



Measurement invariance and differential item functioning of the functionality appreciation scale (FAS) in Colombia and Spain

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ABSTRACT

The Functionality Appreciation Scale (FAS) is increasingly used in diverse national and linguistic contexts. However, limited work has assessed the extent to which the instrument demonstrates measurement invariance and differential item functioning (DIF) across nations and respondent characteristics. Here, we examined measurement invariance and DIF of the FAS using archival data from adults in Colombia (Mebarak et al., 2023) and Spain (Zamora et al., 2024). Participants included 1420 (women $n = 804$, men $n = 616$) respondents from Colombia and 838 (women $n = 415$, men $n = 423$) respondents from Spain who completed translations of the FAS. Confirmatory factor analysis supported a unidimensional structure of the FAS in both national groups. Additionally, the FAS achieved full measurement invariance (up to latent mean invariance) across both groups. We also found that the FAS lacked DIF as a function of age, body mass index (BMI), and gender identity across both national groups. Older participants (relative to younger participants), men (relative to women), and participants with lower BMIs (relative to those with higher BMIs) had higher FAS scores. These results support the notion that the FAS is measuring a common underlying construct across these national groups and respondent characteristics.

1. Introduction

Body functionality refers to “everything that the body can do or is capable of doing” (Alleva & Tylka, 2021, p. 149). On its own, body functionality is not typically considered a facet of body image; however, it transitions to a body image construct when researchers consider individuals’ thoughts, feelings, and perceptions about what their bodies can do (Alleva & Martijn, 2019; Alleva & Tylka, 2021). The latter is known as *functionality appreciation* and is defined as “appreciating, respecting, and honouring the body for what it is capable of doing, extending beyond mere awareness of body functionality” (Alleva et al.,

2017, p. 29). Functionality appreciation is an important facet of the broader positive body image construct (Swami et al., 2020) and a contributor to positive outcomes in a broad range of life domains, including adaptive eating patterns, lower eating pathology, and adaptive well-being (for a review, see Linardon et al., 2023).

1.1. Measurement invariance

The construct of functionality appreciation is assessed using the 7-item Functionality Appreciation Scale (FAS; Alleva et al., 2017), which evidences robust psychometric properties – including a

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unidimensional factor structure, adequate composite reliability, and good patterns of validity – within diverse social identity and cultural groups (e.g., Alleva, Custers et al., 2023; Namatame et al., 2022; Souliard & Vander Wal, 2021; Swami et al., 2019, 2021, 2022; Todd et al., 2019). As this body of work matures, it is imperative that researchers more fully consider the extent to which the FAS measures the same latent construct of functionality appreciation across disparate groups. More specifically, this is a question of the extent to which the FAS achieves measurement invariance (Guenole & Brown, 2014; Swami & Barron, 2019).

If an instrument and its measurement properties behave differently in different groups of respondents, then measurement biases could occur, leading to biased results (Guenole & Brown, 2014). Conversely, if an instrument operates in the same way across groups, then it becomes possible to generalise findings, compare latent scores across groups, and examine differential relations between constructs across groups (Boer et al., 2018, Chen, 2008). While tests of measurement invariance are commonly conducted across national or linguistic groups (at the least in the body image literature; Swami & Barron, 2019), they can also be assessed at the level of other respondent demographic characteristics. When such characteristics occur as continuous variables (e.g., age or body mass index) or when testing for measurement biases as a joint function of multiple variables, it is recommended that tests of differential item functioning (DIF) are conducted. Establishing a lack of DIF increases one's confidence that an instrument is measuring the same latent construct across discrete respondent characteristics.

1.1.1. Invariance across national groups

To date, examinations of measurement invariance of the FAS across national groups remains scarce, as we are aware of only one such study. Specifically, Todd and Swami (2020) examined measurement invariance of the FAS across adults from Malaysia and the United Kingdom (UK). Their results supported partial strong invariance across nations after fixing the intercept for Item #4. Further analyses showed that Malaysian participants had significantly higher scores than participants from the UK. However, the intersection of gender identity also appeared to be important, with Malaysian women reporting significantly greater functionality appreciation than Malaysian men, and UK men reporting significantly higher scores than UK women. In explanation, Todd and Swami (2020) suggested that the intersection of gender identity and nationhood may shape experiences of functionality appreciation.

1.1.2. Gender identity

Beyond national groups, several studies have assessed measurement invariance of the FAS across binary gender identity (women vs. men) within nations (e.g., Alleva et al., 2017; Swami et al., 2019; Swami, Todd, Goian et al., 2021). Thus, studies have typically shown that the scores on the FAS achieve strong invariance, which in turn allows for confident assessments of gender differences in functionality appreciation. Here, no consistent pattern of differences has been found: while most studies have reported no significant differences between women and men (e.g., Anastasiades et al., 2023; Cerea et al., 2021), some studies have reported that women have significantly higher scores than men (e.g., Alleva et al., 2023; Swami et al., 2022) and at least one study has reported that men have significantly higher scores than women (Mebarak et al., 2023). Where significant gender differences have been reported, however, these have typically been of a small effect size ($d_s \sim 0.20$).

1.1.3. Age and body mass index

Beyond gender identity, we are aware of only one study that has assessed measurement invariance of the FAS across age groups. In samples from China, He et al. (2023) reported that the FAS achieved strong invariance across middle school students, high school students, young adults, and older adults. Additionally, He et al. (2023) reported that functionality appreciation generally increased with older age,

although the results of one meta-analysis (Linardon et al., 2023) of 31 studies found that functionality appreciation was not significantly associated with age ($r = .02$). Conversely, Linardon et al. (2023) reported that greater functionality appreciation was significantly and weakly associated with lower body mass indices (BMIs; $r = -.09$). However, there is a high degree of variability across studies, with some studies finding that the significant association with BMI is only significant in women but not in men (e.g., Mebarak et al., 2023; Swami, Todd, Goian et al., 2021) or that functionality appreciation is associated with lower age in women but not in men (Longhurst & Swami, 2023). More generally, beyond the findings of He et al. (2023), research has not examined the extent DIF of the FAS with regards to age and BMI.

