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ASSESSMENT

Relevance of the Thought–Shape Fusion Trait Questionnaire for healthy women and women presenting symptoms of eating disorders and mixed mental disorders

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Thought–shape fusion (TSF) describes the experience of marked concerns about body weight/shape, feelings of fatness, the perception of weight gain, and the impression of moral wrongdoing after thinking about eating fattening/forbidden foods. This study sets out to evaluate the short version of the TSF trait questionnaire (TSF).

The sample consists of 315 healthy control women, 244 women with clinical and subthreshold eating disorders, and 113 women with mixed mental disorders (mixed). The factor structure of the TSF questionnaire was examined using exploratory and subsequent confirmatory factor analyses.

The questionnaire distinguishes between a *Concept scale* and a *Clinical Impact scale*. However, a lack of measurement invariances refers to significant differences between groups in terms of factor loadings, thresholds, and residuals, which questions cross-group validity.

Results indicate that the concept is understood differently in the 3 groups and refers to the suitability of the questionnaire primarily for individuals presenting with symptoms of eating disorders.

KEYWORDS

cognitive distortions, confirmatory factor analysis, eating disorders, thought–shape fusion, women

1 | INTRODUCTION

The phenomenon of *thought–shape fusion* (TSF) has been described as a specific cognitive distortion in eating disorders (EDs; Shafran, Teachman, Kerry, & Rachman, 1999) based on the findings of *thought–action fusion* (TAF; Shafran & Rachman, 2004; Shafran, Thordarson, & Rachman, 1996) in individuals with obsessive–compulsive disorder (OCD). It has been shown that TAF and TSF are highly correlated in clinical samples of patients suffering from an ED as well as in healthy controls (HCs; Coelho, Carter, McFarlane, & Polivy, 2008; Coelho, Ouellet-Courtois, Purdon, & Steiger, 2015; Jauregui Lobera, Santed, Shafran, Santiago, & Estébanez, 2013). Nevertheless, the two concepts distinguish between EDs and OCD as patients suffering from OCD were not more susceptible to TSF than HCs (Coelho, Baeyens, Purdon, Pitet, & Bouvard, 2012).

Transferring the TAF concept to the ED domain, TSF involves that undesirable thoughts about food and weight increase the feeling of fatness and concerns about weight gain. At a theoretical level, three factors were assumed to represent the concept of TSF: *likelihood* (the thought makes weight gain more likely), *moral* (the thought is morally wrong), and *feeling* (the thought evokes feelings of fatness). However, this three-factor structure was not supported in initial evaluations of the measure (Shafran et al., 1999). Consequently, Coelho, Baeyens et al. (2013) introduced a short version of the questionnaire consisting of a unifactorial *Concept scale* with good internal consistency and convergent validity. The authors suggested further a *Clinical Impact scale*, to approximate the clinical relevance of such food-related thoughts.

Prior questionnaire- and laboratory-based research underlines the relevance and specificity of the TSF concept in EDs. Higher TSF trait values were found in individuals suffering from anorexia nervosa or bulimia nervosa compared with HCs and a clinical control sample of patients with OCD (Coelho, Baeyens, et al., 2012). Furthermore, women with EDs were more susceptible than HCs to the induction of TSF in the laboratory where participants were asked to think about fattening/forbidden foods and to imagine eating large amounts of these foods (Coelho et al., 2015). In contrast, overweight adult and adolescent females have shown to be less susceptible to a TSF induction than normal-weight individuals (Coelho, Jansen, & Bouvard, 2012; Coelho, Siggen, Dietre, & Bouvard, 2013).

Based on existing laboratory studies, it can be assumed that TSF is triggered by thinking about fattening/forbidden food, which likely increases a distorted self-perception. TSF is highly clinically relevant as it is not only a cognitive phenomenon but is also associated with behavioural consequences such as body checking or attempts to neutralize the undesirable thought (e.g., Coelho et al., 2008; Coelho et al., 2015; Coelho, Baeyens, et al., 2012; Coelho, Roefs, & Jansen, 2010; Kostopoulou, Varsou, & Stalikas, 2013). Moreover, there are preliminary data revealing associations between ED symptoms including cognitive distortions and correlates of functional dyspepsia (Jauregui Lobera, Santed, & Bolanos Rios, 2011).

