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Perfectionism and Cognitive Rigidity in Anorexia Nervosa: is there an association?

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Abstract

Little is known about the relationship between neuropsychology, personality and eating psychopathology in anorexia nervosa (AN). We aimed to investigate the interaction between set-shifting and perfectionism in AN and to ascertain the role of perfectionism as a mediator between set-shifting and eating psychopathology. 85 patients with AN and 71 healthy controls completed: Eating Disorder Inventory-2, Beck Depression Inventory, Wisconsin Card Sorting Test, Trail Making Task and Hayling Sentence Completion Task. Our findings support heightened cognitive inflexibility in individuals with AN, particularly in those with high perfectionism traits. Considering the sample as a whole, perfectionism resulted to be a mediator of the relationship between a measure of set-shifting (i.e., Trail Making Task) and drive for thinness but this finding did not remain significant when including in the model only those with AN. Taken together, these data suggest a complex and non-exclusive association between set-shifting, eating psychopathology and perfectionism.

Keywords

Eating Disorders

Anorexia Nervosa

Cognitive Rigidity

Set Shifting

Perfectionism

Introduction

Anorexia nervosa (AN) is a complex mental illness whose pathogenesis is largely unknown (Brockmeyer, Friederich, & Schmidt, 2017; Bulik, Berkman, Brownley, Sedway & Lohr, 2007).

Several studies explored the possibility that cognitive rigidity could be an endophenotype of AN (Talbot, Hay, Buckett & Touyz, 2015). Set-shifting has been investigated as an endophenotype also because AN patients consistently showed inefficient set-shifting abilities which have been consistently found to be stable in AN (Abbate-Daga et al., 2011; Abbate-Daga, Buzzichelli, Marzola, Amianto & Fassino, 2014; Tchanturia et al., 2012; Aloi et al., 2015; Westwood, Stahl, Mandy & Tchanturia, 2016). Also personality has been investigated to better understand AN pathogenesis; among personality traits, perfectionism is strongly associated with eating disorders (EDs) as both risk and maintaining factor (Egan, Wade & Shafran, 2011). Interestlyngly, research showed perfectionism not only as correlated with drive for thinness (DT) in patients with AN, but also as preceding eating psychopathology in AN (Halmi et al., 2012).

Little is known about the relationship between set-shifting and personality. Theoretically, rigidity, inhibition, and perfectionism could be linked to difficulties in executive functions. Parallels between perfectionism and set-shifting are common in every-day clinical practice and have been already hypothesized in literature (Schmidt & Treasure, 2006). Furthermore, retrospective research showed set-shifting as associated with childhood perfectionism (Tchanturia et al., 2004); therefore, perfectionism could influence AN patients' thinking style and problem solving abilities thus partially influencing their neuropsychological performances.

The interaction between neuropsychological performance and perfectionism in AN received scant attention and only contradictory findings are available. In a recent study, higher personal standards (Frost, Marten, Lahart & Rosenblate, 1990), were associated with better Trial Making Test scores in both affected and non-affected individuals (Vall & Wade, 2015). In another study higher personal standards were found to be correlated with good set-shifting in recovered AN

patients and with poor set-shifting in healthy controls (Lindner, Fichter & Quadflieg, 2014). Buhren and collaborators (2012) found a correlation between greater accuracy on neuropsychological test and perfectionism in young AN patients (Shott et al., 2012). In contrast, other studies highlighted the need for clarifying the interactions between perfectionism and set-shifting (Pignatti & Bernasconi, 2013) and no significant correlations between these two constructs have been reported as well (Friederich et al., 2012). The available evidence is overall unsatisfactory also because previous studies used different measures of set-shifting and cognitive flexibility in verbal domains has not been investigated so far in this regard.