1.2. The present study

In the present study, we sought to extend existing knowledge by examining measurement invariance of the FAS across adults from two Spanish-speaking nations, namely Colombia and Spain. These sites were selected primarily because comparable data is available for analyses, with translations of the FAS having recently been validated in both nations (Mebarak et al., 2023; Zamora et al., 2024). Beyond this practical reason, assessing functionality appreciation across Colombia and Spain may be informative for several reasons. First, although Spanish is the main official language in both Colombia and Spain, there are small differences in the linguistic variants of Spanish and Colombian Spanish (Ardila, 2020). Second, although both countries have a shared history – Colombia was part of the Spanish Empire until 1819 – and primary religion in Catholicism, the two nations differ considerably in terms of socioeconomic and demographics characteristics. To wit, Spain has a more robust economy (e.g., a higher gross domestic product per capita and lower percentage of the population below the poverty line), whereas Colombia is dealing with the legacy of a long civil war (Balcells & Steele, 2016).

Perhaps more importantly, there are cultural similarities between Colombia and Spain. For example, both Colombia and Spain have been described as highly collectivist nations (Oyserman et al., 2002), with an emphasis on heightened familism (*familismo*), or the centrality of family life (Szapocznik et al., 1990). In particular, individuals in both nations appear to highly value the importance of the family, the socio-emotional bonds created within family units, and one's accountability to family cohesion. In some cultural spaces, *familismo* may be an important protective factor, as it has been linked with positive health behaviours and better support networks (e.g., Unger et al., 2002). At the same time, however, heightened *familismo* may still be limited by embodied representations of gender in Colombia and Spain, which have historically prioritised essentialised forms of masculinity in boys and men (e.g., toughness, interpersonal dominance, physical prowess) and femininity in girls and women (e.g., passivity, communality, dependence, and a focus on appearance) (e.g., Browne et al., 2021; Català et al., 2012; Rogriguez-del-Pino, 2019).

In view of these broad-stroke cultural similarities, we hypothesised that the FAS would evidence full measurement invariance (i.e., up to and including latent mean invariance) across Colombia and Spain. Of note, Mebarak et al. (2023) previously reported small gender differences in functionality appreciation in Colombia (men had higher scores than women), whereas Zamora et al. (2024) reported no significant gender differences in Spain, but both studies utilised manifest scores in analyses that do not control for measurement error. Beyond an assessment of measurement invariance across nations, we also extended knowledge in a different way. Specifically, we assessed the extent to which the FAS functions differently based on age, BMI, and gender identity. Here, we followed best-practice recommendations (Swami, Maïano et al., 2023) in conducting tests of DIF using multiple indicators multiple causes (MIMIC) models, which involve the addition of one or more observed predictors to a previously retained measurement model (Morin et al., 2013). Here, we should expect that the FAS functions in the same way

across these respondent characteristics (see also [Marmara & Zarate, 2022](#)).

2. Method

2.1. Participants and procedures

We extracted data (i.e., FAS item ratings and demographic data) from two published studies reporting validations of translations of the FAS in Colombia ([Mebarak et al., 2023](#)) and Spain ([Zamora et al., 2024](#)), respectively. The Colombian sample consisted of 1420 respondents (women $n = 804$, men $n = 616$), ranging in age from 18 to 49 years ($M = 20.90$, $SD = 3.18$) and in self-reported BMI from 15.22 to 44.58 kg/m² ($M = 23.29$, $SD = 3.85$). In terms of education, 0.4 % had completed primary education, 56.3 % had completed secondary education, 42.0 % had completed an undergraduate degree, 0.6 % had completed a postgraduate degree, 0.1 % had a doctorate, and 0.6 % preferred not to say. In terms of marital status, 61.9 % were single and unpartnered, 36.9 % were married or in a relationship, 0.2 % were divorced or separated, and 1.0 % had another status.

Meanwhile, the sample from Spain consisted of 838 participants (women $n = 415$, men $n = 423$) who ranged in age from 18 to 71 years ($M = 31.79$, $SD = 11.96$) and in self-reported BMI from 13.33 to 44.44 kg/m² ($M = 23.97$, $SD = 4.12$). Of this sample, 1.6 % had completed primary education, 18.5 % had completed secondary education, 50.2 % had an undergraduate degree, 25.7 % had a postgraduate degree, and 4.0 % had a doctorate. In terms of marital status, 48.4 % were single and unpartnered, 48.8 % were married or in a relationship, 2.1 % were divorced or separated, and 0.6 % had another status. Full procedural information is available in the parent studies.

2.2. Measures

2.2.1. Functionality appreciation

Participants completed translations of the 7-item Functionality Appreciation Scale (FAS; [Alleva et al., 2017](#); Colombian Spanish translation: [Mebarak et al., 2023](#); Spanish translation: [Zamora et al., 2024](#)). All items were rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Higher scores are reflective of greater functionality appreciation. A side-by-side comparison of the two translations by all authors of the present work who speak either Colombian Spanish or Spanish indicated that there were minor word choice differences between the two translations, which likely reflects vocabulary differences between the two dialects ([Lipski, 1994](#)). Specifically, word choice differences were evident on Items #2, 3, 4, and 5. The Colombian Spanish translation is available in [Mebarak et al. \(2023\)](#), whereas the Spanish translation is available in [Zamora et al. \(2024\)](#).

