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The Body Image Avoidance Questionnaire: Assessment of its Construct Validity in a Community Sample of French Adolescents

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Abstract
Background Among the few instruments used to measure the behavioral component of body image disturbances, the Body Image Avoidance Questionnaire (BIAQ) is the most widely used. Despite the wide utilization of this instrument, it is currently unknown whether it is appropriate for male and female adolescents from middle and junior high schools.
Purpose The main objective of the present series of studies was to test the construct validity of the BIAQ in a community sample of French adolescents.
Method The content, factor, and convergent validity of the BIAQ were verified in the context of four independent studies conducted on a total sample of 945 adolescents.
Results The first study showed that the content and formulation of the French BIAQ items were adequate for children and adolescents. The following three studies provided support for the factor validity, measurement invariance (across sex), reliability, and convergent validity of the French BIAQ. Regarding the measurement invariance tests, the results revealed that the models were invariant up to the levels of the latent means structures. Post hoc probing of these differences showed a significant higher latent mean score of the global BIAQ scale in females (in samples 2 and 3).
Discussion The present results provide preliminary evidence regarding the construct validity of the BIAQ in a community sample of French adolescents.

Keywords Nonclinical · Body dissatisfaction · Sex · Confirmatory factor analysis · Measurement invariance

Since both contributed equally to the preparation of this paper, the order of appearance of the first and second authors (Christophe Maïano and Alexandre J.S. Morin) was determined at random: both should be considered first authors. This manuscript was prepared while Alexandre J.S. Morin was a visiting scholar at the University of Aix-Marseille II.

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Introduction

Because they represent an important component of multiple prevalent health problems, such as obesity and Eating Disorders (ED), Body Image Disturbances (BID) in children and adolescents from western societies have been identified as a salient public health concern [1, 2]. Although BID was conceptualized as a one-dimensional construct in earlier studies, it is now generally defined as a multidimensional construct with a perceptual, an attitudinal, and a behavioral component [3–5]. The perceptual component of BID is defined as the relative inaccuracy of individuals' judgment regarding the shape of their whole body or of diversified body parts [6]. The attitudinal component of BID includes

two dimensions: an affective one and a cognitive one [3]. The affective and the cognitive dimensions are, respectively, defined as the individuals' negative feelings and thoughts/beliefs concerning the "quality" or "attractiveness" of their own body shape and physical appearance [7]. Finally, authors recently underscored the importance of considering a third, behavioral, component of BID [8–10]. This component comprises two dimensions: (1) body avoidance, being the avoidance of situations that may evoke concerns about physical appearance [11], and (2) body checking, the practice of repeatedly inspecting one's body in a variety of ways [12].

In contrast with the perceptual and attitudinal component of BID, very few measures were developed to measure either body avoidance (i.e., Body Image Avoidance Questionnaire (BIAQ) [9]; Physical Appearance Behavior Avoidance Test [13]), body checking [14], or both (i.e., Body Checking and Avoidance Questionnaire [15]). In a related way, few studies examined these behavioral components of BID [14, 15]. This lack of research is problematic because cognitive–behavioral theories of ED emphasize that these behaviors may play a significant role in the development of disturbed eating behaviors and in the maintenance of BID [12].

A recent literature review conducted within several databases (Francis, Medline, Current Contents, PsycINFO) revealed that, among the few instruments used to measure the behavioral component of BID, the BIAQ [9] is the most widely used. The psychometric properties of the BIAQ were tested in an American sample of 398 female university students. Principal component analyses provided support for a 19-item four first-order factor model: (1) Clothing (CLO, nine items; tendency to disguise or cover-up); (2) Social Activities (SA, four items; avoiding social situations in which food, weight, or appearance could become a focus of attention); (3) Eating Restraint (ER, three items; restricting food ingestion, dieting); (4) Grooming and Weighing (GW, three items; weighing, looking at oneself in the mirror). Additional analyses also showed that the BIAQ presented acceptable internal consistency (α=0.89), test–retest reliability (r=0.87), convergent validity with other measures of BID, and adequate discriminant validity in the comparison of bulimic and nonclinical participants.

Despite the wide utilization of the BIAQ, only two studies attempted to cross-validate it. In one study, Riva and Molinari [16] tested the factor validity and reliability of the Italian version of the BIAQ in three independent male and female samples (439 high school students; 200 university students; 142 obese patients). Exploratory factor analyses supported a truncated 13-item version: (1) three-factor model for the high school sample and (2) four-factor model for the university and obese patients' samples. Additional results revealed acceptable internal consistency coefficients for the BIAQ (α=0.70–0.79). The second study was conducted by Legenbauer et al. [17] on a German sample of 296 female university students and 64 women with ED. The results from exploratory factor analyses resulted in an 11-item three-factor model, different from Riva and Molinari's [16] results. Additional results revealed acceptable internal consistency (α=0.64–0.80), test–retest reliability (r=0.64–0.81), convergent validity (with measures of BID and ED), and discriminant validity (by the comparison of clinical and nonclinical participants).

