$ , which means that both ANR and ANBP are equally scoring on OCI-R. The second model where the interaction was added was significant too,  $F(3,168) = 10.78, p < .001, R^2 = .16$ . In contrast, the second model had no significant added value compared to the first model, with  $\Delta R^2 = .016$ . No difference was found between the subgroups and sensitivity to punishment in relation to OCD-symptoms,  $b = .582, t(168) = 1.80, p = .07$ .

## Discussion

The purpose of this study was to examine the relationship of sensitivity to punishment with OCD-symptomatology in individuals with AN and HC and to distinguish between the two subtypes: the restrictive subtype (ANR) and the binge-purge subtype (ANBP). The first hypothesis was that individuals with AN would be more sensitive to punishment than healthy controls and specifically that individuals with ANBP would be more sensitive to punishment than individuals with ANR. Second, it was expected that individuals with AN who are more sensitive to punishment will show more OCD-symptomatology than individuals with AN lower sensitive to punishment and that this relation will be stronger for individuals with ANBP than for individuals with ANR.

### **The Influence of Sensitivity to Punishment on OCD-symptoms in Individuals with AN**

Results showed that individuals with AN were indeed more sensitive to punishment than healthy controls and that individuals with ANBP were more sensitive to punishment than individuals with ANR. These findings suggest that individuals with AN, and in particular with ANBP, will perceive future stimuli or events as more threatening and thereby will avoid these earlier and more intensively than healthy controls. Furthermore, results showed that OCD-symptoms were predicted both by group (AN versus HC) and SP. This means that the more an individual is sensitive to punishment, the more an individual will display OCD-symptoms. Importantly, the predicted interaction effect was found: more sensitivity to punishment was indeed related to more OCD-symptoms in individuals with AN. However, no difference was found in interaction effect when distinguishing between the subtypes of AN. This means that sensitivity to punishment influences OCD-symptoms to the same extent in individuals with ANBP and ANR, although individuals with ANBP were more sensitive to punishment than individuals with ANR.

The results are partly corresponding with the literature, since all studies did find that individuals with AN were more sensitive to punishment than healthy controls (Danner et al., 2012; Glashouwer et al., 2014; Jappe et al., 2011; Keating et al., 2016; Shott et al., 2012). Only one other study which examined the subtypes of AN in relation to sensitivity to punishment found that individuals with ANBP were more sensitive to punishment than individuals with ANR (Glashouwer et al., 2014). This might be due to larger samples in the current study and in the study of Glashouwer and colleagues (2014), compared to the small sample sizes of the other studies investigating the subtypes of AN in relation to sensitivity to punishment (Danner et al., 2016; Jappe et al., 2011; Matton et al., 2015). Future research with larger sample sizes is needed to confirm that subtypes differ regarding sensitivity to punishment.

This study gives more insight into the role of sensitivity to punishment and OCD in individuals with AN, which has important treatment implications. The results indicate that sensitivity to punishment is indeed an underlying factor in both AN and OCD, which means that it could be effective for treatment to focus on the awareness of sensitivity to punishment and how to use it as an advantage (Kaye et al., 2015). Kaye and colleagues (2015) also suggest that individuals with AN are not motivated to recover since they experience high sensitivity to punishment and low sensitivity to reward, which also may be the reason that many individuals relapse and are chronically ill (Fox & Diab, 2015). Importantly, targeting sensitivity to punishment in treatment as an underlying characteristic of both AN and OCD has several advantages. First, by focusing on an underlying personality characteristics like sensitivity to punishment instead of focusing only on symptomatology of AN and comorbid OCD-symptoms, treatment should be more sustainable. Second, individuals with AN should be better able to diminish comorbid OCD-symptoms, which impact the possibility to benefit from treatment negatively (Pallister & Waller, 2008). OCD-symptoms are maintained by