2.2.2. Demographics

We extracted demographic data where these were comparable across the two studies. Specifically, we extracted gender identity and age data, and recoded highest educational level and marital status so that they were equivalent across sites. Self-reported height and weight were used to compute BMI as kg/m².

2.3. Analytic strategy

There were no missing responses in either dataset. Analyses were performed using Mplus 8.11's Maximum Likelihood Robust (MLR) estimator ([Muthén & Muthén, 2024](#)). In a first stage, the a priori unidimensional structure of the FAS was examined separately in each national sample using confirmatory factor analysis (CFA). Composite reliability of the FAS factor was estimated using the omega (ω) coefficient ([McDonald, 1970](#)). Model fit was assessed based on the following fit indices ([Hu & Bentler, 1999](#); [Marsh et al., 2005](#)): the comparative fit index (CFI), the Tucker-Lewis index (TLI; CFI and TLI $\geq .90$ or $> .95$,

respectively suggest acceptable and excellent fit), the root mean square error of approximation (RMSEA; $\leq .08$ or $< .06$, respectively suggest acceptable and excellent fit), and its 90 % confidence interval.

In a second stage, measurement invariance of the a priori unidimensional model was examined across national samples using the following sequence ([Millsap, 2011](#)): (i) configural invariance; (ii) invariance of loadings (weak invariance); (iii) invariance of intercepts (strong invariance); (iv) invariance of uniqueness (strict invariance); (v) invariance of the latent variance; and (vi) invariance of the latent mean factor. Each invariance sequence was contrasted to the previous one by relying on changes (Δ) in CFI, TLI, and RMSEA. A sequence was considered as invariant when Δ CFI and Δ TLI decreases were $> .01$, and/or the increase in Δ RMSEA was $> .015$ ([Chen, 2007](#); [Cheung & Rensvold, 2002](#)).

In a third stage, a hybrid MIMIC multiple-group model ([Morin et al., 2018](#); [Maïano, Morin et al., 2023](#); [Maïano, Thibault et al., 2023](#)) was used to examine: (a) DIF, that is, direct associations between predictors (age, BMI, and gender identity) and the FAS item responses over-and-above the association between the predictors and the FAS latent factor; (b) the associations between predictors (age, BMI, and gender identity) and FAS latent factor; and (c) the equivalence of these associations across national samples.

These models were built from the most invariant multiple-group model identified in the second stage, to which the predictors were added (age, BMI, and gender identity). Specifically, hybrid MIMIC models were estimated in the following sequence ([Marsh et al., 2013](#); [Morin et al., 2013](#)): (a) null effects model (paths from the predictors to the FAS latent factor and item responses were constrained to be zero); (b) saturated model (paths from the predictors to the FAS item responses were freely estimated, while paths from the predictors to the FAS latent factor were constrained to be zero); and (c) factors only model (paths from the predictors to the FAS latent factor were freely estimated, while paths from the predictors to the FAS item responses were constrained to be zero). To ease interpretations, age and BMI were standardised prior to analyses. Improvement in model fit (Δ CFI/ Δ TLI increases $\geq .01$, Δ RMSEA decreases $\geq .015$) in (b) and (c) relative to (a) reveals the presence of associations between predictors and FAS item responses. Additionally, improvement in model fit for (b) relative to (c) reveals DIF. These models were examined with all associations freely estimated (or constrained to equally) across samples. Then, the most appropriate model was retained and compared to an alternative model in which all associations were constrained to be equal across samples.

3. Results

3.1. Factor validity and reliability across national samples

The goodness-of-fit of the a priori CFA models are reported in the top row of [Table 1](#). Results showed an excellent and acceptable level of fit to the data for the Colombian (Model 1–1) and Spanish (Model 1–2) samples, respectively. Standardised parameter estimates from both solutions are reported in [Table 2](#). They reveal acceptable factor loadings in both samples (Colombian sample: $\lambda = .676$ to $.800$; Spanish sample: $\lambda = .645$ to $.771$). Finally, the composite reliability of the FAS factor was excellent in both samples (Colombian sample: $\omega = .90$, 95 % CI = $.88, .90$; Spanish sample: $\omega = .88$, 95 % CI = $.87, .89$).

3.2. Measurement invariance across national samples

The goodness-of-fit of the measurement invariance models are reported in [Table 1](#) (Models 2–1 to 2–6). Results showed a complete (weak, strong, strict, variance and latent mean) measurement invariance of the FAS across the Colombian and Spanish samples.

Table 1
Goodness-of-Fit Statistics of Confirmatory Factors Analyses (CFA) for the FAS.

Models	N	Description	R ²	df	p	CFI	TLI	RMSEA	RMSEA 90 % CI		CM	ΔR ²	df	p	ΔCFI	ΔTLI	ΔRMSEA	
									LB	UB								
Measurement model	1-1	CFA - Colombian sample	48.131	14	< .001	.987	.981	.041	.029	.055	-	-	-	-	-	-	-	-
	1-2	CFA - Spanish sample	74.425	14	< .001	.965	.947	.072	.056	.088	-	-	-	-	-	-	-	-
	2-1	Configural invariance	119.810	28	< .001	.979	.969	.054	.044	.064	-	-	-	-	-	-	-	-
MI across samples	2-2	Weak invariance	129.562	34	< .001	.979	.974	.050	.041	.059	2-2	6.35	6	.38	.000	+.005	-.004	
	2-3	Strong invariance	163.416	40	< .001	.972	.971	.052	.044	.061	2-3	38.56	6	< .001	-.007	-.003	+.002	
	2-4	Strict invariance	162.889	47	< .001	.974	.977	.047	.039	.055	2-4	6.83	7	.45	+.002	+.006	-.005	
	2-5	Variance invariance	163.577	48	< .001	.974	.977	.046	.039	.054	2-5	1.54	1	.21	.000	.000	-.001	
	2-6	Latent mean invariance	191.275	49	< .001	.968	.973	.051	.043	.058	2-6	36.32	1	< .001	-.006	-.004	+.005	
	3-1	MIMIC Null effects	347.848	91	< .001	.954	.958	.050	.044	.056	-	-	-	-	-	-	-	-
DIF: Age, BMI, and gender identity	3-2	MIMIC Saturated	178.401	49	< .001	.977	.960	.048	.041	.056	3-1	173.92	42	< .001	+.023	+.002	-.002	
	3-3	MIMIC Factors only	258.541	85	< .001	.969	.969	.043	.037	.049	3-1	109.34	6	< .001	+.015	+.011	-.007	
	3-4	MIMIC Factors only (invariance)	285.723	88	< .001	.965	.966	.045	.039	.050	3-3	33.00	3	< .001	-.004	-.003	+.002	