Consequently, at least four limitations affect the possible generalization of the previous results. First, those studies all examined the dimensionality of the BIAQ through exploratory analyses. Confirmatory Factor Analyses (CFA) represents a more rigorous approach to the verification of the construct validity of psychometric tools [18] and allow for the a priori specification of a factor structure consistent with a model-based hypothesis-testing framework. Second, Rosen and colleagues [9] theoretically conceived the measurement structure of the BIAQ as comprising four lower-order factors related to a single second-order factor. However, this specific structure was never directly evaluated, although most of the previous studies relied on a global score for the validity analyses. Third, evidence regarding the convergent validity of the BIAQ remains limited. Indeed, only two studies did attempt to verify it and found that the convergent measures were solely related either to BID or to ED symptoms. Fourth, two out of three studies relied on a female-only sample. Similarly, only one study verified the factor validity of the BIAQ in a sample of adolescents and failed to replicate the proposed factor structure. It is thus currently unknown whether (1) there is a sex-based difference in answers to the BIAQ and (2) the BIAQ is appropriate for adolescents.

The Present Series of Studies

Considering the previous results and their limitations, it is currently unknown whether the BIAQ is appropriate for male and female adolescents from middle and junior high schools. Therefore, given the absence of a validated French version of the BIAQ, the purpose of the first study was to develop a French version of the BIAQ and to verify its applicability in samples of children and adolescents. The second and third studies aimed to: (1) examine the proposed higher order factor structure; (2) assess the sex-based measurement and latent mean invariance of this model; (3) cross-validate this measurement model within an independent sample; (4) test the temporal stability of the BIAQ. The BIAQ convergent validity was tested in the fourth study by examining its relationships with measures of disturbed eating behaviors, self-esteem, and social physique anxiety that are known to be significantly related to BID [19–21].

Method

Samples and Procedures

The study was first approved by the local ethical committee. Then, after school consent to perform the study was granted, informational letters explaining the purpose of the study were sent to parents. Adolescents who agreed to participate and who returned the informed consent forms signed by their parents were included in the study and had the opportunity to complete the questionnaire. All of the study participants had to meet the following inclusion criteria: (1) they had to be between 11 and 18 years old (with the exception of the first study in which 9 and 10-year-old children were included); (2) they had no self-reported history of ED and obesity and were neither underweight, overweight, or obese at the time of the study (according to body mass index cut-off scores for male and female adolescents provided by Cole et al. [22, 23]); (3) they had to be schooled in regular classes and, as such (according to the French education policies), presented no intellectual, motor, or sensory disability; and (4) according to their self-reports, they had never repeated a school year.

The administration of the BIAQ was realized by one of the authors and two research assistants during physical education classes. To ensure the standardization of the administration procedures, each evaluator followed the same set of previously agreed-upon and written down instructions. The adolescents were informed that the questionnaire was not a test and that there were no right and wrong answers. They were also told that they could stop participating in the study at any time and were assured that their answers would remain confidential. They were not allowed to speak while completing the questionnaire, except to ask for help from the researcher if they did not understand the questions. In case of differences in reading and writing skills, adolescents were allowed to complete the questionnaire at their own pace.

First Study A sample of 24 adolescents (M_{age}=10.58 years, SD_{age}=1.56) composed of 12 males (M_{age}=10.50 years, SD_{age}=1.62) and 12 females (M_{age}=10.67 years, SD_{age}=1.56) aged between 9 and 13 years was recruited from one elementary and one middle school located in Southern France. This age bracket was chosen in order to develop a questionnaire that should be accessible to young adolescents. This sample completed the preliminary version of the BIAQ in which the original response format was replaced by a five-point Likert scale (i.e., from 1=not at all clear to 5=completely clear) to assess item clarity. Following the completion of the questionnaires, individual interviews were used to investigate how unclear items could be clarified.

Second Study A sample of 407 adolescents (M_{age}=14.59 years, SD_{age}=1.87) composed of 227 males (M_{age}=14.81 years, SD_{age}=1.89) and 180 females (M_{age}=14.33 years, SD_{age}=1.82) aged between 11 and 18 years was recruited from four middle and high schools in Southern France. This sample completed the adolescent version of the BIAQ. In addition, 23 of those (M_{age}=16.57 years, SD_{age}=0.95), comprising 11 males (M_{age}=16.64 years, SD_{age}=1.03) and 12 females (M_{age}=16.50 years, SD_{age}=0.90), were retested after 2 weeks.