In order to bridge the aforementioned gaps in literature, this study has the following goals: a) to analyze the set-shifting performance concerning both verbal and non-verbal domains across subsamples of AN patients and healthy controls (HCs) grouped according to their degrees of perfectionism; b) to ascertain the role of perfectionism as a mediator between cognitive rigidity and eating psychopathology, in particular drive for thinness. When designing this study we hypothesized to find: a) a relationship between suboptimal neuropsychological performance and perfectionism; b) perfectionism as mediator of the link between cognitive rigidity and eating psychopathology.

Materials and Methods

Participants

The sample consisted of 156 adult female participants, 85 individuals diagnosed with AN restricting subtype (RAN) and 71 healthy controls (HCs). AN patients were consecutively recruited at the Eating Disorders Center of University of Turin, Italy. All participants provided written informed consent according to the ethical committee of University of Turin. Patients were included in this study who met criteria for AN according to DSM-5 (American Psychiatric Association, 2013), HCs were recruited at the University of Turin through flyers. Exclusion criteria for the entire sample are the following: a) male gender; b) Wechsler Adult Intelligence Scale-Revised Intellectual

Quotient < 85 (Wechsler, 1997); c) history of cranial trauma with loss of consciousness; d) alcohol or substance dependenceor abuse ; e) medical problems; f) suicidal ideation. Moreover, none of the HCs was on psychotropic medications or met criteria for a current or lifetime diagnosis of EDs or other mental disorders, as clinically assessed by an experienced psychiatrist. Participants were all Caucasian, all affected individuals completed the assessment in the first week of treatment to minimize confounders due to the treatment.

Measures and procedure

Psychiatric assessment

All participants were assessed using the following self-reported measures: Eating Disorders Inventory-2 (EDI-2; Garner, 1991) to evaluate eating psychopatology and Beck Depression Inventory (BDI; Beck et al., 1961) to assess depression. Participants' weight and high were measured by a trained nurse to calculate body mass index (BMI). Perfectionism was measured with the perfectionism sub-scale of the EDI-2, and we set the cut off at 8 according to the EDI-2 manual instructions (Garner, 1991). Three groups emerged: RAN High Perfectionism (RAN-HP; n=21), RAN Low Perfectionism (RAN-LP; n=64) and HCs with low perfectionism scores (n=64). Seven individuals in the HCs group were outliers and thus excluded.

To evaluate cognitive flexibility we used the following pen and paper neuropsychological tests: Wisconsin Card Sorting Test (WCST; Berg, 1948; Heaton, 1981), Trail Making Task (TMTA-B; Reitan, 1958) and the Hayling Sentence Completion task (HSCT; Burgess & Shallice, 1997).

Statistical Analysis

The SPSS 24.0 statistical software package (IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp) has been used for data analysis. Sample t-test has been run to evaluate significant differences between RAN versus HCs. Cohen's *d* effect size has been calculated for neuropsychological tests. A Chi Square analysis has been used to evaluate the distribution of perfectionism score between RAN and HCs groups; seven HCs were considered as

outliers and thus excluded from all subsequent analyses. To check clinical differences between RAN-HP and RAN-LP a t-test has been used. The one way ANOVA with Bonferroni post-hoc analysis evaluated differences between RAN-HP, RAN-LP, and HCs.

Linear regression analyses were used to: a) explore the eventual independent associations between cognitive rigidity and both perfectionism and Drive for Thinness (DT); b) verify the possible association between perfectionism and DT. Multivariate regression analysis and the Sobel test (Baron & Kenny, 1986; Preacher & Hayes, 2004) were then used in order to ascertain the mediation role of perfectionism. Perfect mediation holds if the independent variable has no effect when the mediator is controlled for (Baron & Kenny, 1986). The amount of mediation is usually called the "indirect effect" (Figure 1).

Results

Demographics and clinical features of the sample

The sample was composed of 156 individuals, 85 were RAN and 71 HCs. Those with RAN were inpatients (see table 1 for sample charactheristics)

Neuropsychological performances

As shown in Table 1, the RAN group performed significantly worse than HCs on all WCST subscales.