Notes. FAS = Functionality Appreciation Scale; R² = robust maximum likelihood chi-square; df = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; 90 % CI = 90 % confidence interval of the RMSEA; LB = lower bound; UB = upper bound; CM = comparison model; ΔR² = robust chi-square difference tests (calculated from loglikelihoods for greater precision); Δ = change from previous model; MI = measurement invariance; DIF = differential item functioning; BMI = body-mass index; MIMIC = multiple indicators multiple causes.

Table 2

Standardised Parameters Estimates from the Confirmatory Factor Models of the FAS in the Colombian and Spanish Samples.

Items	Colombian sample		Spanish sample	
	λ	δ	λ	δ
FAS1	.732	.464	.686	.529
FAS2	.676	.543	.645	.583
FAS3	.771	.405	.733	.462
FAS4	.681	.537	.672	.549
FAS5	.800	.361	.771	.406
FAS6	.735	.459	.737	.457
FAS7	.783	.387	.762	.420
ω	.895		.880	

Notes. FAS = Functionality Appreciation Scale; λ = factor loadings; δ = Uniquenesses; ω = McDonald's omega coefficient of composite reliability

3.3. DIF and latent mean differences

The results from the MIMIC models are presented in Table 1. These models were estimated starting from the most invariant measurement model (Model 2–6). Results showed that both the saturated (Model 3–2) and factors-only models (Model 3–3) resulted in a substantial improvement in model fit relative to the null effects model (Model 3–1). Additional results showed that the factors-only and saturated models resulted in a nearly similar level of model fit (ΔCFI = -.008, ΔTLI = +.009, ΔRMSEA = -.005). Therefore, these results showed a lack of DIF and an association between age, BMI, and gender identity (women = 0, men = 1) and the FAS latent factor. Finally, the last model (Model 3–4), developed based on the factors-only model (Model 3–3), supported the equivalence of the associations between age, BMI, gender identity, and the FAS latent factor.

The results from this final model are displayed in Table 3. They showed that older participants (relative to younger participants) and men (relative to women) had higher FAS scores, and that participants with higher BMIs (relative to those with lower BMIs) had lower FAS scores.

4. Discussion

In the present study, we examined measurement invariance and DIF of the FAS in two samples from Colombia and Spain. Our results showed that, across the two samples, the FAS achieved full measurement invariance across nations and showed a lack of DIF across respondent characteristics (age, BMI, and gender identity). In broad outline, these results are consistent with previous work showing that the FAS is invariant across national contexts (Todd & Swami, 2020) and binary gender identity (e.g., Alleva et al., 2017; Swami et al., 2019; Swami, Todd, Goian et al., 2021). Moreover, for the first time, we show that the

Table 3

Relations between the Predictors and the FAS Latent Factor.

	b (SE)	Sample-specific standardised coefficients	
		β (Colombian)	β (Spanish)
Age	.104(.021)* **	.102 * **	.102 * **
Body mass-index	-.181(.027)* **	-.177 * **	-.177 * **
Gender identity	.183(.045)* **	.089 * **	.090 * **

Notes. * p ≤ .05; ** p ≤ .01; *** p ≤ .001; FAS = Functionality Appreciation Scale; b = unstandardised regression coefficient taken from the factors-only model (3-4) invariant across nation samples; SE = standard error of the coefficient; β = sample-specific standardised regression coefficient (although some of the relations are invariant across samples, the standardised coefficients may still show some variation as a function of within-samples estimates of variability). Because age and body mass index were standardised prior to these analyses and that the FAS factor is estimated based on a model of latent variance invariance in which all latent factors have a SD of 1, all unstandardised coefficients can be directly interpreted in SD units.

items of the FAS function similarly across age and BMI. Although the present results are limited to use of Colombian Spanish and Spanish translations of the FAS in two nations, they corroborate the existing evidence suggesting that the FAS shows strong psychometric properties (Alleva et al., 2017) and can be confidently utilised in diverse national groups.

In terms of national groups, we found that the FAS achieved full measurement invariance across respondents from Colombia and Spain (i.e., there were no between-group differences in latent means). In contrast to previous cross-national work, which reported that Malaysian participants had significantly higher (manifest) functionality appreciation than Britons (Todd & Swami, 2020), our results indicated both that the construct of functionality appreciation is measured in the same way via the FAS in Colombia and Spain and that the two national groups were equivalent in terms of latent mean FAS scores. While our study was not ideally set up to interrogate why this might have been the case, it would seem that – despite diverging historical and socioeconomic trajectories – experiences and levels of functionality appreciation are largely similar across both nations.