Third Study A cross-validation sample of 408 adolescents (M_{age}=14.58 years, SD_{age}=1.88) aged between 11 and 18 years was recruited from four middle and high schools in Southern France. The overall sample included 227 males (M_{age}=14.78 years, SD_{age}=1.89) and 181 females (M_{age}=14.34 years, SD_{age}=1.83) that completed the adolescent version of the BIAQ.

Fourth Study A sample of 106 adolescents (M_{age}=14.90 years, SD_{age}=2.29) composed of 69 males (M_{age}=14.81 years, SD_{age}=2.35) and 37 females (M_{age}=15.05 years, SD_{age}=2.20) aged between 11 and 18 years was recruited from two middle and high schools in Southern France. They completed the BIAQ and the Eating Attitudes Test-26 [24], Rosenberg Self-Esteem Inventory (RSEI) [25], and Social Physique Anxiety Scale (SPAS) [26].

Measures

Inclusion Criteria In all of the studies, before receiving the main instruments, participants filled a short questionnaire investigating their personal characteristics and history. This information was used to determine if they met the inclusion criteria. Participants' age and sex were obtained, using their self-reported date of birth and sex. Their body mass index was calculated on the basis of their self-reported weight and height and the following formula: weight/height×height [27]. A last section briefly covered their school (including school type and grade repetition) and psychiatric history (including previous obesity and diagnosis of ED or hospitalisations for ED or obesity).

Body Image Avoidance The original BIAQ was translated into French following the standardized back-translation procedures described in the literature [28, 29]. Translation from English into French was done separately by two bilingual researchers and a bilingual translator. Thereafter, translation discrepancies between the three translated forms were discussed in order to develop an initial French version. A second bilingual translator whose native language was English and who had not seen the original English version of the BIAQ translated this French version

back into English. The back-translated version was then compared with the original English version and inconsistencies, errors, and biases were highlighted. The translation process was repeated until the back-translated versions were equivalent to the original English version. The final versions exhibited no discrepancies with the original version when back-translated. As an additional check, the final version was independently reviewed by the translators to confirm that each item had kept its original meaning [28]. This preliminary French version comprises 19 items evaluating the aforementioned four subscales and one global scale. These items were rated by the participant on a six-point Likert scale (the frequency to which they exhibit the listed behaviors, from never=0 to always=5).

Disturbed Eating Behaviors The French version of the EAT-26 [24, 30] was used in the fourth study as a self-report inventory to evaluate the presence of disturbed eating behaviors. This instrument comprises a global scale and three subscales: (1) dieting, (2) bulimia and food preoccupation, and (3) oral control. The 26 items of this instrument are rated by the participants, using a six-point scale ranging from always to never. Their answers were then recoded into transformed scores following the recommendations of Garner et al. [24]: the six-point scale was recoded into a four-point scale ranging from 0 to 3 in which 0 is assigned to the three responses that represent the least symptomatic answers and 3 represents the most symptomatic answer. The French version of the EAT-26 [30] was validated on an adolescent and adult sample of clinical and nonclinical females (n=1,196) and provided results that were similar to those obtained with the original version. Indeed, the study of Leichner et al. [30] confirmed the original factor structure and found modest to acceptable internal consistency coefficients, ranging from α=0.54 (oral control) to 0.86 (global scale).

Social Physique Anxiety The French version of the SPAS (Maïano et al., submitted) [26] was used in the fourth study to determine the degree to which people become anxious to the real or perceived evaluation of their physique by others. The seven items (e.g., I worry about wearing clothes that might make me look too thin or overweight) were rated on a five-point Likert-type scale ranging from not at all (1) to extremely (5). The French version of the SPAS (Maïano et al., submitted) was validated on a mixed (males and females) sample of adolescents (n=1,563). Again, Maïano et al. (submitted) confirmed that the psychometric properties of the French version were adequate and similar to those from the original version. Those results gave support to the proposed single-factor model across two independent samples and found acceptable internal consistency (α=0.87) and test–retest (r=0.78) coefficients.

Self-Esteem The French version of the RSEI [25, 31] was used to assess overall feelings of self-worth or self-acceptance. The ten items (e.g., I feel that I have a number of good qualities) from this instrument are rated on a four-point Likert scale ranging from strongly agree (4) to strongly disagree (1). This instrument was used in the fourth study. The French version of the RSEI [31] was validated on a mixed (males and females) university sample (n=539) and provided results that were very similar to those obtained on the original version. Indeed, this study confirmed the proposed single-factor structure and found acceptable internal consistency (ranging from α=0.70 to 0.90) and test–retest (r=0.84) coefficients.