Regarding the TMT, both time scores, part A and B were significantly higher in RAN patients when compared to HCs; in contrast, no significant differences were found in the number of errors in part B (Table 1).

RAN individuals performed significantly worse on the HSCT with both net score and reaction time significantly higher than those of HCs ($p<0.001$ and $p<0.05$, respectively; Table 1).

Neuropsychological performances across perfectionism groups

Within the RAN group, 21 (24.7%) individuals had high perfectionism scores (RAN-HP) and 64 (75.3%) had low perfectionism scores (RAN-LP); within the HCs group 7 individuals

(9.9%) reported high perfectionism while the majority of this group (n=64, 90.1%) had low perfectionism scores. The distribution of high perfectionism scores significantly differed between RAN and HCs (p=0.013). Also in this light, HCs with high perfectionism have been considered as outliers and excluded from subsequent analysis.

Between RAN-HP and RAN-LP no significant differences were found in BMI,, and years of education but RAN-HP showed a significantly longer duration of illness , more severe eating and depressive symptoms (Table 1).

With respect to the differences in neuropsychological performances across perfectionism groups (Table 2), RAN-LP and RAN-HP performed significantly worse than HCs on the WCST global score although the differences between RAN groups did not reach statistical significance. Perseverative errors did not significantly differ across groups; in contrast, RAN-HP differed from HCs in non-perseverative errors with RAN-HP making considerably more errors than HCs. Although not statistically significant, RAN-LP were found to have intermediate scores between RAN-HP and HCs with respect to non-perseverative errors. Finally, HCs reported a significantly lower number of failures than both AN groups which did not differ from each other.

Time A on the TMT resulted significantly lower for HCs when compared to RAN-LP. Time B resulted significantly lower in HCs when compared to both RAN groups also, RAN-HP showed greater scores than RAN-LP but the differences between RAN groups showed only a trend toward statistical significance. Similarly, the score time B-A was significantly higher in RAN-HP than HCs , with RAN-LP scoring an intermediate value; however, only the difference between RAN-HP and RAN-LP reached significance.

Concerning the HSCT, we found that the net score resulted significantly higher in RAN-HP when compared to HCs. The net score of RAN-LP was intermediate between those of RAN-HP and HCs although not reaching statistically significance.

Mediation model

We used the whole sample to run the mediation model. As a proxy for cognitive rigidity we chose to carry on in the mediation model those indices of cognitive rigidity that significantly differed across groups of perfectionism (Table 2), namely TMT A, TMT B, TMT B-A, WCST global score, WCST non perseverative errors, WCST failures, and HSCT net score. As a first step, as shown in Table 3, we investigated the association between cognitive rigidity and DT finding that TMT B, TMT B-A, and WCST non perseverative errors resulted as significantly associated with DT (p= 0.024; p=0.027; p=0.015, respectively). Secondly, we tested the effect of cognitive rigidity on perfectionism reporting that TMT A, TMT B, and HSCT net score were significantly associated with perfectionism (p=0.016; p=0.017; p=0.005, respectively). Lastly, we found a significant association between perfectionism and DT (p=0.001). Among cognitive rigidity indices, only TMT B was significantly associated with both DT and perfectionism (p= 0.024 and p=0.017, respectively), so we used TMT B to run the mediation model. TMT B was significantly associated to DT but, when controlling for perfectionism, such an association was no longer significant (Table 3) thus supporting perfectionism as a mediator of the relationship between cognitive rigidity and DT. The Sobel test confirmed this finding (Sobel test p= 0.031; Figure 1).

When including only the AN sample in the mediation model the association between cognitive rigidity and both DT and perfectionism was no longer significant (data not shown) while the association between perfectionism and DT remained significant (p=0.001).

Discussion

Findings from this study confirmed heightened cognitive rigidity in AN and showed perfectionism to be a significant mediator of the relationship between set-shifting and eating psychopathology; nevertheless, this finding did not remain significant when only patients with AN were included in the same mediation model.