It may be that certain cultural values that are shared across the two national sites contribute to similar lived experiences and levels vis-à-vis functionality appreciation. For example, both Colombian and Spanish cultures have been described as “friendly” (*simpáticas*); that is, both cultures share a proactive, socioemotional concern for the well-being of others (e.g., Triandis et al., 1984). This may contribute to similar experiences of body acceptance by others that, in turn, result in similar levels of functionality appreciation in both contexts. Additionally, both countries are characterised by heightened familism (*familismo*; an emphasis on the centrality of family life; Szapocznik et al., 1990), which may contribute to better psychological adjustment (e.g., Calderón-Tena et al., 2011) and more positive body image in both nations.

Of course, it is also possible that the similar levels of functionality appreciation across both samples also reflects sampling homogeneity across groups (e.g., both samples were relatively young and well educated). While, in a sense, this is a strength of the present study, we also cannot rule out the possibility that our findings may have been different had we relied on samples with greater heterogeneity. Future qualitative research that is positioned to better understand the development and maintenance of functionality appreciation in Colombia and Spain may help us to better contextualise the present results. More generally, there is a need also to broaden the scope of existing cross-national work to include more diverse national, linguistic, and cultural groups. For instance, recent work has examined the measurement invariance of the Body Appreciation Scale-2 across 65 national groups (Swami, Tran et al., 2023). Similar work utilising the FAS would help scholars to more fully understand how and when functionality appreciation differs across national groups.

Beyond national groups, our results also showed that there was no DIF in responses to the FAS as a function of gender identity. This is broadly consistent with previous work showing that the FAS achieves strong invariance across gender identity in distinct national groups (e.g., e.g., Alleva et al., 2017; Swami et al., 2019; Swami, Todd, Goian et al., 2021). Here, we found that men had significantly higher functionality appreciation than women, albeit of a small effect size. One possible explanation for this difference stems from gendered understandings of the physical self and embodied representations of the body in Spanish-speaking countries. For instance, to the extent that men aspire towards hegemonic masculine ideals, they may have greater opportunities to engage their bodies in ways that lead to greater functionality appreciation. Conversely, the centrality of *familismo* may mean that women in Colombia and Spain spend more time than men caring for others (e.g., their children) and have less time to participate in activities that may promote functionality appreciation, such as physical activity. Nevertheless, it should be noted that the gender difference reported here was small and this is another aspect of our study that may benefit from future qualitative work.

Our results also showed that, across the two national sites, participants with lower BMIs were more likely to report higher functionality appreciation. While we acknowledge the limits of using BMI as a proxy for weight status and as a measure in its own right (see Calogero et al., 2016), this finding is consistent with the results of a recent meta-analysis showing that functionality appreciation is inversely associated with BMI (Linardon et al., 2023). In explanation, it may be that individuals with higher BMIs experience greater weight-based stigma and pressure to strive to thinness or leanness, which leaves them with fewer resources and opportunities to appreciate the functions of their bodies. Indeed, as Alleva, Atkinson et al. (2023) have noted, negative stereotypes of individuals with higher BMIs often centre on their bodily functions. Such negative stereotypes – if internalised – may jeopardise or limit attempts by individuals with higher BMIs to develop and maintain healthy functionality appreciation.

Finally, in terms of age, we found that older participants tended to have higher functionality appreciation than younger participants, which is consistent with the findings of an assessment of Chinese samples (He et al., 2023). Broadly speaking, this is consistent with the view that positive body image should increase with older age, as individuals begin to deprioritise an aesthetic view of the body and increasingly prioritise the body’s functions and capabilities (see Tiggemann & McCourt, 2013). In the context of Colombia and Spain specifically, it is also possible that older individuals more strongly appreciate the functions of their bodies to the extent that they are able to enact and fulfil familial expectations (e.g., being able to provide for the family, being a good parent). Additionally, the context of *familismo* may also mean that older individuals have greater opportunities to develop benevolent characteristics, not just toward others but also toward the self, which in turn might promote greater functionality appreciation.

4.1. Limitations and conclusion

We acknowledge that some of the evaluation above is speculative, which reflects the opportunistic nature of the present study. That is, we utilised existing datasets, rather than designing a specific study for our objectives here, which would have offered greater scope to ask and answer different research questions. Nevertheless, as we have intimated above, establishing measurement invariance of the FAS across national groups is important in its own right, and it is our hope that the present study offers a springboard for future work to delve more fully into the issues we have discussed here. Such future work may also benefit from a greater emphasis on operational equivalence (for a discussion, see Swami & Barron, 2019), or the use of identical (insofar as possible) procedures across research sites. Recent cross-national work (e.g., Swami, Tran et al., 2023) has shown how this might be accomplished.

Additionally, the present work was limited in terms of the demographic data that were collected in the original studies. In future work, it may be useful to extend our findings vis-à-vis respondent demographics to other characteristics, such as minoritised sexual identity. In the United States, for example, it has been shown that the FAS retains its unidimensional factor structure in minoritised sexual identity populations (Souliard & Vander Wal, 2021) and is invariant across minoritised sexual orientation women and heterosexual women (Souliard & Vander Wal, 2022). Examining issues of invariance and DIF at the intersection of nationality and diverse sexual identities and orientations would, therefore, be a useful step for future research. Likewise, it would also be useful to consider DIF across socioeconomic status, especially as low-income Colombians may be more likely than Spaniards to have been exposed to violence, conflict, and organised crime (Mesurado et al., 2014). How such experiences may affect functionality appreciation is currently unknown, but would be worthy of future research.