Data Analysis

First Study Analyses of the clarity of the items from the preliminary French version of the BIAQ were performed following Vallerand's [32] recommendations: An item with a clarity score of <4 (on the Likert scale ranging from 1 to 5) was considered unsatisfactory [32]. For the unsatisfactory items, follow-up interviews were conducted with participants to identify the problems.

Second Study In this study, analyses were conducted in three stages. In the first stage, a hierarchical CFA model was used to verify whether the hypothetical factor structure of the BIAQ provided an adequate representation of the observed data. This hierarchical model hypothesized that: (1) answers to the BIAQ could be explained by four first-order factors; (2) each item would have a non-zero loading on the lower-order BIAQ factor it was designed to measure, and zero loadings on all other factors; (3) the four first-order factors would load on a single second-order factor representing the BIAQ global scale; and (4) measurement errors (uniquenesses) would be uncorrelated. The CFA was performed, using Full-Information ML (FIML) estimation with AMOS 4.0 [33]. FIML was selected because there were missing responses to a few items (from 4% to 8%) in the questionnaires.

In the second stage, the temporal stability of the resulting questionnaire was estimated, using test–retest reliability correlations uncorrected for measurement errors on the data from the 23 adolescents who were retested after 2 weeks. Finally, in the third stage, the French version of the BIAQ generated in the first stage was used to test the measurement invariance of the second-order CFA model across sex groups. CFA models were first estimated separately in all sex-related subsamples and then measurement invariance tests across sex were performed in the sequential order

recommended by Chen et al. [34] with the preceding model serving as reference [34].

Assessment of fit of the CFA models was based on multiple indicators: the chi-square statistic (χ^2), the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and the 90% confidence interval of the RMSEA (RMSEA 90%CI). Values >0.90 for CFI and TLI are considered to be indicative of adequate model fit, although values >0.95 are preferable [18, 35]. Values smaller than 0.08 or 0.05 for the RMSEA support acceptable and good model fit, respectively [35, 36]. Concerning the RMSEA 90%CI, values <0.05 for the lower bound (left side) and <0.08 for the upper bounds (right side) or containing zero for the lower bound and <0.05 for the upper bounds (right side) provide acceptable and good model fit, respectively [37]. Critical values for the tests of sex measurement invariance of the second-order CFA models were evaluated by the examination χ^2 difference tests. However, recent studies also suggest that this information should be complemented with changes in CFIs and RMSEAs [36, 38, 39]. They also suggest that those additional indices present advantages over chi-square difference tests, this letter being known to be oversensitive to sample size and to violations of multivariate normality. A ΔCFI of 0.01 or less and a ΔRMSEA difference of 0.015 or less between a more restricted model and the preceding one indicate that the invariance hypothesis should not be rejected. Finally, reliability was computed from the model's standardized parameters estimates, using the formula provided by Bagozzi and Kimmel [40]:

$$\rho = \left(\sum \lambda_i\right)^2 \Big/ \left(\left[\sum \lambda_i\right]^2 + \sum \delta_{ii}\right)$$

where λ_i are the factor loading and δ_{ii} are the error variances.

Third Study In this study, CFA analyses of the BIAQ model developed in the second study were performed in two stages, using FIML estimation with AMOS 4.0 [33]. In the first stage, the CFA model was applied to this sample in order to cross-validate the factor structure of the BIAQ obtained in the preceding study. Finally, in the second stage, the factor and latent mean invariance of this model was then verified in the sex groups following the same procedures that were used in the previous study.

Fourth Study This study was used to evaluate the convergent validity of the resulting version of the BIAQ with measures of self-esteem (RSEI), disturbed eating behaviors (EAT-26), and social physique anxiety (SPAS). A Bonferroni correction was applied to minimize type I error rate inflation (alpha error was thus set at 0.05/3= 0.02).

Results

First Study: Items' Content Clarity of the Preliminary Version of the French BIAQ

Items from the French and English versions of the BIAQ are reported in Table 1. Analyses of items clarity reveal that all items were satisfactory, using the cut-off criteria proposed by Vallerand [32]. In fact, the results range from M=4.46 (SD=0.51) for the sixth item to M=4.75 (SD= 0.44) for the third item. This first study thus provided support to the appropriateness of the translated items for younger and older adolescents.