In this line, it has been shown in a cross-sectional study that TSF partially mediates the association between body dissatisfaction and ED pathology in healthy men (Wyssen, Bryjova, Meyer, & Munsch, 2016) and women (Wyssen, 2015). Body dissatisfaction in turn is related to negative affect and represents an important trigger and maintenance factor of EDs (Stice, Gau, Rohde, & Shaw, 2017). Preliminary evidence additionally indicates that TSF can be positively influenced by ED-specific therapeutic interventions in treatment-seeking samples (Coelho et al., 2014). Additionally, recent laboratory studies found that cognitive distortions can also be induced by the imagination of thin ideals in women (Wyssen, Coelho, Wilhelm, Zimmermann, & Munsch, 2016).

The growing evidence supports the role of TSF as a relevant feature of EDs with negative emotional and behavioural sequelae, even though the *Clinical Impact scale* has not yet been validated. Furthermore, there is only few data on the specificity of TSF for EDs (Coelho, Baeyens, et al., 2012).

Therefore, the aim of this study was twofold: First, we aimed at examining the factor structure of the TSF trait questionnaire including the *Concept* and the *Clinical Impact scales* (according to the short version of Coelho, Baeyens, et al., 2013) in a sample of healthy women, women with EDs, and mixed mental disorders. We hypothesize to replicate the proposed factor structure of Coelho et al. (2013) and expect the best fit for a two-factorial solution. Furthermore, we explore configural invariance in different samples to be able to make more differentiated statements about the suitability and relevance of TSF for different diagnostic groups. Second, we aimed at examining validity of the TSF questionnaire. We expect the TSF questionnaire to discriminate between diagnostic groups, with most pronounced values in the ED group. In terms of convergent validity, we expect higher TSF levels to be associated with higher ED pathology.

Key Practitioner Message:

- The factor structure of the short version of the thought–shape fusion (TSF) trait questionnaire has been confirmed with the German version; the questionnaire is thus feasible to apply and consists of a *Concept scale* and a *Clinical Impact scale*.
- The two-factorial TSF questionnaire demonstrated high reliability and good convergent validity. Patients suffering from an eating disorder showed significantly higher values on TSF trait than healthy controls and the clinical control group.
- A lack of measurement invariance questions cross-group validity of TSF. TSF assessment may be most reliable with individuals who report some degree of eating disorder symptoms, further supporting the specificity of this cognitive distortion.

2 | METHODS

2.1 | Participants

Data were obtained from 714 female participants, who took part in substudies related to a multicentre study in different clinical and

research units in Switzerland and Germany (for the design of the main study, see Munsch, 2014). Thirty-nine participants (5.5%) dropped out before completion of data assessment. Three more participants were excluded from analyses since values on the TSF scale were missing. Of the remaining 672 participants, 315 did not meet the criteria of any *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-5), diagnosis (American Psychological Association, 2013) and were termed HCs, 244 participants were identified as having a threshold or subthreshold ED (*n* = 77 threshold anorexia nervosa; *n* = 53 threshold bulimia nervosa; *n* = 30 threshold binge-eating disorder; *n* = 84 subthreshold ED), and 113 participants were assigned to the mixed group (*n* = 28 threshold depressive disorder; *n* = 23 threshold anxiety disorder; *n* = 62 subthreshold depressive disorder or anxiety disorder or other). Participants' mean age was 23.87 years (*SD* = 5.24). Sixty percent of the participants were Swiss, 37% were German, and 3% reported another nationality.

2.2 | Measures

2.2.1 | Diagnostic Interview for Mental Disorders

Either the "Diagnostisches Interview für Psychische Störungen" (DIPS; Schneider & Margraf, 2011) or its short version (Mini-DIPS; Margraf & Cwik, 2015) was used to assess mental disorders according to the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (American Psychological Association, 2013). Interviews were conducted by trained graduate students, either face to face or through telephone. Both interviews have shown good psychometric properties for assessing mental disorders. The accordance between diagnoses with the DIPS and the Mini-DIPS is high (Margraf, Cwik, Pflug, & Schneider, 2017).

2.2.2 | Thought–Shape Fusion Trait Questionnaire—German short version (TSF)

To assess TSF, the short version from Coelho et al. (2013) was translated into German and back-translated. The final version includes 13 items capturing the *Concept scale* and an extended *Clinical Impact scale* (asking about the frequency, impact, importance of suppression, and uncontrollability of TSF-like thoughts) comprising seven items. Items are rated on a 5-point Likert scale ("How much do you agree with the following statement?" 0 [*not at all*], 1 [*slightly*], 2 [*moderately*], 3 [*very much*], 4 [*totally/always*]). Except for two items of the *Clinical Impact scale*, which ask for details about the frequency of thoughts (number of hours per day and number of days per week). The French short version by Coelho, Baeyens, et al. (2013) demonstrated good psychometric properties and high reliability with a Cronbach's α of .92 for the *Concept scale*. Psychometric properties of the German version (TSF) are reported in Section 3. The full German version of the Thought-Shape Fusion Trait Questionnaire is available online as supplementary material.

