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Validation of an Adapted Version of the Glasgow Anxiety Scale for People with Intellectual Disabilities (GAS-ID)

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Abstract

Aims. To validate adapted versions of the Glasgow Anxiety Scale for People with Intellectual Disabilities (GAS-ID) simultaneously developed in English and French.

Methods. A sample of 361 youth with mild to moderate intellectual disability (ID) (*M* = 15.78 years) from Australia (English-speaking) and Canada (French-speaking) participated in this study.

Results. The results supported the factor validity and reliability, measurement invariance (between English and French versions), a lack of differential items functioning (as a function of youth's age and ID level, but not sex in the English-Australian sample), temporal stability (over one year interval), and convergent validity (with global self-esteem and school loneliness) of a bi-factor exploratory structural equation modeling representation of the GAS-ID.

Conclusions. The present study supports the psychometric properties of the English-Australian and French-Canadian versions of the adapted GAS-ID.

Keywords: Age, intellectual disability, psychological wellbeing, measurement invariance, multiple indicators multiple causes, special education needs

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Introduction

Systematic reviews and meta-analyses have synthesized research on the occurrence of anxiety among people with intellectual disabilities (ID) (Buckles et al., 2013; Einfeld et al., 2011; Hudson & Chan, 2002; Maïano et al., 2018; Oeseburg et al., 2011; Reardon et al., 2015; Whitaker & Read, 2006). These syntheses indicate that manifestations of anxiety tend to be highly prevalent in this population and may be even more frequent than among typically developing populations. To help researchers achieve a better understanding of anxiety among individuals with ID, some instruments have been developed or adapted for this population (Hermans et al., 2011; Reardon et al., 2015). However, most of these instruments rely on reports provided by external informants (e.g., parent, teacher) to circumvent the challenges posed by the assessment of internal states among individuals with limited levels of cognitive functioning. Importantly, manifestations of anxiety remain mainly internal, and hard to observe, thus highlighting the value of self-reports, even among populations with ID (Hermans et al., 2013; Smith, 2007). This recognition matches the multiple calls that have been made for the empowerment of persons with ID, who should be able to express their unique perspectives in the assessment of their own internal states (Hartley & MacLean, 2006).

1.1 Anxiety among Youth with and without ID

Anxiety encompasses a range of manifestations, including apprehensions, fears, and worries that are typically accompanied by somatic symptoms such as tension (American Psychological Association, 2020). Anxious symptoms tend to become more frequent as youth without ID transition from childhood into adolescence, before becoming more stable from late adolescence to adulthood (Vasey et al., 2014). Males and females tend to present a similar risk of anxiety during childhood, but the increased rates of anxiety observed in adolescence is particularly marked for females (Vasey et al., 2014). Comparing youth with and without ID, Rodas et al. (2020) found that manifestation of anxiety followed similar developmental trends from childhood into adolescence for members of both subpopulations, but that the sex differences observed among typically developing (TD) youth in adolescence may not generalize to youth with ID. Other studies conducted among individuals with ID have also failed to identify the sex differences that are usually found among TD youth (Chester et al., 2013; Rojahn et al., 2011). Furthermore, youth levels of ID do not seem to influence the risk of anxiety (Hermans et al., 2013; Rojahn et al., 2011).

As for TD youth, research conducted among youth with ID suggests that anxiety tends to be associated with a less positive psychosocial adjustment (Byrne, 2000; Maes et al., 2019; Sowislo & Orth, 2013). Anxious youth with ID thus tend to report lower levels of global self-esteem than their non-anxious peers (Chester et al., 2013). This greater tendency to devalue themselves might also explain why anxious youth with ID tend to feel more socially isolated than their TD peers (Klein et al., 2018). Anxious youth with ID thus seem to present a higher risk of feeling lonely irrespective of their true level of social integration (Bond et al., 2020).

1.2 The Glasgow Anxiety Scale for People with ID (GAS-ID)

In their systematic review of instruments available to assess anxiety among individuals with ID, Hermans et al. (2011) concluded that the most promising self-report instrument was the Glasgow Anxiety Scale for people with ID (GAS-ID; Mindham & Espie, 2003). The GAS-ID includes 27 questions measuring three types of anxiety manifestation: (1) worries (10 items), (2) fears (9 items), and (3) physiological symptoms (8 items). Individuals with ID answer each item using a three point scale ranging from “Never felt like this” (coded 0) to “Always felt like this” (coded 2). These response choices are accompanied by cue cards providing a visual representation. Mindham and Espie (2003) investigated the psychometric properties (content, discriminant, criterion and concurrent validities, and reliability) of the GAS-ID among an English sample of 35 anxious and non-anxious adults with ID and 19 anxious adults without ID. Their results supported the content validity of the 27 questions, and the discriminant validity of the global GAS-ID score (i.e., anxious adults with ID scored significantly higher than non-anxious adults with ID). Their results also supported the criterion-related validity of scores on the GAS-ID in relation to scores on the Beck Anxiety Inventory among anxious adults without ID. Their results also supported the criterion-related validity of scores on the physiological symptoms dimension of the GAS-ID and changes in pulse rate among anxious and non-anxious adults with ID. Finally, their results supported the test-retest reliability of the global GAS-ID score (among anxious and non-anxious adults with ID) over a period of 4 weeks (r= .95), and the scale score reliability of the global score (α=. 96), and of the specific dimensions (α=. 80 to .92).

