Subjective cognitive rigidity and attention to detail: A cross-cultural validation of the Detail and Flexibility Questionnaire (DFlex) in a French clinical sample

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Subjective Cognitive Rigidity and Attention to Detail: a cross-cultural validation of the Detail and Flexibility Questionnaire (DFlex) in a French Clinical Sample.

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Subjective Cognitive Rigidity and Attention to Detail: a cross-cultural validation of the Detail and Flexibility Questionnaire (DFlex) in a French Sample of Anorexia Nervosa Inpatients.

Introduction: People diagnosed with Anorexia Nervosa (AN) are at risk for poor cognitive flexibility and excessive attention to detail. These difficulties are traditionally quantified using neuropsychological tests. These tests do not capture the subjective repercussions of these cognitive styles. The Detail and Flexibility Questionnaire (DFlex) has been specifically developed to measure these repercussions.

The aim of this study was to evaluate the psychometric properties of the French version of this scale (F-DFlex) and to adapt it if needed.

Methods: The instrument factor structure, internal consistency, convergent and discriminant validity were assessed in a sample of 107 French women AN inpatients. For convergent validity, associations between F-DFlex scores, perceived levels of autistic traits (Autism Quotient questionnaire - AQ) and eating disorders symptomatology (Eating Disorder Examination Questionnaire – EDE-Q), as well as neuropsychological evaluations (Wisconsin Card Sorting Test - WCST, Rey Complex Figure - RCF) were tested. Discriminant validity was assessed by comparing F-DFlex scores of the patients with a chronic-versus non-chronic illness.

Results: The results of the exploratory factorial analysis led to the removal of 4 items. Internal consistency indices of this shortened version were good. Correlation coefficients directions and values between F-DFlex factors and relevant AQ Switching and Detail subscores were satisfactory, indicating good convergent validity. F-DFlex Rigidity scores were associated with the WCST percentage of perseverative errors, but the F-DFlex Attention to Detail scores were not associated with the RCF central coherence index. F-DFlex scores were associated with the severity of eating disorders symptomatology independently of BMI, illness duration, or anxiety and depression.

Conclusion: This study indicates good psychometric properties of this new version of the DFlex. The F-DFlex appears as a promising self-report screening tool of important cognitive dimensions for use in clinical management of people diagnosed with AN.

Keywords: anorexia nervosa, set-shifting, central coherence, psychometric properties, F-DFlex

Introduction

Anorexia Nervosa (AN) is a complex and difficult-to-treat illness characterised by the severity of its prognosis. This disorder results from and is maintained by a complex mix of biological, psychological and social factors (Gorwood et al., 2016). Recent models emphasise on factors underlying the pathology, rather than on the core and visible symptoms of AN (Treasure, Lopez, & Roberts, 2007). In this framework, there is growing evidence suggesting that some cognitive difficulties may be critically involved in the development and maintenance of AN and these difficulties have been posited as viable endophenotypes of the disorder (Treasure & Schmidt, 2013).

Cognitive flexibility (also called set-shifting) is a high-level cognitive process that refers to the ability to change (*i.e.* shift) selectively between mental processes or thoughts in consequence to environmental stimuli or demand and to generate appropriate behavioural adjustments (Dajani & Uddin, 2015; Scott, 1962). Such flexible switching is thus a core aspect of self-regulation and poor set-shifting and its clinical correlates (*e.g.* obsessive-compulsive traits and behaviours, perfectionism) may be involved in the vulnerability to eating disorders (Anderluh et al., 2003; Southgate et al., 2005; Tchanturia et al., 2005) and negatively impact patients' outcome (Crane et al., 2007). Several performance-based evaluations are used to capture difficulties in set-shifting, the most commonly used in AN being the Wisconsin Sorting Card Test (WCST, Heaton et al., 1993). Perseverative errors at this test, which occur when participants continue to select a response choice according to a pattern or rule that is no longer relevant, are commonly used to index set-shifting. A first meta-analysis of set-shifting ability in eating disorders has been conducted in 2007, showing that patients diagnosed with AN make more perseverative errors than healthy controls, with a medium effect size (Roberts et al., 2007), a result that has recently been confirmed in a larger meta-analysis gathering 815 patients and 916 healthy controls (Westwood et al., 2016).

Studies also reported that patients recovered from AN made more perseverative errors than healthy controls but less than participants with acute AN (Tchanturia et al., 2012; Tenconi et al., 2010). In addition, worse set-shifting performances were found among unaffected sisters of patients with AN than among healthy controls (Tenconi et al., 2010), supporting the hypothesis that poor set-shifting is an endophenotype in AN.

Excessive detail-oriented information processing, at the expense of global processing of information, is another aspect of cognitive functioning that has been incriminated in AN. Like for set-shifting, several performance-based measures can be used to asses this information processing style, among which the Rey Complex Figure (Osterrieth, 1944; Rey, 1941) is the most widely used. In AN, meta-analyses have already been conducted on this subject and the most recent one (Lang et al., 2016) showed that patients diagnosed with AN presented poorer central coherence at the Rey Complex Figure than healthy controls, with a medium effect size. Unaffected relatives were found to perform similarly than patients diagnosed with AN and more poorly than healthy controls, supporting the hypothesis that weak central coherence is another endophenotype in AN (Kanakam et al., 2013).