Second Study: Factor Validity of the Preliminary Version of the French BIAQ

First Stage The results from the four-factor second-order CFA model of the BIAQ are presented in Table 2. This model showed significant bootstrapped χ^2 values (Table 2). However, the obtained CFI and TLI exceeded 0.95, and the RMSEA was equal to 0.06. All loadings in this CFA model were significant (Table 3). Moreover, the structural parameters estimates among the second-order BIAQ factor and the four first-order factors were all significant (Table 4). Examination of the model modification indices revealed no significant problem with this model (i.e., cross-loadings or correlated uniquenesses). These results support the factor validity of the measurement model of the French version of the BIAQ.

Descriptive statistics (i.e., mean, standard deviation, and reliability coefficients) for the French version of the BIAQ are provided in Table 5. In this version, the global scale and all subscales presented modest to acceptable reliability (ρ) coefficients (i.e., ranging from 0.74 for the GW subscale to 0.95 for the BIAQ global scale).

Second Stage The test–retest reliability correlation coefficients of the BIAQ are provided in Table 5 and were significant and highly satisfactory in all cases (r_{tt}=0.78–0.90).

Third Stage The results from the sex-based measurement invariance tests are reported in Table 2. These analyses first show that the second-order model performed relatively well in the separate samples of males and females (i.e., CFI; TLI >0.95; RMSEA<0.08; significant loadings). The results from the sex-based measurement invariance tests showed that: (1) the χ^2 tests were all significant and χ^2 difference tests were all significant, with the exception of the χ^2 difference test associated with the invariance of the first-order factor loadings; (2) CFIs, TLIs, and RMSEAs values indicated adequate model fit, with an exception for the CFIs

Table 1 Items of the body image avoidance questionnaire

1. Je porte des vêtements très larges (*I wear baggy clothes*)	CLO
2. Je porte des vêtements que je n'aime pas (*I wear clothes I do not like*)	CLO
3. Je porte des vêtements de couleur sombre (*I wear darker color clothing*)	CLO
4. Je porte des vêtements particuliers (exemple : des vêtements pour personnes à forte corpulence) [*I wear a special set of clothing (e.g., my "fat clothes")*]	CLO
5. Je limite la quantité de nourriture que je mange (*I restrict the amount of food I eat*)	ER
6. Je ne mange que des fruits, des légumes et des aliments à basses calories (*I only eat fruits, vegetables and other low calorie foods*)	ER
7. Je jeûne pendant un jour ou plus (*I fast for a day or longer*)	ER
8. Je ne sors pas en groupe si je pense que je vais être observé(e) (*I do not go out socially if I will be "checked out"*)	SA
9. Je ne sors pas en groupe si je sais que les personnes avec qui je sors vont parler de poids (*I do not go out socially if the people I am with will discuss weight*)	SA
10. Je ne sors pas en groupe si les personnes avec qui je sors sont plus minces que moi (*I do not go out socially if the people I am with are thinner than me*)	SA
11. Je ne sors pas en groupe si cela implique de manger (*I do not go out socially if it involves eating*)	SA
12. Je me pèse moi-même (*I weigh myself*)	GW
13. Je suis inactif(ve) (*I am inactive*)	CLO
14. Je me regarde dans le miroir (*I look at myself in the mirror*)	GW
15. J'évite l'intimité corporelle (*I avoid physical intimacy*)	CLO
16. Je porte des vêtements qui détourneront l'attention de mon problème de poids (*I wear clothes that will divert attention from my weight*)	CLO
17. J'évite d'acheter des vêtements (*I avoid going clothes shopping*)	CLO
18. Je ne porte pas de vêtements qui révèlent mon corps (exemple : des maillots de bain, des débardeurs ou des shorts….) [*I don't wear "revealing" clothes (e.g., bathing suits, tank tops, or shorts)*]	CLO
19. Je me mets sur mon trente et un (*I get dressed up or made up*)	GW

CLO clothing, *ER* eating restraint, *SA* social activities, *GW* grooming and weighing

and TLIs indices when equality constraints were placed on the second-order factor mean; and (3) none of the ΔCFIs and ΔRMSEAs values did, respectively, exceed the recommended cut-off points of 0.01 and 0.015, with an exception for the ΔCFIs and ΔRMSEAs indices when equality constraints were placed on items' uniquenesses and on the second-order factor mean. More precisely, these results revealed that the items' uniquenesses were not completely invariant. The examination of AMOS 4.0 modification indices showed that this was mostly due to items 1, 3, 4, 9, and 17. Indeed, when this model was re-estimated while relaxing the equality constraints on those items' uniquenesses, the resulting model (named D′ in Table 2) did not result in a significant decrement in model fit, compared to the previous models with constrained factor loadings and intercepts. This provides evidence for the partial strict measurement invariance of the model [41]. Finally, and this time in conformity with the hypothesis, the second-order factor mean also proved to be noninvariant across sex: post hoc probing revealed that females (latent mean=0.78, t=11.67, p<0.0001, d=1.17) presented significantly higher BIAQ scores than males (latent mean fixed to 0 to act as reference).