To our knowledge, only two other studies have examined the psychometric properties of the GAS-ID, and both studies did so in other languages (Hermans et al., 2013; Müller et al., 2019). Hermans et al. (2013) administered a Dutch version of the GAS-ID to 195 adults with ID (aged between 16 to 87 years). Their results supported the test-retest reliability of the global GAS-ID score over 14 to 37 days (r = .89), its scale score reliability (α=. 86), and its convergent validity in relation to scores on the anxiety subscale of the Hospital Anxiety and Depression Scale (r = .61). They also found a significant association with age and sex (but not with ID level or comorbid diagnoses of autism) and the global GAS-ID score and supported the discriminant validity of this global score (higher scores among participants with a psychiatric diagnosis relative to other participants).

Müller et al. (2019) administered a German version of the GAS-ID among 72 adults with ID. Their results supported the scale score reliability (α=. 90) and convergent validity in relation to the global score on the Beck Anxiety Inventory (r = .76) of the global GAS-ID score. They also found support for the discriminant validity of the global GAS-ID score between anxious adults with ID and adults with ID without comorbid mental disorders.

1.3 Factor Validity and Measurement Invariance of the GAS-ID

Although these previous studies supported the psychometric properties of the GAS-ID, they remain limited in various ways. First, the relatively small samples used in these studies call into question the true generalizability of their results. Second, the factor validity of the *a priori* three-dimensional structure of the GAS-ID has never been systematically assessed. Third, no evidence currently exists to support the idea that the three *a priori* dimensions of the GAS-ID can be combined into a global score. Fourth, the psychometric results reported by two out of these three studies are limited to the global GAS-ID score (Hermans et al., 2013; Müller et al, 2019), leaving as an open question whether their results would generalize at the subscale level. These limitations reinforce the need for a thorough examination of the global and specific factor structure of the GAS-ID to clearly inform practitioners and scholars about whether it is appropriate to use a global score, specific dimensions scores, or both when using the GAS-ID.

Another important issue that has not yet been examined is related to whether the GAS-ID can be reliably used to compare scores (observed or latent) as a function of the main characteristics of the individual with ID who is the focus of the rating (e.g., sex, age, and ID level). This verification of generalizability involves tests of measurement invariance (Millsap, 2011) conducted on the factor structure of the GAS-ID to detect possible measurement biases which may invalidate group comparisons (Maïano et al., 2015; Maïano et al., 2021).

Finally, the GAS-ID has been developed among samples of adults with ID and its psychometric properties have been exclusively examined among this population. Therefore, the appropriateness of the format and content (items and response scale) of the GAS-ID and of its psychometric properties among samples of youth with ID remains to be verified.

1.4 Objectives

The main objective of this study was to examine the psychometric properties of a new version of the GAS-ID specifically adapted for youth with ID. To further contribute to the availability of this instrument for purposes of cross-cultural research, this adapted version was systematically developed in English and French from the original English GAS-ID. More specifically, this study pursues five objectives that address some of the previous research limitations. First, we examine the factor validity and reliability of the adapted version of the GAS-ID among a sample of youth with ID using bifactor confirmatory factor analysis (CFA) and exploratory structural equation modeling (ESEM). Second, we examine the measurement invariance of the factor structure of the adapted version of the GAS-ID across linguistic versions. Third, we examine the presence of differential item functioning (DIF) and latent mean differences (and their invariance across linguistic versions) on the adapted version of the GAS-ID as a function of main characteristics (i.e., sex, age, and ID level). Fourth, we examine the convergent validity of the adapted version of the GAS-ID with measures of global self-esteem and school loneliness. Fifth, we examine the measurement invariance and temporal stability over a one-year period of the adapted version of the GAS-ID.