These limitations aside, the present study contributes to the growing body of research on functionality appreciation. Specifically, we show that, in the context of Spanish-speaking adults in Colombia and Spain,

the FAS demonstrates measurement invariance across nations and lacks DIF in terms of age, BMI, and gender identity. This is important from a theoretical point-of-view because it adds weight to the notion that the FAS is capturing a common, underlying construct of functionality appreciation across cultural and national groups (Todd & Swami, 2020). From a practical point-of-view, our findings suggest that Spanish variants of the FAS can be effectively utilised in cross-national comparisons across adults from Colombia and Spain. In addition, the present work may also inform cross-national clinical initiatives, especially as recent work has shown that greater functionality appreciation is associated with body image improvements in patients with an eating disorder (Engel et al., 2023).

Ascertaining the extent to which the present results hold in more diverse national, cultural, and linguistic settings will be important in the future. Indeed, as a general point, we advocate for greater explorations of how linguistic and cultural differences may (or may not) affect responses to common body image instruments (e.g., Swami, Tran et al., 2023). Scholars may sometimes assume that language makes little difference to the way that instruments are completed, but language encodes meaning in different ways and body image instruments often impose severe restrictions in the ways that meaning can be conveyed (Swami, Todd, & Barron, 2021). As such, ensuring measurement invariance of body image instruments that are increasingly used in different linguistic groups, such as the FAS, remains a vital task for body image researchers and practitioners.

CRedit authorship contribution statement

Moises Mebarak: Writing – review & editing, Project administration, Methodology, Data curation, Conceptualization. **Christophe Maïano:** Writing – review & editing, Formal analysis, Data curation. **Juan Mendoza:** Writing – review & editing, Project administration, Investigation, Data curation, Conceptualization. **Ángel Zamora:** Writing – review & editing, Investigation, Data curation. **Rosa Baños:** Writing – review & editing, Investigation. **Lorena Desdentado:** Writing – review & editing, Investigation. **Marta Miragall:** Writing – review & editing, Investigation. **Rocío Herrero:** Writing – review & editing, Investigation. **Viren Swami:** Writing – original draft, Validation, Methodology, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

References

- Alleva, J. M., Atkinson, M. J., Vermeulen, W., Montpellier, V. M., & Martijn, C. (2023). Beyond body size: Focusing on body functionality to improve body image among women who have undergone bariatric surgery. *Behavior therapy, 54*(1), 14–28. <https://doi.org/10.1016/j.beth.2022.06.007>
- Alleva, J. M., Custers, M., Wu, Y., & Martijn, C. (2023). Psychometric properties of a Dutch translation of the Functionality Appreciation Scale (FAS) among adults in the Netherlands. *Body Image, 47*, Article 101624. <https://doi.org/10.1016/j.bodyim.2023.101624>
- Alleva, J. M., & Martijn, C. (2019). Body functionality. In T. L. Tylka, & N. Piran (Eds.), *Handbook of positive body image and embodiment: Constructs, protective factors, and interventions* (pp. 33–41). Oxford University Press. <https://doi.org/10.1093/med-psych/9780190841874.003.0004>
- Alleva, J. M., & Tylka, T. L. (2021). Body functionality: A review of the literature. *Body Image, 36*, 149–171. <https://doi.org/10.1016/j.bodyim.2020.11.006>
- Alleva, J. M., Tylka, T. L., & Kroon Van Diest, A. M. (2017). The Functionality Appreciation Scale (FAS): Development and psychometric properties in U.S. community women and men. *Body Image, 23*, 28–44. <https://doi.org/10.1016/j.bodyim.2017.07.008>