Although neuropsychological tests that are classically used to assess these cognitive particularities can provide useful and objective information about cognitive profile, these evaluations present some limitations, *i.e.* they are often time-consuming, lack ecological validity, and may not be sensitive enough to detect subclinical cognitive impairments, as it is the case in AN. Besides objective difficulties, subjective one have been found to influence the patients outcome, as exemplified in the field of Cognitive Remediation Therapy (CRT) in schizophrenia (Prouteau, 2012). A self-report questionnaire has been designed to evaluate perceived set-shifting and central coherence difficulties: The Detail and Flexibility Questionnaire (Roberts et al., 2011). Original items were generated by experienced clinicians and researchers from the Institute of Psychiatry, Maudsley Hospital, London. From an initial set of 54 items, 24 were kept in the final version of the scale on the basis of : first an exploratory factorial analysis, to remove items with weak loadings or which did not conceptually fit their factor; second an item response analysis to remove items that showed poor differentiation between level response. The discriminant validity of the DFlex was established by showing that adults with acute AN endorsed higher scores than people recovered from AN, with a large effect size. Moreover, the recovered AN group endorsed higher scores than healthy controls. Further studies using the DFlex showed that children and adolescents diagnosed with AN reported higher scores on both dimensions than healthy controls, with a large effect size (Lang et al., 2015). In addition, the DFlex is used as an outcome criteria in several studies on the benefits of CRT in AN (see Lindvall Dahlgren and Rø, 2014; Tchanturia et al., 2014 for reviews), a promising therapeutic modality targeting specifically cognitive flexibility and central coherence improvement (Leppanen et al., 2018; Roberts, 2018; Tchanturia, Larsson, & Adamson, 2016; Tchanturia, Larsson, & Brown, 2016). Yet, to the best of our knowledge, there was only one validation study of the DFlex.

The objectives of this study were to evaluate the psychometric properties of the French version of the DFlex, and to test its concomitant validity using not only relevant self-reports but also neuropsychological evaluations.

Material and Methods

Participants

The sample was composed of patients hospitalised for a severe form of AN and participating in a randomised clinical trial (TRECOGAM, ClinicalTrials.gov id: NCT01772394). The study was conducted in compliance with the Good Clinical Practices (ICH-GCP) and Declaration of Helsinki and has been approved by an independent ethics committee (*"Comité de Protection* *des Personnes Ile de France VII”)*. All the participants (as well as their legal representatives in case of minor participants) gave their written informed consent to participate in the study, after the investigator and the clinical trial team had answered all their questions.

Inclusion criteria of the TRECOGAM clinical trial were: (a) women, (b) aged from 15 to 40 years old, (c) hospitalised for AN in one of the four study centres (Institut Mutualiste Montsouris, Paris; Paul Brousse Hospital, Villejuif; Maison des Adolescents – Cochin Hospital, Paris; Clinique Villa Montsouris, Paris), (d) fluent in French. Exclusion criteria were as follows: (a) actual substance abuse disorder, (b) schizophrenic disorder, (c) history of neurological disorder, (d) serious, progressive or life-threatening somatic pathology, (e) neuroleptic or psychotropic treatment at doses causing drowsiness or concentration problems, (f) impaired colour vision, (g) non-affiliation to social security scheme, (h) under guardianship.

Patients were evaluated 3 times during the study: at baseline (T0), 6 weeks later (T1) and after one-year of follow-up (T2) and completed the DFlex at each time point. Out of the 120 AN inpatients that were enrolled, 107 completed the DFlex at T0 and T1, and 91 at T2. Only the 107 participants who fully completed the DFlex at T0 and T1 were selected for the present analyses.

Measures

Detail and Flexibility Questionnaire (DFlex)

The Detail and Flexibility Questionnaire (Roberts et al., 2011) is a self-report questionnaire evaluating two aspects of cognitive profile and their correlates in daily life in patients diagnosed with AN: difficulties in flexibility/cognitive rigidity (12 items) and attention to detail/weak central coherence (12 items). Items are rated on a 6-point Likert scale from 1 (“Strongly disagree”) to 6 (“Strongly agree”). The Rigidity subscale score is obtained by summing up odd numbered items scores and the Attention to Detail subscale score is obtained by summing up even numbered items scores. Subscales scores range from 12 to 72. Higher scores indicate greater perceived difficulties. In the original version, Cronbach's alphas were 0.91 and 0.88 for the DFlex Rigidity and DFlex Attention to Detail respectively.

With the permission of the authors of the original English version, the DFlex was translated in French by a bilingual French-English clinical psychologist working in an eating disorders unit to ensure semantic equivalence. It was then back translated separately by two of the authors (ASM & SB). They were no discrepancies, except for item 22 (*"I depend on others to help me get things into perspective, as I tend to have a rather blinkered view on things in my life"*), the wording of which includes an English expression difficult to translate in French. The final wording of this item was resolved by consensus between the three.

Other Self-report questionnaires

Autism Quotient (AQ, Baron-Cohen et al., 2001; Sonié et al., 2011). The AQ is a 50-item self-report evaluating 5 different traits associated with autism spectrum: Attention Switching, Attention to Detail, Social skills, Communication and Imagination. The level of agreement with each statement is rated on a 4-point Likert scale. In the present analyses, we used the Attention Switching and Attention to Detail subscores to test the convergent validity of each dimension of the DFlex.

Eating Disorders Examination Questionnaire (version EDE-Q-5.2, Fairburn & Beglin, 1994; Peterson et al., 2007). The EDE-Q is a self-report questionnaire composed of 33 mixed-type items (yes/no, 7-point Likert scales and visual analogic scales) evaluating the frequency of eating disorders symptoms during the last 28 days. Four subscores can be computed: Restraint, Eating Concern, Shape Concern and Weight Concern. High scores indicate a higher frequency or clinical severity of eating disorder symptoms.