2. Material and Methods

2.1 Participants

Participants were 361 youth (60.7% boys; Age: 11.92-21.52 years; M= 15.78 years) presenting mild (51.2%; corresponding to IQ scores between 50 and 70) and moderate (48.8%; corresponding to

IQ scores between 35 and 49) levels of ID. ID classifications were determined using IQ scores available in the school records, which were in line with the revised fourth version of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2000) at the time of data collection. These participants were recruited in secondary schools or community organizations located in Australia (English-speaking; N = 242; 66.9% boys; M_{age} = 15.20 years; 59.6% with mild levels of ID; 40.4% with moderate levels of ID) and Canada (French-speaking; N = 119; 47.9% boys; M_{age} = 16.70 years; 32.4% with mild levels of ID; 67.6% with moderate levels of ID). Of those youth, 237 completed the GAS-ID one year later (62% boys; 47.1% with mild levels of ID; 52.9% with moderate levels of ID; 166 from Australia and 71 from Canada).

2.2 Procedures

Authorization to conduct the study was obtained from the research ethics committees of the first, fifth, and sixth author's institutions. All participants were recruited within schools or community organizations that agreed to support this research proposal. No compensation was offered in Australia, whereas Canadian participants were eligible to win one out of 40 gift certificates ($30 CAD) annually. The parents or legal representatives of all participants provided signed informed consent for their children's participation. For those recruited via participating schools, this consent form was directly sent to the parents by the school, together with an information letter, and the signed consent form was returned directly to the school where it was recuperated by members of the research team. For participants recruited outside of the participating schools, parents received this material directly from the research team, and returned the signed consent form to the researchers using reply paid envelope.

Participating youth were met at their schools or at a location most convenient for them (for those recruited outside of schools) by members of the research team or trained research assistants who explained the goals and procedures of the study, as well as youth's right not to participate or to withdraw from the study at any time without consequences. Participants were asked to actively and voluntarily consent. Testing was realized in small groups including up to 8 youth with mild level of ID or including 1 or 2 youth with moderate level of ID. A read-aloud assisted procedure was utilized to maximise understanding, and youth were encouraged to ask questions. The trained research assistants, using sample questions for each questionnaire, explained how to use the response scale using a template comprising a graphical displays and pictograms. Sometimes, despite the available support, participants remained unable to understand an item's sentence. In these instances, they were instructed to select the "do not understand the statement" option. Those responses (0.6% to 3.7%; M=0.88%) were treated as missing values. All youth reported their answers on a paper questionnaire by circling their response. All discussions were related to youth's understanding of the items and response scales, and not to the content of their answers. Youth were instructed to circle their answer rather than to say it out loud, which ensured that their responses were kept private. Irrespective of the number of youth in each testing group, the same standardized procedures were followed.

2.3 Measures

2.3.1 Youth's Characteristics. Information about youth's age (i.e., determined based on date of birth), sex, and ID level were obtained from school records. The access to school records, including youth's most recent level of intellectual functioning, was granted by parents in their consent form. The IQ test most frequently used by the schools in both countries was the Wechsler (Wechsler, 2003) Intelligence Scale for Children – Fourth Edition (WISC-IV). However, when the last IQ assessment available in the school records was older than four years, a new IQ assessment was conducted (14% for English-Australian; 50.4% for French-Canadian) by a registered psychologist using the WISC-IV, the Wechsler Adult Intelligence Scale-IV (Wechsler et al., 2008), or the Leiter international performance scale-revised (Roid & Miller, 1997), depending on age and verbal expression skills.

2.3.2. Anxiety. The GAS-ID was adapted for youth with ID following a four step process. First, members of the research team familiar with the use of self-report questionnaires among youth with ID examined the appropriateness of the original version of the GAS-ID for use among this population. Based on this preliminary assessment some adaptations were proposed: (a) the interrogative questions (which could potentially inflate youth tendencies to respond in an extreme either-or manner rather than as a matter of degree) were reformulated in an affirmative manner; (b) the words forming the sentences were accompanied by pictograms (presented above the words); and (c) the original response scale was replaced by a Likert-style graphical bucket scale (Argus et al., 2004) to maximize youth's understanding. Second, this preliminary adaptation of the English version of the GAS-ID was translated

into French following a translation back-translation procedure. In a third step, this preliminary adaptation of both linguistic versions was pre-tested among a first sample of youth with ID, which led to slight changes in formulation and in the format of the Likert-style graphical bucket scale. These slight changes were systematically made in both languages by bilingual members of the research team, and versions were again compared in committee to maintain linguistic equivalence. Fourth, this revised version was pre-tested among a second sample of youth with ID, which supported its adequacy and suitability. A more extensive presentation of these procedures is provided in section S1 of the online supplements.