sensitivity to punishment, since compulsions are performed to lower anxiety for possible punishment (Salkovskis, 1999; Kaufmann et al., 2013). More specifically, it could be effective to focus even more on sensitivity to punishment in the treatment of individuals with ANBP, since they are more sensitive to punishment than individuals with ANR. However, when it comes to comorbid OCD-symptoms, individuals with ANR and ANBP did not differ and thus do not have to be treated differently. Third, individuals with AN may be more motivated to recover, since weight gain should be perceived less threatening by targeting sensitivity to punishment. Since both the personality characteristics of sensitivity to punishment and reward sensitivity play a role in the lack of motivation to recover, it is relevant for future research to study sensitivity to reward in addition to sensitivity to punishment. Sensitivity to reward alludes to the extent in which an individual perceives stimuli or events as rewarding and therefore engages in approaching behaviour (Ceschi et al., 2011). Moreover, there is controversy about the role of sensitivity to reward in individuals with AN. Some studies did find individuals with AN are more sensitive to reward (Ferreira, Yücel, Dawson, Lorenzetti, & Fontenelle, 2017; Glashouwer et al., 2014), while other studies found they were lower (Kaye et al., 2015; Matton et al., 2015). Examining if sensitivity to reward influences OCD-symptoms in individuals with AN and the subtypes of AN, will lead to a more complete overview of the influence of personality characteristics. This could indicate whether treatment should focus on sensitivity to reward in addition to sensitivity to punishment.

Besides looking at personality characteristics like sensitivity to punishment and reward, it is relevant to study obsessive compulsive personality disorder (OCPD) in relation to AN and sensitivity to punishment. This study focused on the degree in which individuals with AN experience OCD-symptoms, since OCD is relatively common in individuals with AN (e.g. Carrot et al., 2017; Swinbourne et al., 2012; Ulfvebrand et al., 2015). However, OCPD is

thought to play at least an equally important role in individuals with AN (Gaudio & Di Ciommi, 2011; Sansone & Sansone, 2011; Strober, Feeman, Lampert & Diamond, 2007), which may be due to the role of sensitivity to punishment. Ross and colleagues (2012) suggest that sensitivity to punishment may be a core vulnerability factor for developing OCPD. Indeed, sensitivity to punishment is found to be heightened in individuals with OCPD (Caseras, Torrubia, Farré, 2001; Pastor et al., 2007; Ross et al., 2012). Individuals with OCPD are intensively preoccupied with rules, lists, organization, order, details, productivity, perfectionism and are considered to be strongly inflexible when it comes to ethics, values and morality which interferes with daily living (Sansone & Sansone, 2011). These OCPD-symptoms are also common in AN, with rules for eating, focusing on detail and ordering and making schedules regarding eating and weighing for example (Sansone & Sansone, 2011). OCPD and traits of OCPD contribute to a poor prognosis of AN (Crane, Roberts, & Treasure, 2007; Starcevic & Brakoulias, 2014). This makes it relevant for future studies to examine the relationship between sensitivity to punishment, AN and OCPD.

### **Strengths, Limitations and Future Research**

This study has several strengths: a matched control group was included and sample size was large. Furthermore, this study also distinguished between the AN subtypes: ANR and ANBP. Lastly, the current study was the first to compare individuals with ANR or ANBP regarding the relation between sensitivity to punishment and OCD-symptomatology.

The following limitations also need to be mentioned. First, this study was unable to identify the cause of why individuals with ANBP were more sensitive to punishment than individuals with ANR. Glashouwer and colleagues (2014) attributed this difference to the fact that individuals with ANBP experienced more severe symptoms than individuals with ANR. This study does not take other factors into account causing this difference, which may impede the validity of the found results. Future research should look into symptom severity as well to

clarify this. Second, the results show that individuals with AN are more sensitive to punishment, but do not tell if the individuals were already more sensitive to punishment before suffering from AN, or if sensitivity to punishment is caused by AN. When it is caused by AN, this would mean that sensitivity to punishment is not an underlying factor for AN and that treatment on sensitivity to punishment would therefore not help to diminish AN. However, since sensitivity to punishment is a personality characteristic and Danner and colleagues (2012) found that sensitivity to punishment is still heightened when individuals are recovered, it is likely that it is already heightened in individuals with AN. Longitudinal research is needed to confirm this.

In conclusion, the present findings showed that individuals with AN experience more sensitivity to punishment, which influences the degree of OCD-symptomatology more than in healthy controls. Individuals with ANBP report more sensitivity to punishment than individuals with ANR, but this does not affect the existent interaction effect: sensitivity to punishment influences OCD-symptoms to the same extent in individuals with ANR as with ANBP. When an individual with AN shows heightened sensitivity to punishment, which leads to more OCD-symptomatology, treatment of AN should focus on the awareness, use and managing of sensitivity to punishment as an underlying personality characteristic to help diminish OCD-symptoms (Kaye et al., 2015). This could lead to more personalized and more sustainably effective treatment with less relapsing for individuals suffering from AN (subtypes).

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