Hospital Anxiety and Depression scale (HAD, Lépine et al., 1985; Zigmond & Snaith, 1983) includes 14 items rated on a 4-point Likert, with 7 items evaluating the level of depression and the remaining ones the level of anxiety. For each dimension, higher scores indicate higher level of symptoms.

Neuropsychological tests

Rey Complex Figure (RCF, Osterrieth, 1944; Rey, 1941). The RCF is a visuospatial evaluation in which the participant is asked to reproduce the figure while it is in view (copy condition) and again from memory, 20 minutes later, without prior warning (recall condition). A particular scoring has been developed by Savage et al. (1999) and Booth (2006) to assess the strategies used to copy and reproduce the figure. For each condition (*i.e.* copy and recall), a central coherence index can be computed, based on the Order of the construction scores (order in which the different elements of the figure are drawn) and Style scores (continuity of drawing)[1]. Scores range from 0, which results from a detailed approach of the task, to 2, which results from a bigger picture approach.

Wisconsin Card Sorting Test. We used the Wisconsin Card Sorting Test Computerised Version 4 (WCST-CV4 Research Edition, Heaton and Psychological Assessment Resources, 2003). It is a neuropsychological evaluation assessing cognitive rigidity. The objective is to match stimuli cards with one of four category cards. Category cards comprises several stimuli (different colours, shapes and numbers of shapes), each of

[1] See https://www.katetchanturia.com/clinical-work-packages--protocols

them defining a sorting rule, *i.e.* the stimulus card can be matched with the category cards according to either colour, shape or number of shapes. The participant is not aware of the sorting rule and has to discover it, by trial and error, with the help of a feedback (« Right » or « Wrong » on the screen after each sort. After 10 correct sorts, the sorting rule changes and the participant has to discover and adapt to the new one. The test comprises 5 rule shifts (Colour – Shape – Number – Colour – Shape – Number). It ends when the participant has completed 10 correct sorts in each category, or when the 128 cards are sorted. The following parameters were used: card animation move time of 1.5sec; visual feedback (in French) time of 1sec; frame time of 10ms. In the present study, cognitive rigidity is indexed by the percentage of perseverative errors, that is when the participant persists to behave according to a wrong sorting rule. It is considered the most representative index of set-shifting difficulties in AN and is associated with the largest effect size in studies among AN inpatients (Tchanturia et al., 2012; Westwood et al., 2016).

Statistical analyses

Analyses were conducted using R 3.6.1 (R Core Team, 2019) with the following packages: “psy” (Falissard, 2012), “lavaan” (Rosseel, 2012), and “psych” (Revelle, 2015).

Factorial structure

The investigation of the factorial structure of the DFlex was conducted separately for the data available at T0 (N=107) and T1 (N=107). Before proceeding with EFA, to assess sampling adequacy, we used the Kaiser-Meyer-Olkin (KMO) test and the Bartlett’s test of sphericity (Bartlett, 1954; Tabachnick & Fidell, 2007). To assess the bidimensionality of the DFlex, we used parallel analysis (Horn, 1965), i.e. a graphic representation of the eigenvalues with simulated data sets having the same number of variables and subjects. This method is supported by stronger empirical evidence than other methods for determining the number of factors to retain (Fabrigar et al., 1999). EFAs using minimum residual method on the correlation matrix were conducted (R 3.6.1 (2019), packages: “psy” (Falissard, 2012), “psych” (Revelle, 2015)). For factor extraction, we employed Minimum Residuals (MINRES) that uses an ordinary least squares function because it does not require distributional assumptions, is very robust, and can be used with small samples (Zygmunt & Smith, 2014). As the DFLEX items have more than 5 response categories Pearson correlations were used (Izquierdo et al., 2014). An oblique rotation (oblimin) was applied as the factors were expected to be strongly correlated (Tabachnick & Fidell, 2007).

An expert panel, consisting of two research psychologists (ASM and SB) and a statistician (CB), reviewed the results for each factor and discussed which items should be dropped to improve the F-DFlex. Criteria for removal were based on loading value at both time-point (below .20 on the factor they were supposed to belong to in theory and/or above .40 on the factor they were not supposed to belong to in theory) as well as on the clinical importance of the item, readability in French, relevance and redundancy.

Construct validity and reliability

Descriptive analyses (mean, standard deviation, range) were conducted on quantitative socio-demographic and clinical data.

An internal consistency coefficient (Cronbach’s alpha) was computed for each dimension of the scale and was considered acceptable if $0.80 > \alpha \geq 0.70$, good if $0.90 > \alpha \geq$

0.90 and excellent if ≥ 0.90, as proposed for measure instruments in the health field (Tavakol & Dennick, 2011).

Item-total correlations were calculated by Pearson's product-moment correlation coefficients (*r*). The correlation between each individual item and the domain scores omitting the item was assessed. Correlation values above 0.20 between an item and its domain score were considered satisfactory (Kline, 2015). To evaluate whether there were items that measured almost the same construct, inter-item correlations were also calculated.