2.2.3 | Eating Disorder Examination Questionnaire

ED psychopathology was assessed by the 28-item self-report questionnaire Eating Disorder Examination Questionnaire (German version; Hilbert & Tuschen-Caffier, 2006). Besides a global score, four subscales (restraint eating, eating concern, weight concern, and shape concern) were calculated. In the present sample, the Cronbach's α of the global score was .97.

2.2.4 | Beck Depression Inventory

This 21-item questionnaire was employed to assess the severity of depressive symptoms during the previous 2 weeks (German version; Hautzinger, Keller, & Kuehner, 2009). For the present sample, a Cronbach's α was .95 was obtained.

2.3 | Procedure

After the diagnostic interview in a face-to-face setting (DIPS) or via telephone (Mini-DIPS), participants received a link and were asked to complete a set of online questionnaires. The diagnostic interview took between 60 and 90 min for the DIPS or around 30 min for the Mini-DIPS, whereas the completion of the questionnaires took approx. 40 min. Monetary compensation or class credits were offered for participation. All studies were conducted in German. Local ethics committees approved the study protocols.

2.4 | Statistical analyses

Cases with missing items values were removed, resulting in overall 672 subjects. The two highest response options on the TSF questionnaire (Scores 3 [*very much*] and 4 [*totally/always*]) were lumped together into a single response option as the highest score (4) was not commonly chosen by a significant portion of participants (only 0.3% of HCs, 0.8% of mixed, and 16.6% of ED have chosen this response option). Thus, the ordinal scale for which all analyses were performed ranged from 0 to 3. We first performed exploratory factor analysis (EFA) based on a polychoric correlation matrix and a weighted least squares estimator due to the ordinal nature of the items, using oblique rotation (promax) (Brown, 2006). Parallel analysis was conducted to determine the number of meaningful factors. Analyses were performed for each of three groups (HC, ED, and mixed) separately. Confirmatory factor analysis (CFA) was used to test for the factorial structure of the construct consisting of two latent factors. Items 4 ("I feel huge if I just imagine not exercising for a month.") and 5 ("Just thinking about not exercising for a month makes me want to cut down on what I eat.") were always allowed to correlate to improve model fit. These analyses were conducted for each group individually, as well as for the total sample in order to assess measurement invariance (i.e., the degree to which the structure of the TSF differs across the three groups). Measurement invariance was tested using the approach suggested by Millsap and Yun-Tein (2004) and implemented in Pornprasertmanit (2017).

To test whether the TSF questionnaire differed in manifestation of values between the three diagnostic groups, we additionally conducted a one-way multifactorial analysis of variance (MANOVA) with the factor groups (HC, ED, and mixed) and the two TSF trait subscales as dependent variables. Because variables were not normally distributed, the scales were log-transformed. Bivariate correlations were performed to examine convergent validity (Pearson's correlation). Alpha was set at .05. Effect sizes (Cohen's η^2) were calculated for MANOVAs.

3 | RESULTS

3.1 | Sample characteristics

Sample characteristics of the assessed variables are listed in Table 1.

3.2 | Factor structure and measurement invariance across groups

EFA suggested a six-factor (HC), three-factor (ED), and two-factor solutions (mixed). Fit indices are shown in Table 2. However, factors beyond 2 in the HC and ED groups were not well defined (too few items with high loadings). In addition, an EFA performed across all three groups suggested a two-factor solution. We therefore ran CFA based on two factors, which were corresponding with the two factors proposed in previous studies (Coelho, Baeyens, et al., 2013). Fit indices based on CFA are shown in Table 2 and were good for the mixed group and satisfactory for the HC and ED groups. Correlations between the two factors ranged between .60 (ED) and .87 (mixed).

Comparing all three groups suggested weak invariance, that is, equal magnitude of loadings but differing magnitudes of thresholds and residuals across groups. Additional analyses comparing only two groups at a time revealed configural invariance between HC and ED groups, strict invariance between HC and mixed groups, and weak invariance between ED and mixed groups. We therefore assessed measurement invariance based on previously log-transformed items, assuming that they were obtained on a metric rather than on an ordinal scale. This approach eliminated nonconvergence problems. Results suggested configural invariance among the three groups, between HC and ED, and between ED and mixed, and weak invariance between HC and mixed.