Third Study: Cross-Validation of the French BIAQ

First Stage As illustrated in Tables 2, 3, 4 and 5, the results from the second-order CFA model of the BIAQ replicated in this new independent sample the results from the second study. This model presents acceptable goodness-of-fit indices (i.e., CFI; TLI>0.90; RMSEA<0.08; significant loadings; acceptable and equivalent composite reliability coefficients). Once again, examination of the model modification indices revealed no significant problem with this model (i.e., cross-loadings or correlated uniquenesses).

Second Stage The results from the sex-based measurement invariance tests are reported in Table 2. They also replicate the results from the second study and confirm that the first-order uniquenesses may be partially invariant, although the uniqueness of only a single item (first item) proved to be noninvariant in this study. The results also confirm the noninvariance of the second-order factor mean across sex: post hoc probing of this difference revealed that females (latent mean=0.34, t=4.92, p<0.0001, d=0.49) presented significantly higher BIAQ scores than males (latent mean fixed to 0).

Table 2 Goodness-of-fit statistics of BIAQ models

Study	Model	Description	χ^2	*df*	CFI	TLI	RMSEA	RMSEA 90%CI	$\Delta\chi^2$	Δdf	|CFI|	|RMSEA|
Study 2 (n=407)	CFA, second-order	4 first-order factors and 1 second-order factor	395.98*	148	0.960	0.948	0.064	0.057–0.072				
	CFA, second-order, invariance tests	Males (n=227)	306.72*	148	0.952	0.939	0.069	0.058–0.080				
		Females (n=180)	264.04*	148	0.959	0.947	0.066	0.053–0.079				
		A—no invariance	562.33*	292	0.956	0.943	0.048	0.041–0.053				
		B—assuming A and loadings invariant	567.63*	307	0.957	0.947	0.045	0.039–0.051	5.30	15	0.001	0.003
		C—assuming B and intercepts invariant	620.68*	322	0.951	0.943	0.047	0.042–0.053	53.05*	15	0.006	0.002
		D—assuming C and uniquenesses invariant	784.13*	341	0.928	0.920	0.056	0.051–0.061	163.45*	19	0.023	0.009
		D′—assuming D and uniquenesses 1, 3, 4, 9, 17 free	694.79*	336	0.942	0.934	0.051	0.046–0.057	74.11*	14	0.009	0.004
		E—assuming D′ and first-order factor means invariant	742.50*	340	0.935	0.927	0.054	0.049–0.059	47.71*	4	0.007	0.003
		F—assuming E and structural relations among latent constructs invariant	766.37*	349	0.933	0.927	0.054	0.049–0.060	23.87*	9	0.002	0.000
		G—assuming F and factor error terms invariant	779.76*	353	0.931	0.926	0.055	0.049–0.060	13.39*	4	0.002	0.006
		H—assuming G and second-order factor means invariant	1,170.03*	354	0.868	0.858	0.075	0.071–0.080	390.27*	1	0.063	0.020
Study 3 (n=408)	CFA	4 first-order factors and 1 second-order factor	489.16*	148	0.940	0.923	0.075	0.068–0.083				
	CFA, second-order, invariance tests	Males (n=227)	357.20*	148	0.931	0.912	0.079	0.068–0.089				
		Females (n=181)	330.20*	148	0.936	0.917	0.082	0.070–0.094				
		A—no invariance	668.39*	292	0.936	0.917	0.056	0.050–0.062				
		B—assuming A and loadings invariant	718.01*	307	0.929	0.913	0.057	0.051–0.062	49.62*	15	0.007	0.001
		C—assuming B and intercepts invariant	785.66*	322	0.920	0.906	0.059	0.054–0.064	67.65*	15	0.009	0.002
		D—assuming C and uniquenesses invariant	872.90*	341	0.907	0.898	0.061	0.056–0.067	87.24*	19	0.013	0.002
		D′—assuming D and uniquenesses 1 free	837.95*	340	0.915	0.905	0.060	0.055–0.065	52.29*	18	0.005	0.001
		E—assuming D′ and first-order factor means invariant	887.00*	344	0.907	0.898	0.062	0.057–0.067	49.05*	4	0.008	0.002
		F—assuming E and structural relations among latent constructs invariant	925.24*	353	0.902	0.895	0.063	0.058–0.068	38.24*	9	0.005	0.001
		G—assuming F and factor error terms invariant	966.15*	357	0.896	0.889	0.065	0.060–0.070	40.91*	4	0.006	0.002
		H—assuming G and second-order factor means invariant	1,340.46*	358	0.832	0.822	0.082	0.078–0.087	374.31*	1	0.064	0.017