In line with the a priori hypothesis we found a relationship between neuropsychological performance and perfectionism. Moreover, those with high perfectionism reported the most marked

inefficiencies in cognitive rigidity when compared to patients with low perfectionism and HCs; however, the differences between patients with high versus low perfectionism did not reach statistical significance in all comparisons.

Patients with different levels of perfectionism differed on the majority of the neuropsychological tests performed but not all, providing support to a multifaceted interaction between cognitive rigidity and perfectionism. With more detail, all AN patients scored poorly on perseverative errors of the WCST, while non-perseverative errors resulted more linked to perfectionism. This finding is in line with literature showing perfectionism as influencing negatively recovered individuals' set-shifting (Lindner et al., 2014). Moreover, RAN-HP resulted significantly slower than RAN-LP on the TMT Time B-A; this finding is interesting as Time B-A represents the time required to perform cognitive set-shifting without considering the time required to perform the control task (Time A). RAN-HP showed significantly longer shifting time than RAN-LP, thus indicating greater difficulty in applying an effective and flexible strategy in cognitive shifting with perfectionism potentially complicating and slowing down RAN patients' set-shifting ability.

Our findings are not in line with previous research (Val & Wade, 2015) reporting an association between TMT scores and perfectionism in an opposite direction; however, different measures have been used to assess perfectionismin fact, clinical perfectionism (as measured by the EDI-2) could have a pejorative role on cognitive flexibility while high personal standards might be interpreted as enhancing cognitive performance.

Similarly, also verbal domains of cognitive rigidity seemed to be partially linked with perfectionism even though statistical significance was not reached between RAN-HP and RAN-LP. This is a novel finding because very few studies investigated the verbal domains of cognitive rigidity (Abbate-Daga et al., 2011; Pignatti & Bernasconi, 2013).

From a clinical point of view, RAN-HP and RAN-LP differed in duration of illness and eating psychopathology but not in BMI. According to these findings, perfectionism resulted indeed

unrelated to malnutrition but rather to AN patients' history and severity. This is consistent with data proposing perfectionism as maintaining factor in AN (Fairburn, Shafran & Cooper, 1999; Schmidt & Treasure, 2006; Lilenfeld, 2011); relatedly, it could potentially increase AN severity and duration (Pignatti & Bernasconi, 2013) In future l'associazione tra perfezionismo, basse performances cognitive, longere duration of illness e maggir sintomatologia psichiatrica potrebbe essere studiata anche in relazione ai tratti autisitic evidenziati in AN (ref,…).

We tested the role of perfectionism as a possible mediator of the association between cognitive rigidity and drive for thinness This hypothesis was then confirmed when the relationship between cognitive rigidity and DT was controlled for perfectionism and such an association did not remain significant. However, caution is required when analyzing this mediation model because of two main reasons: a) only TMT B resulted to mediate this association; b) the mediation effect resulted significant when considering the whole sample (Sobel test p=0.031) but not if only individuals with AN were carried on into the analysis. Considering only patients with AN, perfectionism was significantly associated with DT but set-shifting was unrelated to both DT and perfectionism. On one hand, the sample size could partially explain this discrepancy so studies with more power are needed; notwithstanding, perfectionism would seem to play a partially independent role in the acute stage of AN.

According to our findings, set-shifting and perfectionism resulted to be related factors and this is in line with every-day clinical practice. However, the mediation role of perfectionism should be targeted by future studies. In fact, earlier research (Tchanturia et al., 2004) found that cognitive rigidity in AN was associated with childhood perfectionism but not with perfectionism in adulthood. Similarly to our findings on the AN sample, when eating psychopathology is taken into account, perfectionism and cognitive rigidity seem to have an independent role.

When analyzing these data, some limitations should be borne in mind: first and foremost, perfectionism has been assessed with a unidimensional scale while other instruments could be more detailed in describing perfectionism in a multidimensional way. also, other factors (e.g., anxiety

symptoms) could be taken into account when investigating perfectionism and eating psychopathology. Finally a larger sample would be preferable and AN patients and HCs are not matched with respect to years of education.