3.3 | Internal consistency and construct validity

Internal consistencies (Cronbach's α) in the three groups HC, ED, and mixed were .90, .95, and .93 for the *Concept scale*, and .81, .87, and .88 for the *Clinical Impact scale*, respectively.

MANOVA revealed that women in the ED group had higher TSF values on the *Concept scale* (*M* = 21.93, *SD* = 14.70) and *Clinical Impact scale* (*M* = 11.49, *SD* = 5.11) than in the HC (*Concept scale*: *M* = 3.90, *SD* = 5.75; *Clinical Impact scale*: *M* = 2.65, *SD* = 2.89) and the mixed groups (*Concept scale*: *M* = 6.08, *SD* = 8.19; *Clinical Impact scale*: *M* = 3.93, *SD* = 3.77). Results for the two scales were (log-transformed variables): *Concept scale*, $F(2, 669) = 217.66$, $p < .001$, $\eta^2 = .39$; *Clinical Impact scale*, $F(2, 669) = 247.82$, $p < .001$, $\eta^2 = .43$.

Correlations between the two TSF scales and general psychopathology (Beck Depression Inventory) and ED psychopathology (Eating Disorder Examination Questionnaire) are shown in Table 3. In post hoc analyses, no differences were found between bulimic and restrictive types of EDs; in both subgroups, the TSF *Concept* and *Clinical Impact scales* were significantly correlated with ED pathology and depressiveness ($r \geq .31$, $p < .01$).

4 | DISCUSSION

The aim of this study was to investigate factor structure of the TSF trait questionnaire in different samples (HCs, EDs, and mixed) and to address the issue of configural invariance. We anticipated to find the two-factorial structure as proposed by Coelho et al. (2013). In addition, we aimed at examining validity of TSF. We expected that TSF would differentiate between diagnostic groups (with being most pronounced in EDs) and would be associated with more pronounced ED pathology.

EFA and CFA resulted in the expected two-factorial solution (*Concept* and *Clinical Impact scales*), as proposed in the validation of the short version of the TSF trait questionnaire (based on a French translation of the measure; Coelho, Baeyens, et al., 2013). The present two-factorial TSF questionnaire demonstrated high reliability and good convergent validity. In accordance with our hypotheses, the ED group showed significantly higher values on both scales than the HC and the mixed groups. Values were comparable to findings of Coelho et al. (2013) and Ouellet-Courtois, Coelho, Radomsky, Israël, and Steiger (2015). However, the EFA pointed to different number of factors for the three groups, which indirectly refers to nonconfigural invariance and thus to a potential limitation of this measure (De Roover, Timmerman, De Leersnyder, Mesquita, & Ceulemans, 2014). The findings suggest that the structure and the meaning of the measurement model differ especially between the ED group and the other

TABLE 1 Sample characteristics

	HC *M* (*SD*)	ED *M* (*SD*)	Mixed *M* (*SD*)	Statistics[a] *F*	*p*
Age	*n* = 313	*n* = 244	*n* = 113		
	23.43 (5.06)	24.42 (5.79)	24.05 (4.37)	2.36	.096
BMI	*n* = 315	*n* = 243	*n* = 112		
	21.60 (2.92)	21.61 (5.25)	22.69 (4.31)	3.05	.049
BDI-II	*n* = 315	*n* = 244	*n* = 113		
	4.18 (4.27)	20.83 (13.31)	13.53 (11.26)	203.87	<.001
EDE-Q global	*n* = 315	*n* = 244	*n* = 113		
	0.70 (0.66)	3.44 (1.39)	1.11 (0.88)	408.75	<.001

Note. HC = healthy control group; ED = eating disorder group; mixed = mixed mental disorder group; *M* = mean; *SD* = standard deviation; BMI = body mass index; BDI-II = Beck Depression Inventory; EDE-Q = Eating Disorder Examination Questionnaire.

[a]One-way analysis of variance between diagnostic groups, *df* age (2,298.58), *df* BMI (2,262.43), *df* BDI-II (2,227.48), *df* EDE-Q (2,268.45); because analyses showed a violation of the assumption of homogeneity of variances, results of the Welch *F* test were reported.