- Anastasiades, E., Todd, J., Argyrides, M., & Swami, V. (2023). Psychometric properties of a Greek translation of the Functionality Appreciation Scale (FAS) in adults from the Republic of Cyprus. *Body Image, 45*, 25–33. <https://doi.org/10.1016/j.bodyim.2023.01.010>
- Ardila, A. (2020). Who are the Spanish speakers? An examination of their linguistic, cultural, and societal commonalities and differences. *Hispanic Journal of Behavioral Sciences, 42*(1), 41–61. <https://doi.org/10.1177/0739986319899735>
- Balcells, L., & Steele, A. (2016). Warfare, political identities, and displacement in Spain and Colombia. *Political Geography, 51*, 15–20. <https://doi.org/10.1016/j.polgeo.2015.11.007>
- Browne, A., Bennouna, C., Asghar, K., Correa, C., Harker-Roa, A., & Stark, L. (2021). Risk and refuge: Adolescent boys' experiences of violence in "post-conflict" Colombia. *Journal of Interpersonal Violence, 36*(19–20), 9393–9415. <https://doi.org/10.1177/0886260519867150>
- Calderón-Tena, C. O., Knight, G. P., & Carlo, G. (2011). The socialization of prosocial behavioral tendencies among Mexican American adolescents: The role of familism values. *Cultural Diversity and Ethnic Minority Psychology, 17*(1), 98–106. <https://doi.org/10.1037/a0021825>
- Calogero, R. M., Tylka, T. L., & Mensinger, J. L. (2016). Scientific weightism: A view of mainstream weight stigma research through a feminist lens. In T.-A. Roberts, N. Curtin, L. E. Duncan, & L. M. Cortina (Eds.), *Feminist perspectives on building a better psychological science of gender* (pp. 9–28). Springer International Publishing/Springer Nature. https://doi.org/10.1007/978-3-319-32141-7_2
- Català, V. B., Colom, S. M., Santamaria, L. C., & Casujust, A. G. (2012). Male hegemony in decline? Reflections on the Spanish case. *Men and Masculinities, 15*(4), 406–423. <https://doi.org/10.1177/1097184x12455399>
- Cerea, S., Todd, J., Ghisi, M., Mancini, P., & Swami, V. (2021). Psychometric properties of an Italian translation of the Functionality Appreciation Scale. *Body Image, 38*, 210–218. <https://doi.org/10.1016/j.bodyim.2021.04.007>
- Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement. *Structural Equation Modeling, 14*, 464–504. <https://doi.org/10.1080/10705510701301834>
- Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*, 233–255. https://doi.org/10.1207/S15328007SEM0902_5
- Chen, F. F. (2008). What happens if we compare chopsticks with forks? The impact of making inappropriate comparisons in cross-cultural research. *Journal of Personality and Social Psychology, 95*(5), 1005. <https://doi.org/10.1037/a0013193>
- Engel, M. M., Woertman, E. M., Dijkerman, H. C., & Keizer, A. (2023). Functionality appreciation is associated with improvements in positive and negative body image in patients with an eating disorder and following recovery. *Journal of Eating Disorders, 11*, 179. <https://doi.org/10.1186/s40337-023-00903-y>
- Guenole, N., & Brown, A. (2014). The consequences of ignoring measurement invariance for path coefficients in structural equation models. *Frontiers in Psychology, 5*, 980. <https://doi.org/10.3389/fpsyg.2014.00980>
- He, J., Cui, T., Barnhart, W. R., & Chen, G. (2023). The Chinese version of the Functionality Appreciation Scale: Psychometric properties and measurement invariance across gender and age. *Journal of Eating Disorders, 11*, 99. <https://doi.org/10.1186/s40337-023-00826-8>
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Linarodon, J., Messer, M., & Tylka, T. L. (2023). Functionality appreciation and its correlates: Systematic review and meta-analysis. *Body Image, 45*, 65–72. <https://doi.org/10.1016/j.bodyim.2023.02.002>
- Lipski, J. M. (1994). *Latin American Spanish*. Longman.
- Longhurst, P., & Swami, V. (2023). A feeling difficult to identify: Alexithymia is inversely associated with positive body image in adults from the United Kingdom. *Journal of Affective Disorders, 334*, 121–128. <https://doi.org/10.1016/j.jad.2023.04.142>
- Maïano, C., Morin, A. J., Tietjens, M., Bastos, T., Luiggi, M., Corredeira, R., ... Sánchez-Oliva, D. (2023). German, Portuguese and Spanish versions of the revised short form of the Physical Self-Inventory (PSI-S-R). *Measurement in Physical Education and Exercise Science, 27*(1), 10–20. <https://doi.org/10.1080/1091367X.2022.2034164>
- Maïano, C., Thibault, I., Dreiskämper, D., Henning, L., Tietjens, M., & Aimé, A. (2023). Psychometric properties of the French and German versions of the Physical Self-Concept Questionnaire for Elementary School Children – Revised (PSCQ-C-R). *Measurement in Physical Education and Exercise Science, 27*(2), 181–194. <https://doi.org/10.1080/1091367X.2022.2129971>
- Marmara, D., & Zarate, D. (2022). Functionality Appreciation Scale (FAS): Item Response Theory examination. Research Square. <https://doi.org/10.21203/rs.3.rs-1148688/v1>
- Marsh, H. W., Hau, K.-T., & Grayson, D. (2005). Goodness of fit evaluation in structural equation modeling. In A. Maydeu-Olivares, & J. McArdle (Eds.), *Contemporary psychometrics* (pp. 275–340). Erlbaum.
- Marsh, H. W., Nagengast, B., & Morin, A. J. S. (2013). Measurement invariance of Big-Five factors over the life span: ESEM tests of gender, age, plasticity, maturity, and la dolce vita effects. *Developmental Psychology, 49*(6), 1194–1218. <https://doi.org/10.1037/a0026913>
- McDonald, R. P. (1970). Theoretical foundations of principal factor analysis, canonical factor analysis, and alpha factor analysis. *British Journal of Mathematical and Statistical Psychology, 23*, 1–21. <https://doi.org/10.1111/j.2044-8317.1970.tb00432.x>
- Mebarak, M., Todd, J., Chamorro Coneo, A. M., Muñoz-Alvis, A., Polo-Vargas, J. D., De Los Reyes Aragón, C., Herrera, M., Martínez, M., Hoyos De Los Ríos, O. L., Mendoza, J., Carrasquilla, A., & Swami, V. (2023). Psychometric properties of a Spanish translation of the functionality appreciation scale (FAS) in adults from