Construct validity was assessed by searching convergence and divergence with other instruments using Pearson correlation tests using the data available at T1 (N=107). We expected the DFlex Rigidity scores to be positively associated with the AQ Switching scores and – to a lesser extent given the differences between assessment methods (*i.e* subjective versus objective) – with the WCST percentage of perseverative errors. We expected the DFlex Attention to Detail scores to be positively associated with the AQ Detail scores but negatively with the RCF (copy and recall) central coherence index. Here too, we expected the association between the self-report scores (DFlex Attention to Detail/AQ Detail) to be of greater magnitude than the one between the DFlex Attention to Detail and RCF scores given the differences between assessment methods.

To test the discriminant validity of the scale, we used paired t-tests for independent samples and associated effect size (Cohen's *d*) to compare the participants presenting or not a chronic condition and the data available at T1 (N=107). In line with the Cognitive-Interpersonal model of AN that posits that difficulties in central coherence and cognitive flexibility are involved in prolonged course of the disorder (Treasure & Schmidt, 2013), we expected the group with the longest illness duration to endorse greater DFlex Rigidity and Attention to Detail scores. We used 5 years for the cut-off. This choice was based on the evidence that more than 2/3rd of people with AN will reach clinical recovery within 5 years after onset of illness (Keski-Rahkonen et al., 2007).

Regarding the severity of clinical presentation, we expected both DFlex scores to be associated with the EDE-Q scores (positively) but not with BMI.

For the convergent and discriminant validity analyses, self-report scores and neuropsychological tests' performances measured at T1 were used.

Finally, test-retest reliability of the DFlex was assessed by means of intraclass correlation coefficients (ICC) with 95% confidence intervals and based on a single measurement, absolute agreement, two-way mixed effect model (Koo & Li, 2016) between DFlex scores available at T1 and at the last time point of the TRECOGAM study (1 year post-baseline: median = T0+335 days; N=91).

Results

Sample's characteristics

The sample comprised only women aged from 15 to 40 years (mean age=20.5 years; SD=5.9) with a mean illness duration of 4.2 years (SD=5.4), a mean number of previous hospitalization for AN of 2.27(SD=2.23), Mean Body Mass Index (BMI) of 15.59 (SD=1.47) at baseline (T0) and 16.72 (SD=1.57) at T1. Regarding subtype of AN, 78% (N=83) presented a restrictive subtype and 22% (N=24) a binge-purging subtype. The proportion of patients under medication was as follows: Antidepressant 38.3% (N=41), Anxiolytic 54.2% (N=58), Neuroleptic 33.6% (N=36), Hypnotic 13.1% (N=14); 43.9% (N=47) had two treatments or more.

As regards mood and anxiety disorders (evaluated using the Composite International Diagnostic Interview 3.0), the prevalence were : Major depressive disorder: 64.5% (N=69), Generalized Anxiety Disorder: 34.6% (N=37), Social phobia: 28.0% (N=30), Specific phobia: 28.0% (N=30), OCD: 19.6% (N=21), PTSD: 15.0% (N=16).

Exploratory factorial analysis

In order to investigate and improve the factorial structure of the F-DFlex if needed, we conducted EFAs to first identify the number of factors explained and then remove the items that did not perform as expected if necessary.

Sampling adequacy was good both at T0 (KMO=0.82) and T1 (KMO=0.84), confirming the suitability of the EFA. Moreover, in favor of the factorability of the correlation matrix, the Bartlett's test of sphericity reached statistical significance at both time points (T0: $p<0.0001$; T1: $p<0.0001$).

Parallel analysis showed that 2 dimensions emerged whose eigenvalues were, respectively, 7.63 and 1.92 at T0 and 7.28 and 2.09 at T1 (see Figure 1; for the representation of eigenvalues with simulated data sets at T0 and T1).

– Insert Figure 1 about here –

Thus, a two-factor analysis with oblique rotation was performed. Factor loadings of the assumed 2-factor model are presented in Table 1. At both T0 and T1, the majority of the even items (*i.e* DFlex Attention to Detail items) loaded on one factor (Fa), whereas the majority of the odd items (*i.e* DFlex Rigidity) loaded on the other factor (Fb). These two factors explained 56% of the total variance at T0 and 52% at T1.

– Insert Table 1 here –

As regards the Rigidity dimension, following Roberts et al. who removed the items with weak loadings or which did not conceptually fit their factor, we first, decided to drop item 9 (*"I like to make plans about complex arrangements, e.g. journeys and work projects"*) because of its absence of loading on the factor it is theoretically supposed to belong to at both T0 and T1. Moreover, items 7 (*"Once I get into an emotional state, e.g. anger or sadness, it is very difficult to soothe myself"*), 11 (*"I have high levels of anxiety/discomfort: I can see/feel/taste that things might not be quite right"*) and 23 (*"I often feel vulnerable and unsafe as I am unable to see threats (or opportunities) that are out of my field of vision"*) were excluded because of their loadings at both T0 and T1 on the other factor than the one they were supposed to belong to in theory (*i.e.* loaded with the items of the Attention to Detail dimension instead of with those of the Rigidity one). Hence, 8 of the initial 12 Rigidity items were kept for the F-DFlex Rigidity scoring.

As regards the Attention to Detail dimension, item 8 did not load on any of the factors at T1 but had a loading of .54 on the factor it is supposed to belong to at T0. Item 18 loaded at T1 on the other factor than the one it was supposed to belong to in theory (*i.e* with the items of the Rigidity dimension instead of with those of the Attention to Detail one) but had a loading of .46 on the factor it is supposed to belong to at T0. Therefore, all the original Attention to Detail items were kept.