CFA confirmatory factor analytic model, χ^2 chi-square, *df* degrees of freedom, *CFI* comparative Fit Index, *TLI* Tucker–Lewis index, *RMSEA* root mean square error of approximation, *RMSEA 90%CI* 90% confidence interval for the RMSEA point estimate, $\Delta\chi^2$ change in goodness-of-fit χ^2 relative to baseline model, Δdf change in degrees of freedom relative to baseline model, ΔCFI change in CFI relative to baseline model, $\Delta RMSEA$ change in root mean square error of approximation relative to baseline model

*$p<0.05$

Table 3 CFA's factor loadings–uniquenesses

Factor	Item n°	Study 2 (n=407) Loadings (uniquenesses)	Study 3 (n=408) Loadings (uniquenesses)
CLO	1	0.426 (0.154)[a]	0.405 (0.184)[a]
	2	0.596 (0.355)	0.436 (0.256)
	3	0.402 (0.144)	0.438 (0.219)
	4	0.519 (0.270)	0.446 (0.160)
	13	0.407 (0.127)	0.423 (0.144)
	15	0.402 (0.173)	0.444 (0.193)
	16	0.585 (0.343)	0.650 (0.417)
	17	0.517 (0.267)	0.424 (0.192)
	18	0.481 (0.232)	0.411 (0.165)
ER	5	0.444 (0.215)[a]	0.829 (0.687)[a]
	6	0.402 (0.156)	0.570 (0.325)
	7	0.664 (0.441)	0.429 (0.253)
SA	8	0.594 (0.352)[a]	0.589 (0.347)[a]
	9	0.765 (0.585)	0.667 (0.445)
	10	0.838 (0.702)	0.770 (0.593)
	11	0.737 (0.542)	0.695 (0.483)
GW	12	0.464 (0.215)[a]	0.527 (0.278)[a]
	14	0.601 (0.362)	0.597 (0.356)
	19	0.413 (0.171)	0.403 (0.120)

All loadings are significant (p<0.001)

CLO clothing, *ER* eating restraint, *SA* social activities, *GW* grooming and weighing

[a] Item that was set to be 1.0

Fourth Study: Convergent Validity of the French BIAQ

As reported in Table 6, the internal consistency coefficients of the different instruments used in the fourth study were all in the acceptable range (0.69 to 0.87). The results revealed that most of the BIAQ subscales were positively and significantly correlated with the global scale score of the EAT-26 (see Table 6), with the largest coefficients for the global scale (r=0.52, p<0.01) and ER scales (r=0.54, p<0.001). The analyses also showed that most BIAQ subscales were significantly and positively correlated with the SPAS (see Table 6), with the strongest coefficients for the global (r=0.42, p<0.01) and ER scales (r=0.30, p<0.001). Finally, some BIAQ subscales were, as expected, negatively and significantly correlated with the RSEI (see Table 6), with the largest correlations for the CLO scale (r=−0.50, p<0.001).

Table 4 Structural relations among latent constructs

Latent constructs	Study 2 (n=407) Estimates	Study 3 (n=408) Estimates
SOF→CLO	0.895[a]	0.997[a]
SOF→ER	0.762	0.509
SOF→SA	0.920	0.674
SOF→GW	0.520	0.526

All loadings are significant (p<0.001)

SOF second-order factor, *CLO* clothing, *ER* eating restraint, *SA* social activities, *GW* grooming and weighing

[a] Item that was set to be 1.0

Discussion

The objectives of the first study were to develop a preliminary French version of the BIAQ for adolescents and to verify the content clarity of the items in a French sample of adolescents. Results showed that the translated items were successfully understood and that the vocabulary of the French BIAQ was suitable for community samples of adolescents.

The objectives of the second and third studies were to examine the factor validity and reliability of the French BIAQ in adolescents and to assess the measurement and latent mean invariance of this instrument across sex. In contrast with the previous studies [9, 16, 17] that only verified first-order factor models and reached inconsistent results, the present findings provided strong support for the

Table 5 Descriptive statistics of the BIAQ

Factor	Possible scoring range	Study 2 (n=407)			Study 3 (n=408)	
		Mean (SD)	ρ	r_{tt}	Mean (SD)	ρ
CLO	0–45	9.75 (6.30)	0.90	0.83*	9.54 (6.30)	0.90
SA	0–15	1.64 (3.27)	0.74	0.83*	1.09 (3.27)	0.73
ER	0–20	3.50 (2.92)	0.80	0.79*	3.50 (2.83)	0.80
GW	0–15	8.35 (3.43)	0.74	0.78*	8.64 (3.49)	0.76
Global	0–95	23.25 (10.80)	0.95	0.90*	22.77 (9.60)	0.95