- Colombia. *Body Image*, 47, Article 101631. <https://doi.org/10.1016/j.bodyim.2023.101631>
- Mesurado, B., Richaud, M. C., Mestre, M. V., Samper-García, P., Tur-Porcar, A., Morales Mesa, S. A., & Viveros, E. F. (2014). Parental expectations and prosocial behavior of adolescents from low-income backgrounds: A cross-cultural comparison between three countries—Argentina, Colombia, and Spain. *Journal of Cross-Cultural Psychology*, 45(9), 1471–1488. <https://doi.org/10.1177/0022022114542284>
- Millsap, R. E. (2011). *Statistical approaches to measurement invariance*. Routledge.
- Morin, A. J. S., Maïano, C., Scalas, L. F., Aşçı, F. H., Boughattas, W., Abid, S., Mascret, N., Kara, F. M., Fadda, D., & Probst, M. (2018). Cross-cultural validation of the short form of the Physical Self Inventory (PSI-S). *Sport, Exercise, and Performance Psychology*, 7(1), 60–79. <https://doi.org/10.1037/spy0000096>
- Morin, A. J. S., Marsh, H. W., & Nagengast, B. (2013). Exploratory structural equation modeling. In G. R. Hancock, & R. O. Mueller (Eds.), *Structural equation modeling: A second course* (pp. 395–436). Information Age.
- Muthén, L.K., & Muthén, B. (2024). Mplus user's guide, V 8.11. Muthén & Muthén.
- Namatame, H., Yamamiya, Y., Shimai, S., & Sawamiya, Y. (2022). Psychometric validation of the Japanese version of the Functionality Appreciation Scale. *Body Image*, 40, 116–123. <https://doi.org/10.1016/j.bodyim.2021.11.007>
- Oyserman, D., Coon, H. M., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: Evaluation of theoretical assumptions and meta-analyses. *Psychological Bulletin*, 128(1), 3–72. <https://doi.org/10.1037/0033-2909.128.1.3>
- Rodriguez-del-Pino, J. A. (2019). A farewell to the Iberian Spanish macho? An analysis of masculinity in Spain. Conversation with experts. *Revista Crítica Dèlèlòtt Ciències Socials*, 118, 5–24. <https://doi.org/10.4000/rccs.8398>
- Soulliard, Z. A., & Vander Wal, J. S. (2021). Confirmatory factor analyses of the Body Image-Acceptance and Action Questionnaire and Functionality Appreciation Scale among LBGQ adults. *Current Psychology*, 40, 4278–4286. <https://doi.org/10.1007/s12144-020-01199-w>
- Soulliard, Z. A., & Vander Wal, J. S. (2022). Measurement invariance and psychometric properties of three positive body image measures among cisgender sexual minority and heterosexual women. *Body Image*, 40, 146–157. <https://doi.org/10.1016/j.bodyim.2021.12.002>
- Swami, V., & Barron, D. (2019). Translation and validation of body image instruments: Challenges, good practice guidelines, and reporting recommendations for test adaptation. *Body Image*, 31, 204–220. <https://doi.org/10.1016/j.bodyim.2018.08.014>
- Swami, V., Furnham, A., Horne, G., & Stieger, S. (2020). Taking it apart and putting it back together again: Using Item Pool Visualisation to summarise complex data patterns in (positive) body image research. *Body Image*, 34, 155–166. <https://doi.org/10.1016/j.bodyim.2020.05.004>
- Swami, V., Maïano, C., & Morin, A. J. S. (2023). A guide to exploratory structural equation modeling (ESEM) and bifactor-ESEM in body image research. *Body Image*, 47, 101641. <https://doi.org/10.1016/j.bodyim.2023.101641>
- Swami, V., Todd, J., Aspell, J. E., Mohd. Khatib, N. A., Toh, E., Zahari, H. S., & Barron, D. (2019). Translation and validation of a Bahasa Malaysia (Malay) version of the functionality appreciation scale. *Body Image*, 30, 114–120. <https://doi.org/10.1016/j.bodyim.2019.06.001>
- Swami, V., Todd, J., Azzi, V., Malaeb, D., Sarray El Dine, A., Obeid, S., & Hallit, S. (2022). Psychometric properties of an Arabic translation of the Functionality Appreciation Scale (FAS) in Lebanese adults. *Body Image*, 42, 361–369. <https://doi.org/10.1016/j.bodyim.2022.07.008>
- Swami, V., Todd, J., & Barron, D. (2021). Translation and validation of body image instruments: An addendum to Swami and Barron (2019) in the form of frequently asked questions. *Body Image*, 37, 214–224. <https://doi.org/10.1016/j.bodyim.2021.03.002>
- Swami, V., Todd, J., Goian, C., Tudorel, O., Barron, D., & Vintilă, M. (2021). Psychometric properties of a Romanian translation of the Functionality Appreciation Scale (FAS). *Body Image*, 37, 138–147. <https://doi.org/10.1016/j.bodyim.2021.02.010>
- Swami, V., Tran, U. S., Stieger, S., Aavik, T., Abdollahpour Ranjbar, H., Adebayo, S. O., Afhami, R., Ahmed, O., Aimé, A., Akel, M., Al Halbusi, H., Alexias, G., Ali, K. F., Alpdal, N., Alsahlani, A. B., Álvares-Solas, S., Amaral, A. C. S., Andrianto, S., Apsden, T., & Voracek, M. (2023). Body appreciation around the world: Measurement invariance of the Body Appreciation Scale-2 (BAS-2) across 65 nations, 40 languages, gender identities, and age groups. *Body Image*, 46, 449–466. <https://doi.org/10.1016/j.bodyim.2023.07.010>
- Szapocznik, J., Kurtines, W., Santisteban, D. A., & Rio, A. T. (1990). Interplay of advances between theory, research, and application in treatment interventions aimed at behavior problem children and adolescents. *Journal of Consulting and Clinical Psychology*, 58(6), 696–703. <https://doi.org/10.1037/0022-006X.58.6.696>
- Tiggemann, M., & McCourt, A. (2013). Body appreciation in adult women: Relationships with age and body satisfaction. *Body Image*, 10(4), 624–627. <https://doi.org/10.1016/j.bodyim.2013.07.003>
- Todd, J., & Swami, V. (2020). Assessing the measurement invariance of two positive body image instruments in adults from Malaysia and the United Kingdom. *Body Image*, 34, 112–116. <https://doi.org/10.1016/j.bodyim.2020.05.009>
- Triandis, H. C., Marín, G., Lisansky, J., & Betancourt, H. (1984). *Simpattia* as a cultural script of Hispanics. *Journal of Personality and Social Psychology*, 47(6), 1363–1375. <https://doi.org/10.1037/0022-3514.47.6.1363>
- Unger, J. B., Ritt-Olson, A., Teran, L., Huang, T., Hoffman, B., & Palmer, P. (2002). Cultural values and substance abuse in a multiethnic sample of California adolescents. *Addictions Research and Theory*, 10(3), 257–280. <https://doi.org/10.1080/16066350211869>
- Zamora, Á., Desdentado, L., Herrero, R., Miragall, M., & Baños, R. (2024). Psychometric properties of the Spanish version of the functionality appreciation scale. *Journal of Eating Disorders*, 12, 50. <https://doi.org/10.1186/s40337-024-01004-0>