Descriptive statistics and reliability properties of the F-DFlex

Mean, standard deviation, range of the original DFlex (24 items) and of the F-DFlex (20 items, 8 for the F-DFlex Rigidity dimension and 12 for the F-DFlex Attention to Detail dimension) dimensions scores along with other psychometric characteristics (internal consistency, inter-items and item-dimension correlations) at T1 are presented in Table 2.

– Insert Table 2 here –

Skewness values were -0.27 for the F-DFlex Rigidity dimension and -0.18 for the F-DFlex Attention to Detail dimension. Kurtosis values were 2.47 for the F-DFlex Rigidity dimension and 2.60 for the F-DFlex Attention to Detail dimension.

Regarding internal consistency of the F-DFlex, Cronbach's alpha values were 0.86 for the Rigidity dimension and 0.79 for the Attention to Detail dimension.

Average inter-item correlations were 0.45 and 0.24 for the F-DFlex Rigidity and the F-DFlex Attention to Detail respectively.

Average item-dimension correlations were 0.61 and 0.44 for the F-DFlex Rigidity and F-DFlex Attention to Detail respectively.

As these reliability indices were better for the F-DFlex than the DFlex, all the subsequent analyses were conducted on this new version comprising 20 items in total.

Convergent and divergent validity

Mean score and standard deviation for the scales and subscales scores and neuropsychological test performances at T1 are presented in Table 3.

Pearson correlation coefficients between F-DFlex dimension scores, AQ scores and neuropsychological evaluation scores (WCST and RCF) are presented in Table 4.

– Insert Tables 3 & 4 here –

As expected, F-DFlex Rigidity scores were positively and significantly correlated with AQ Switching scores and, to a lesser extent, to WCST percentages of perseverative errors. F-DFlex Attention to Detail scores were positively and significantly correlated to AQ Detail scores. No significant correlation was found between F-DFlex Attention to Detail scores and RCF central coherence index (copy or recall) scores.

Pearson correlation coefficients between the F-DFlex dimension scores, age, BMI, and EDE-Q and HAD scores are presented in Table 5.

– Insert Table 5 here –

F-DFlex and EDE-Q scores were all positively and significantly correlated. Pearson correlation coefficients ranged from 0.24 (EDE-Q Restraint) to 0.39 (EDE-Q Weight Concern) with the F-DFlex Rigidity, and from 0.26 (EDE-Q Restraint) to 0.43 (EDE-Q Shape Concern) with the F-DFlex Attention to Detail. F-DFlex scores were not significantly correlated with age or BMI, but were both positively correlated with HAD Anxiety and Depression scores. As expected, the association between the F-DFlex Rigidity and AQ Switching scores was of greater magnitude (0.76) than with the HAD Anxiety (0.26) and Depression scores (0.22). Conversely, the association between the F-DFlex Attention to Detail and AQ Detail scores was of lower magnitude (0.22) than with the HAD Anxiety (0.32) and Depression scores (0.40).

As HAD scores, BMI and illness duration were also found to be associated with EDE-Q scores, and in line with the study by Wang et al. (2019), we conducted a multiple regression to test whether the relationship between the overall level of cognitive difficulties (F-DFlex total score) and eating pathology (EDE-Q total score) existed independently of anxiety and depression scores, BMI and illness duration. As indexed by the R^2, this model accounted for 52.4% of the total variability of the EDE-Q. Moreover, it showed that when controlling for BMI, HAD, and illness duration, the F-DFlex remained a significant predictor of the EDE-Q score (B=0.019, 95%CI (0.01,0.03) p=0.0015).

Insert Table 6 about here

Discriminant validity

In our sample, using a 5-years illness duration cut-off, 29 participants were classified in the 'chronic AN' group and 75 in the 'non-chronic AN' group.

The between-group comparisons showed that F-DFlex Rigidity scores were significantly higher in the chronic AN group (Mean= 33.59; SD=7.78) than in the non chronic AN group (Mean= 28.64; SD=8.25), (p=.006; d=0.61 [95% CI: 0.17–1.05]). The same pattern of results was observed for the F-DFlex Attention to Detail scores, with significantly higher scores in the chronic AN group (Mean= 43.03; SD=8.52) than in the non chronic AN group 38.45; SD=9.90), (p=.029; d=0.48 [95% CI: 0.04–0.92]).

As regards the 1 year test-retest stability, ICC for the F-DFlex Rigidity dimension was 0.75 [0.66-0.82] (while it was 0.71 [0.62-0.79] for the original DFlex Rigidity score) and ICC for the Attention to Detail dimension was 0.70 [0.60-0.78].

Discussion

The DFlex has been specifically designed to address cognitive particularities in patients diagnosed with AN, namely poor cognitive flexibility and central coherence (Roberts et al., 2011) as perceived in their daily life. These cognitive styles are increasingly incriminated as transdiagnostic difficulties, not only in the various eating disorders (Smith et al., 2018) and in obesity (Raman et al., 2018), but also in other disorders such as ASD (Zhou et al., 2018). This self-report could thus be an interesting tool to better characterize the subjective repercussions of these cognitive difficulties and the wording of the items presents the interest not to be gender-oriented. Besides presenting advantage regarding time and cost of completion for both the patients and the clinical staff, evaluations of the subjective health status are increasingly considered as necessary (World Health Organization, 2001). This is well illustrated among people suffering from schizophrenia, with an increasing number of studies suggesting that perceived difficulties impact the response to cognitive remediation (Medalia & Saperstein, 2011; Moritz et al., 2018). This could be the case in AN as well, and such results foster the need for the development of a reliable instrument to evaluate these difficulties in AN. Yet, to our knowledge, the development and validation study of the DFlex conducted by Roberts et al. (2011) is the only one that tested the psychometric properties of the scale.