CLO clothing, *ER* eating restraint, *SA* social activities, *GW* grooming and weighing, *SD* standard deviation, ρ composite reliability estimate, r_{tt} test–retest intraclass correlations

*$p<0.01$

hypothesized four-factor second-order CFA model of the French BIAQ in two independent community samples of adolescents. Further analyses of the French BIAQ also confirmed, within the two independent samples, that the various subscales possessed adequate internal consistency coefficients (ranging from 0.73 to 0.95), given the reduced length of three of them (ER and GW: three items; SA: four items). Indeed, internal consistency coefficients tend to be positively related to the number of items included in the scale due to a statistical artifact (e.g., [42]). Moreover, the test–retest reliability correlation coefficients were satisfactory for all subscales. The replication of those results in two independent samples provided strong evidence that the obtained measurement model was not due to samples specificities. Researchers can thus confidently rely on this version in studies of body image avoidance among French adolescents.

Numerous studies in the literature showed that BID might take different forms in males and females (e.g., [43]). In consequence, additional CFAs analyses were performed to test whether the BIAQ measurement model was invariant across male and female adolescents. These results mostly support the measurement invariance of the French BIAQ across male and female subsamples, within two independent studies: only a limited number of items' uniquenesses or measurement errors were found to differ across sex. It should be noted that the complete invariance of the items' uniquenesses has often been referred to as a test of *strict* measurement invariance [41] and is not considered as a prerequisite for the measurement invariance of an instrument, as long as a majority of the items uniqueness remains invariant (for review, see [36]). Second, across the two independent samples, the findings from the latent mean invariance test also show that females presented significantly higher scores than males on the global BIAQ. This is coherent with the current knowledge showing that females tend to present a significantly higher level of self-reported BID in comparison to males (e.g., [1, 2]).

Table 6 Convergent validity of the BIAQ

Scale	Study 4 (n=106)			
	EAT-26	SPAS	RSEI	Alpha
CLO	0.31*	0.28*	−0.50*	0.69
SA	0.30*	0.28*	−0.28*	0.74
ER	0.54*	0.30*	−0.25*	0.71
GW	0.22*	0.19	−0.06	0.71
Global	0.52*	0.42*	−0.25*	0.81
Alpha	0.87	0.83	0.83	

CLO clothing, *ER* eating restraint, *SA* social activities, *GW* grooming and weighing, *EAT-26* eating attitudes test-26 items, *SPAS* social physique anxiety scale, *RSEI* Rosenberg self-esteem inventory

*$p<0.01$

The purpose of the last study was to examine the convergent validity of the French BIAQ with psychological measures other than those measuring the attitudinal component of BID. The results show that the subscales and global scale of the BIAQ modestly correlate with a diverse array of constructs (self-esteem and social physique anxiety) and moderately converge with a measure of disturbed eating behaviors (EAT-26). Thus, in addition to the results from previous studies [9, 17], the present findings raise questions about whether the BIAQ is actually measuring (1) a behavioral component of BID and/or (2) a specific symptom of ED. Consequently, the examination of the discriminant and predictive property of this instrument, using nonclinical samples without BID, nonclinical samples with high levels of BID, and clinical samples (e.g., patients with anorexia nervosa, bulimia nervosa, and obesity), should be a future research priority.

Two limitations of the current series of studies must be taken into account when interpreting their results. First, results regarding the factor structure and measurement invariance of the French BIAQ were based on a mixed

(males and females) sample of nonclinical and normally achieving adolescents, which might not be considered representative of the French adolescent population. This indicates that the use of this instrument should be limited to samples similar to this one. Therefore, examining the factor structure and measurement invariance of the French BIAQ across a more diverse sample of adolescents should be a future research priority. Such research should be performed, using various clinical samples known to have a high level of BID (e.g., anorexia and bulimia nervosa, overweight, and obesity), as well as samples from other cultural or linguistic backgrounds.

Second, the reliance on a cross-sectional sample also precludes the verification of the developmental stability or change of the BIAQ. Although the present study allowed for the verification of the 2-week test–retest reliability of the instrument, a complete test of its construct validity would involve testing developmental continuity and change during the adolescent years. This issue should be addressed in the context of longitudinal studies.

In conclusion, the psychometric properties of the French version of the BIAQ, tested in two independent and heterogeneous adolescents' samples, were found to be adequate. This instrument may thus be used in research assessing body image avoidance in French adolescents with a background similar to those from the present series of studies. However, regarding the aforementioned limitations of these studies, it is premature at this time to recommend the use of this instrument in clinical adolescents' samples.

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