A complex and non-exclusive association between set-shifting, eating psychopathology, and perfectionism emerged from this study with perfectionism having a potential mediation role. Treatment approaches have been developed to target such aspects [e.g., cognitive remediation therapy (ref) and perfectionism-focused treatments (Lloyd, Schmidt, Khondoker & Tchanturia, 2015; Tchanturia, Larsson & Adamson, 2016;)] but further research would be recommended to improve the therapeutic armamentarium in this regard.

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Table 1. Demographic, clinical and neuropsychological assessment

		RAN (n=85) Mean(SD)	HC (n=71) Mean(SD)	*Test statistics* t	*p*
Age, years		23.73 (6.68)	24.82 (3.09)	-1.263	0.209
Years of education		11.99 (2.97)	15.52 (2.67)	-7.735	0.001**
Body Mass Index		15.06 (1.89)	20.82 (2.19)	-17.618	0.001**
Duration of illness		6.24 (6.37)	-	-	-
EDI-2	DT	12.54 (7.24)	2.07 (3.97)	10.886	0.001**
	B	2.07 (3.46)	1.01 (2.38)	2.176	0.031*
	BD	13.34 (6.76)	5.48 (5.41)	7.912	0.001**
BDI		13.77 (7.85)	3.12 (3.77)	10.446	0.001**
HSCT	Net Score	3.58 (2.60)	2.32 (1.97)	3.331	0.001**
	Reaction time A	0.502 (0.238)	0.389 (0.233)	2.967	0.003*
	Reaction time B	2.110 (1.632)	1.518 (1.130)	2.570	0.011*
TMT	Time A	40.69 (15.53)	34.05 (9.27)	3.162	0.002*
	Time B	79.12 (31.64)	64.42 (17.24)	3.504	0.001**
	Time B-A	39.28 (26.23)	30.52 (15.10)	2.489	0.014*
	Errors part B	0.28 (0.64)	0.17 (0.41)	1.247	0.214
WCST	Global Score	26.40 (21.14)	16.77 (11.49)	3.434	0.001**
	Perseverations	6.42 (5.01)	4.62 (2.89)	2.686	0.008*
	No perseverative errors	10.07 (10.09)	6.61 (6.32)	2.510	0.013*
	Failure	0.62 (1.32)	0.17 (0.61)	2.676	0.008*

Female AN-R patients and healthy controls; mean and (standard deviation) are provided; statistically significant differences are shown with * if $p<0.05$, and** if $p<0.001$; BMI: Body Mass Index; BDI: Beck Depression Inventory; EDI-2: Eating Disorders inventory-2; DT: Drive for

Thinnes; B: Bulimia; BD: Body Dissatisfaction; WCST: Wisconsin Card Sorting Test; HSCT: Hayling Sentence Completion Task; TMT: Trail Making Test.

Table 2. Neuropsychological performance across groups comparing AN patients with high versus low perfectionism and healthy controls.