The present study was thus designed to investigate the psychometric properties of the French version of the DFlex in a sample of women hospitalised for AN.

The F-DFlex, which dropped four items from the original version of the scale, provided satisfactory psychometric properties in our clinical sample of adolescents and adults diagnosed with severe AN. As in the Roberts et al. (2011) study, psychometric properties of the Rigidity subscale of the F-DFlex appeared stronger than those of the Attention to Detail subscale.

Reliability indices of this 20-item version of the scale were satisfactory. Cronbach's alpha were slightly below those reported for the original version (for the Rigidity dimension: 0.86 in our study vs. 0.91 in that of Roberts et al. (2011) ; for the Attention to Detail dimension : 0.79 in our study vs. 0.88 in that of Roberts et al. (2011)) but remained above the recommended cut-off of 0.70 for acceptable reliability (Tavakol & Dennick, 2011). Average item-dimension correlations were also above the recommended cut-off of 0.20 (Kline, 2015), suggesting the items were measuring the same construct. Average inter-items correlations values were comprised between 0.22 and 0.43, falling within the suggested range of values suggested by Clarke and Watson (1995) for acceptable internal consistency (*e.g.* between 0.15 and 0.50). Results indicated that items were relatively homogeneous but presented sufficient unique variance not to be redundant with one another. Reliability indices were better for the Rigidity dimension than the Attention to Detail dimension. As regards the test-retest reliability, after on average 11 months and 11 days, ICC were found to be good for the F-DFlex Rigidity dimension and at the upper range of a moderate stability for the F-DFlex Attention to Detail dimension.

Moreover, in favour of the instrument's satisfying construct validity, we observed the expected associations between the F-DFlex Rigidity and AQ Switching scores and F-DFlex Attention to Detail and AQ Detail scores. Correlation coefficient values between F-DFlex and AQ scores were comparable to those found by Roberts et al. (2011), with a strong positive association between F-DFlex Rigidity and AQ Switching scores (r=0.76 in our study, r=0.72 in that of Roberts et al.) and a moderate positive association between F-DFlex Attention to Detail and AQ Detail scores (r=0.22 in our study, r=0.26 in that of Roberts et al. (2011)). However, construct validity indices were better for the Rigidity dimension than the Attention to Detail dimension as for this dimension convergent correlations (i.e F-DFlex Attention to detail and AQ Detail) were not higher than the discrimant ones (i.e F-DFlex Attention to detail and HAD scores).

Regarding associations between F-DFlex and neuropsychological scores, results were mixed.

While modest in comparison to the magnitude of the association between the F-DFlex Rigidity dimension and AQ Switching scores, the significant positive correlation between the

F-DFlex Rigidity dimension and the percentage of perseverative errors at the WCST is a strong indicator of the convergent validity of this subscale. Conversely, there was no association between the F-DFlex Attention to Detail and RCF central coherence index. It should be noted that the difference between methods of assessment (subjective vs. objective) often leads to an absence of correspondence between scores, not only in AN (Lounes et al., 2011; Stedal & Dahlgren, 2015), but also in other pathologies (Byrne et al., 2017; Schwert et al., 2018; Serra-Blasco et al., 2018; Srisurapanont et al., 2017), as well as in healthy controls (Schwert et al., 2018). Therefore, our results are consistent with the idea that objective and subjective evaluations should be considered complementary but are not interchangeable (Lounes et al., 2011). This being said, although the RCF is currently the most widely used objective measure of central coherence in AN, it does not consider the fact perceptual processing has different components: global and local processing and the balance between the two. With this in mind, a recent study used a task allowing to examine these independent aspects of central coherence (Weinbach et al., 2017). The results of this comparative study of 18 weight-restored AN adolescents and 22 healthy controls, which used an arrow-version of the Navon task (Navon, 1977), were threefold. Weinbach et al. (2017) showed first that both groups were faster in processing global information than local information. Moreover, the clinical group was not only better at ignoring an irrelevant bigger picture while attending to details (*i.e* smaller global interference), but also had greater difficulty ignoring details when they were task-irrelevant (*i.e* larger local interference). Future research is needed to replicate these findings, and the optimal design would be to include several objective tests (such as the RCF and the Embedded Figure Test (EFT; Witkin et al., 1971) in addition to the Navon task, as well a subjective evaluation with the DFlex. From a psychometric perspective, such a study could help to improve the DFlex Attention to Detail dimension by guiding the rewording or new formulation of some items. In this respect, because we observed stronger associations between the Attention to detail and HAD scores than between the Rigidity and HAD scores, efforts could be made so that the Attention to detail items relate more to the cognitive style itself than the emotional difficulties it entails. From a clinical stand, this could help to better understand which components of central coherence impacts the modulation of caloric intake, weight management and body shape preoccupations and, in turn, how to target these neurocognitive symptoms more efficiently in cognitive remediation therapy.