TABLE 2 Results from exploratory (EFA) and confirmatory factor analyses (CFA) of the TSF across three groups

18 TSF items, scale range after regrouping: 0–3	Healthy controls *n* = 315	Eating disorder *n* = 244	Mixed disorder *n* = 113
Mean item values (range)	0.10–0.85	0.90–2.37	0.19–1.13
Correlation matrix (range)	.10–.66	.17–.76	.27–.79
EFA: Fit indices for two-factor solution	TLI = .688 RMSEA = .034 RMSR = .06	TLI = .761 RMSEA = .027 RMSR = .05	TLI = .835 RMSEA = .019 RMSR = .04
EFA: Correlation between the two factors	.64 (.51–.70)	.59 (.47–.66)	.78 (.60–.87)
CFA with two-factor solution: Fit indices	TLI = .976 RMSEA = .047 WRMR = .895	TLI = .976 RMSEA = .075 WRMR = 1.019	TLI = .990 RMSEA = .046 WRMR = .682
CFA: Correlation between the two factors	.63	.60	.87

Note. TSF = thought–shape fusion; HC = healthy control group; ED = eating disorder group; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; WRMR = weighted root mean square residual. RMSR = Root Mean Square Residual.

Comparison for invariance among all three groups, between HC and ED groups, between HC and mixed groups, and between ED and mixed groups. Testing for equal means was never possible for all three groups. Between HC and ED groups, between HC and mixed groups, and between ED and mixed groups, estimates are not robust. Depending on which of the two groups is compared, specific loadings are constrained to be 1; otherwise, the algorithm will fail.

TABLE 3 Pearson's correlations between TSF scales, BDI-II, and EDE-Q in HC, ED, and mixed groups

	TSF Concept scale			TSF Clinical Impact scale		
	HC *n* = 315	ED *n* = 244	Mixed *n* = 113	HC *n* = 315	ED *n* = 244	Mixed *n* = 113
BDI-II	.24**	.45**	.20*	.15**	.30**	$.10^{n.s.}$
EDE-Q global	.55**	.59**	.64**	.51**	.55**	.68**

Note. HC = healthy control group; ED = eating disorder group; mixed = mixed mental disorder group; BDI-II = Beck Depression Inventory; EDE-Q = Eating Disorder Examination Questionnaire, TSF = Thought–Shape Fusion Trait Questionnaire correlation analyses with log-transformed variables; n.s. = nonsignificant. *$p < .05$; **$p < .01$ (two-tailed).

two groups. This means that the structure and the meaning of the measurement model differ between groups. Although patients with EDs respond to the items covering cognitive distortions of the TSF type, a lack of suitability or relevance (e.g., misunderstanding of the items' meaning) of the TSF concept for individuals other than those with ED pathology (e.g., insufficient linguistic precision of the wording) cannot be excluded. It could be assumed that ED patients have a better or specific understanding of the meaning of thoughts of eating fattening/forbidden foods and its consequences compared with HCs or patients presenting with other mental disorders. Future studies should investigate whether ED patients generally reveal more pronounced susceptibility to thought fusion as well as more difficulties in thought defusion than healthy individuals due to an overall behavioural and cognitive inflexibility (Coelho et al., 2015; Tchanturia et al., 2012). Interventions that specifically target the process of thought fusion and defusion (e.g., Hayes, 2016) may proof to be beneficial for ED patients (Manlick, Cochran, & Koon, 2013).

Nevertheless, statistically, due to the lack of measurement invariance, the scores and factors cannot be compared between groups. To obtain valid cross-group comparisons, measurement invariance for the scales assessing TSF has to be established.

The study has limitations that need to be taken into account: First, the EFA and CFA were performed on the same sample, because sample size in subgroups was not large enough for a cross-validation. Second, data were merged from different substudies raising possible concerns about context effects across different settings (e.g., participants who were recruited through clinics vs. research units). Third, ED subtypes and diagnosis in the mixed sample were not specified and comorbidities or stage of treatment was not considered.

To conclude, the German version of the TSF trait questionnaire supports a two-factorial structure, as proposed by previous studies (e.g., Coelho, Baeyens, et al., 2013). No evidence was found for a more detailed differentiation of the *Concept scale*, according to the theoretically postulated components likelihood, feeling, and moral (Shafran et al., 1999). The lack of measurement invariance refers to significant differences between clinical groups and questions cross-group validity of TSF. TSF assessment may be most reliable with individuals who report some degree of ED symptoms, further supporting the specificity of this food/weight-related cognitive distortion.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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