		RAN-HP (n=21)	**RAN-LP (n=64)**	**HC (n=64)**	**Test statistics**		
		Mean(SD)	Mean(SD)	Mean(SD)	**F**	***p***	**Bonferroni post-hoc**
HSCT	Net Score	4.05 (2.99)	3.42 (2.46)	2.45 (2.02)	4.662	0.011*	RAN-HP>HC
	Reaction time A	0.508 (0.141)	0.501 (0.263)	0.399 (0.235)	3.354	0.055	-
	Reaction time B	1.850 (1.358)	2.193 (1.711)	1.563 (1.152)	3.017	0.052	-
TMT	Time A	41.90 (13.61)	40.29 (16.19)	34.05 (9.38)	4.685	0.011*	RAN-LP>HC
	Time B	88.95 (39.56)	75.90 (28.20)	64.40 (17.73)	7.650	0.001**	RAN-HP>HC RAN-LP>HC
	Time B-A	50.47 (31.65)	35.61 (23.31)	30.53 (15.45)	6.617	0.002*	RAN-HP>AN-LP RAN-HP>HC
	Errors part B	0.33 (0.79)	0.27 (0.59)	0.17 (0.45)	0.784	0.459	-
WCST	Global Score	27.19 (21.53)	26.14 (21.18)	17.09 (12.01)	4.978	0.008*	RAN-HP>HC RAN-LP>HC
	Perseverations	6.00 (4.75)	6.56 (5.11)	4.77 (2.93)	2.916	0.057	-
	No perseverative errors	12.67 (16.35)	9.22 (6.92)	6.69 (6.63)	3.974	0.021*	RAN-HP>HC
	Failure	0.52 (0.98)	0.66 (1.42)	0.17 (0.63)	3.302	0.040*	RAN-LP>HC

Female AN-HP (high perfectionism), AN-LP (low perfectionism) patients and healthy controls; mean and (standard deviation) are provided; statistically significant differences are shown with * if $p<0.05$, and** if $p<0.001$; WCST: Wisconsin Card Sorting Test; HSCT: Hayling Sentence Completion Task; TMT: Trail Making Test.

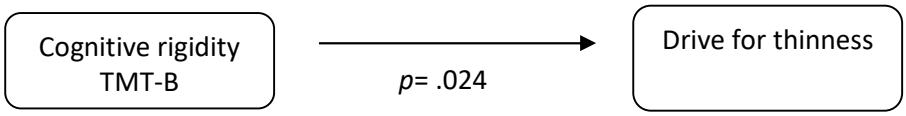
Table 3. Linear regressions of the unmediated and mediated model investigating the relationship between set-shifting and drive for thinness

		DT	
		F (1.148)	***p***
HSCT	Net Score	3.781	0.054
TMT	Time A	2.660	0.105
	Time B	5.166	0.024*
	Time B-A	4.966	0.027*
WCST	Global Score	3.732	0.055
	No perseverative errors	6.061	0.015*
	Failure	1.690	0.196
TMT	Time B[§]	27.384	0.230

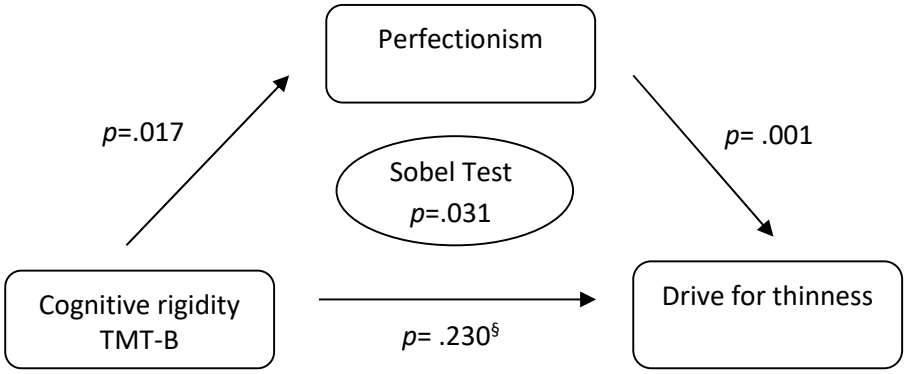
WCST: Wisconsin Card Sorting Test; HSCT: Hayling Sentence Complention Task; TMT: Trail Making Test. F and *p* value of the association between Cognitive Rigidity and Drive for Thinness are given. Statistically significant differences are shown in bold under *p* values. [§]After correcting the model for perfectionism.

Figure 1. Mediation model

A) Unmediated model



B) Mediated model



Representation of the mediation model. A) The direct effect of cognitive rigidity on drive for Thinness is represented, B) The mediator role of perfectionism is shown and Sobel Test is given. §After correcting the model for perfectionism.