Indeed, regarding the associations with the level of perceived clinical eating disorder symptoms, our study showed positive associations between both F-DFlex dimensions and all the facets of the EDE-Q. Due to the lack of literature on this issue, we are unable to compare directly this result with that of other studies. Of interest, in the Wang et al. (2019) study among adolescents with different eating disorders, both DFlex scores we associated with the severity of eating pathology (i.e with EDE, Clinical Assessment and Body checking questionnaire scores). Moreover, in the Weinbach et al. (2017) study, greater local interference (irrespective of the group) was associated with higher levels of perceived symptomatology (eating disorders : EAT-26 and EDI-2 total scores; body dissatisfaction : BSQ total score). Such associations were not found using the global interference score. Although not the goal of the present study but following these results, we checked whether the RCF central coherence index scores were associated with the EDE-Q scores in our sample. At the recall condition (but not the copy), lower central coherence was associated with greater EDE-Q Restraint and Eating scores (r=0.20, $p<0.05$ for both associations). On the basis of our results and that of Weinbach et al. (2017) among weight-restored AN adolescents, one can speculate that irrespective of starvation, central coherence and cognitive flexibility may play a role in the severity of the clinical presentation in AN, but future studies are required to confirm this suggestion and specify whether this is a direct or indirect effect.

Unlike for eating disorder symptoms, we found no associations between the nutritional status (BMI) and the F-DFlex dimensions. To the best of our knowledge, neither the study of Roberts et al. (2011) nor the studies on the impact of cognitive remediation therapy for AN evaluated the association between subjective cognitive profile as measured by the DFlex and BMI. As our sample comprised women diagnosed with severe AN, additional studies including a larger number of people and with a broader range of levels of undernutrition should help to clarify this issue. This being said, the observed lack of association is in line with the suggestion that cognitive styles in AN can be increased but not explained solely by undernutrition or repeated episodes of malnourishment, and with the results of several studies showing that neurocognitive symptoms in AN are independent of nutritional status, using either the WCST (Abbate-Daga et al., 2011, 2014; Galimberti et al., 2013; Lang et al., 2015; Roberts et al., 2010; Tenconi et al., 2010) or other performance measures of set-shifting, *i.e.* Brixton task (Tchanturia et al., 2011) and of central coherence (Lang et al., 2015; Lopez et al., 2009; Tenconi et al., 2010).

Finally, the results of the comparison of the participants depending on their illness duration and the associated effect sizes (large for both DFlex dimensions) were in favour of the DFlex good discriminant power, with greater Rigidity and Attention to Detail scores in the subgroup with an illness duration of 5 years or more.

One major strength of our study is that it is the first to evaluate the validity of the DFlex with performance-based instruments (*i.e* WCST for set-shifting and RCF for central coherence). Moreover, of an important note, the overall level of cognitive difficulties and of eating pathology (*i.e.* F-DFlex and EDE-Q total scores) were associated independently of the illness duration, BMI and the level of dysphoric affects. However, it presents some limitations. Given the particular nature of our sample (inpatients) and as the size of our sample did not allow to divide the sample to have a training subsample for the EFA and a replication subsample for the CFA, further studies are needed to replicate its factorial structure, including among patients with less severe AN (*i.e.* outpatients and/or inpatients with mild and moderate weight status severity). Moreover, we did not have the opportunity to compare the results of our sample with a healthy control population, neither with a group of people recovered from AN, as conducted in the validation study of the original version of the scale. In addition, the shortened version of the DFlex we propose was based on the responses of French women with AN, and it will be necessary to establish that it behaves similarly in people from different culture, *i.e* to evaluate the cultural measurement invariance of the F-DFlex. Additional studies among unaffected relatives of patients with AN could test whether subjective evaluations of cognitive flexibility and central coherence might be endophenotypes of AN, as already shown with objective measures of cognitive difficulties.

Conclusion

This new version of the DFlex (F-DFlex) has good psychometric properties and may be a valuable simple assessment tool for use in routine clinical practice with patients diagnosed with AN. Replication studies, notably on its factorial structure and relationship to additional objective cognitive measures, and investigating its predictive power of cognitive remediation treatment outcome are needed.

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Disclosure of interest

The authors report no potential conflict of interest.

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Supplemental online material

French version of the Detail and Flexibility Questionnaire (F-DFlex)

Table 1. Factor loadings of the original version of the DFlex conducted at T0 (N=107) and T1 (N=107).

	Loadings			
DFlex items	T0		T1	
	Fa	Fb	Fa	Fb
1	**0.41**	0.00	**0.60**	-0.03
3	**0.91**	-0.13	**0.73**	-0.01
5	**0.45**	0.35	**0.59**	0.13
7	0.17	*0.44*	0.18	*0.47*
9	0.14	-0.02	0.07	*-0.30*
11	-0.14	*0.68*	-0.16	*0.47*
13	**0.42**	0.33	**0.60**	0.11
15	**0.40**	0.04	**0.48**	0.03
17	**0.53**	0.15	**0.43**	0.33
19	**0.72**	0.14	**0.88**	-0.03
21	**0.52**	0.19	**0.73**	-0.04
23	0.08	*0.52*	0.01	*0.56*
2	0.08	**0.40**	-0.28	**0.55**
4	0.16	**0.26**	-0.02	**0.36**
6	-0.21	**0.66**	0.07	**0.43**
8	-0.04	**0.54**	0.10	0.15
10	0.10	**0.53**	0.12	**0.49**
12	0.01	**0.71**	0.04	**0.68**
14	0.10	**0.66**	0.22	**0.55**
16	0.15	**0.42**	0.01	**0.57**
18	0.33	**0.46**	*0.54*	**0.28**
20	0.30	**0.46**	0.21	**0.46**
22	0.05	**0.55**	0.16	**0.43**
24	-0.04	**0.43**	-0.19	**0.43**

Italics: items loading on the other DFlex dimension than the one they are expected to load on.

Table 2. Descriptive scores and reliability properties of the original version of the DFlex (24 items) and of the F-DFlex (20 items).

	DFlex and F-DFlex		
	DFlex Rigidity (12 items)	**F-DFlex Rigidity (8 items)**	**DFlex Attention to Detail (12 items)**
Mean (SD)	44.89 (9.86)	29.98 (8.39)	39.69 (9.72)
Median (IQR)	45 (38-52)	30 (24–37)	40 (32-46)
[Min – Max]	25-66	8–44	15-64
Cronbach's alpha	0.81	0.86	0.79
Average Inter-item correlations (SD)	0.27 (0.21)	0.45 (0.10)	0.24 (0.13)
Median (Range) Inter-item correlations	0.30 (0.15–0.39)	0.43 (0.38–0.52)	0.22 (0.16–0.33)
[Min–Max]	-0.17–0.69	0.26–0.69	-0.08–0.50
Average Item-dimension correlations (SD)	0.47 (0.24)	0.61 (0.09)	0.44 (0.15)
Median (Range) Item-dimension correlations	0.56 (0.42–0.59)	0.62 (0.56–0.64)	0.47 (0.29–0.53)
[Min–Max]	-0.13–0.71	0.48–0.77	0.20–0.64

DFlex: Translation of the original version of the Detail and Flexibility Questionnaire (24 items); F-DFlex: French version of the Detail and Flexibility Questionnaire (20 items); SD: Standard deviation; IQR: Interquartile range; Min: Minimum; Max: Maximum

Table 3. Descriptive statistics for the AQ, EDE-Q, HAD, WCST and RCF scores (T1 ; N=107).

	Mean (SD)
AQ Switching	4.38 (2.33)
AQ Detail	4.83 (2.02)
EDE-Q Restraint	1.29 (1.41)
EDE-Q Eating Concern	1.75 (1.3)
EDE-Q Shape Concern	3.21 (1.73)
EDE-Q Weight Concern	2.38 (1.54)
EDE-Q Total score	2.16 (1.34)
HAD-Depression	5.54 (3.56)
HAD-Anxiety	8.64 (3.89)
WCST %Perseverative errors	8.22 (5.13)
RCF CC Index - Copy	1.66 (0.18)
RCF CC Index - Recall	1.53 (0.26)

SD: Standard deviation; AQ: Autism Quotient questionnaire; EDE-Q: Eating Disorders Examination Questionnaire; HAD : Hospital Anxiety and Depression scale ; WCST: Wisconsin Card Sorting Test; RCF CC Index: Rey Complex Figure Central Coherence Index

Table 4. Pearson correlation coefficients between the F-DFlex, and AQ, WCST and RCF scores.

	F-DFlex Rigidity	F-DFlex Attention to Detail	AQ Switching	AQ Detail	WCST % of Pers. Errors	RCF CC Index - Copy	RCF CC Index - Recall
F-DFlex Rigidity	*1*	0.59 ***	0.76 ***	0.26 **	0.24 *	-0.04	-0.14
F-DFlex Attention to detail		*1*	0.62 ***	0.22 *	0.15	0.03	-0.13
AQ Switching			*1*	0.18	0.17	0.05	-0.17
AQ Detail				*1*	0.17	0.00	-0.01
WCST % of Pers. Errors					*1*	0.00	-0.18
RCF CC Index - Copy						*1*	0.53 ***
RCF CC Index - Recall							*1*

*F-DFlex: French version of the Detail and Flexibility Questionnaire (20 items); AQ: Autism Quotient questionnaire; WCST: Wisconsin Card Sorting Test; % Pers. Errors: Percentage of Perseverative errors; RCF CC Index: Rey Complex Figure Central Coherence Index; ***: p<.001; **: p<.01; *: p<.05*

Table 5. Pearson correlation coefficients between the F-DFlex, BMI and EDE-Q scores.

	Age	BMI	HAD Depression	HAD Anxiety	EDE-Q Restraint	EDE-Q Eating Concern	EDE-Q Shape Concern	EDE-Q Weight Concern
F-DFlex Rigidity	0.07	-0.02	0.22*	0.26*	0.24*	0.27**	0.36***	0.39***
F-DFlex Attention to detail	0.03	-0.12	0.32**	0.40***	0.26**	0.34***	0.43***	0.38***

*F-DFlex: French version of the Detail and Flexibility Questionnaire (20 items); BMI: Body Mass Index; HAD: Hospital Anxiety and Depression scale ;EDE-Q: Eating Disorders Examination Questionnaire; ***: p<.001; **: p<.01; *: p<.05*

Table 6. Multiple regression predicting the EDE-Q total score

	Estimate	IC95%	p
BMI	0.060	-0.06 ; 0.18	0.3182
Illness duration	-0.063	-0.10 ; -0.03	0.0007
HAD Depression	0.101	0.03 ; 0.17	0.0039
HAD Anxiety	0.139	0.08 ; 0.20	<0.0001
F-DFlex total	0.019	0.01 ; 0.03	0.0015

F-DFlex: French version of the Detail and Flexibility Questionnaire (20 items); BMI: Body Mass Index; HAD: Hospital Anxiety and Depression scale; EDE-Q: Eating Disorders Examination Questionnaire

Figure 1. Scree plots on the original DFlex data at T0 (N=107; left handside) and T1 (N=107; right handside)