The 27 items of the adapted GAS-ID encompass worries (10 items), fears (9 items), and physiological symptoms (8 items). For each item, participants were asked to nominate either "Yes" or "No" regarding whether or not they have felt this way or whether or not they have thought about this since the last week. If the participant answered "Yes", they were asked to tell how many times they have felt this way or have thought about it since the last week. As recommended by Argus et al. (2004), the "concept of a week was explained in terms of school days and weekend days" (p. 497). Additionally, to increase youth's understanding, if the day of data collection was "Tuesday", the participant was asked to answer "since, last Tuesday". Participants responded to each item using a Likert-graphical bucket five-point answer scale (see Table S1 of the online supplements for English and French answer scales), ranging from "No, never associated with an empty bucket" to "Yes, always associated with a bucket full of timepiece pictograms". The original English items, as well as the adapted English and French items and response scales are presented in Table S1 of the online supplements. The complete questionnaires are available upon request from the corresponding author.

2.3.3 Global Self-esteem. English and French versions of the global self-esteem scale of the Self-Description Questionnaire I – Individual Administration for people with intellectual disabilities (SDQ-IA-ID; Marsh et al., 2006) were used. The global self-esteem scale includes eight items measuring how participants perceived themselves in general (e.g., "I am proud of myself"). For purposes of this study, the original answer scale (i.e., "No, always" to "Yes, always") was replaced by a six-point answer scale including graphical faces (i.e., "No, I totally disagree" associated with a very unhappy face to "Yes, I totally agree" associated with a very happy face).

2.3.4 School loneliness. English and French versions of a short form of the School Loneliness Scale (SLS; Asher et al., 1984) was used. The SLS scale includes eight items measuring the youth's perception of how they feel at school (e.g., "I feel lonely in my school"). For purposes of this study, items were maximally simplified and the original five-point response scale (i.e., "Not true" to "Always true") was replaced by a similar five-point answer scale including graphical faces (i.e., "No, I totally disagree" associated with a very unhappy face to "Yes, I totally agree" associated with a very happy face).

2.4 Data Analysis

Given the ordinal nature of the data, analyses were performed using Mplus' (version 8.5; Muthén & Muthén, 2017) robust weighted least squares (WLSMV) estimator. The few missing responses (Time 1: 0.86% to 5.14%; Time 2: 0.84% to 3.38%) were managed using algorithms implemented in Mplus for WLSMV estimation (Muthén & Muthén, 2017). First, the *a priori* factor structure of the GAS-ID was estimated using CFA and ESEM. In CFA, answers to the GAS-ID were explained by three (physiological symptoms, fears, and worries) correlated factors and no cross-loading or correlated uniqueness was allowed. The *a priori* ESEM model was estimated using confirmatory target rotation (Asparouhov & Muthén, 2009; Browne, 2001) in which answers to the GAS-ID were explained by three correlated factors defined as in CFA, but where all cross-loadings were freely estimated and "targeted" to be as close to zero as possible. A single factor CFA solution was also estimated. Bifactor-CFA (BCFA) and bifactor-ESEM (BESEM) representations of the GAS-ID were also examined. The bifactor solutions include one more factor than their CFA or ESEM counterparts. Indeed, in these solutions, all items were specified as having a main loading on both a global factor (G-factor) and on their *a priori* specific factors (S-factors; physiological symptoms, fears, and worries). As in typical bifactor models (Morin et al., 2016; Reise, 2012), all factors were specified as orthogonal. Additional specifications were identical to those used in the CFA and ESEM solutions. These four alternative solutions were first estimated among the overall sample, and the optimal solution was then re-estimated separately in the English-Australian and French-Canadian samples.

For all models, the composite reliability of the GAS-ID factors was estimated using McDonald's

(1970) omega (ω). Model fit was assessed with (e.g., Hu & Bentler, 1999; Marsh et al., 2005; Yu, 2002): the comparative fit index (CFI≥.90 or >.95, suggest acceptable and excellent fit, respectively), the Tucker-Lewis index (same thresholds than for CFI), the root mean square error of approximation (RMSEA ≤.08 or <.06, suggest acceptable and excellent fit, respectively). As mentioned by Morin et al. (2016) goodness-of-fit assessment is insufficient to guide model selection when contrasting CFA, ESEM, BCFA, and BESEM solutions. Indeed, they recommend a careful examination of the parameter estimates (i.e., loadings, cross-loadings, latent correlations, composite reliability) from these various models. This examination should start with a comparison of the CFA and ESEM models, where the observation of reduced factor correlations in ESEM coupled with generally well-defined factors could be taken as evidence in favor of the ESEM solution over a similarly fitting CFA solution. Then, the retained model should be contrasted to its bifactor counterpart. In this second comparison, the observation of a well-defined G-factor coupled with at least a subset of well-defined S-factors supports a bifactor solution over a similarly fitting first-order solution.

Second, the measurement invariance of the optimal solution was examined between English-Australian and French-Canadian versions in the following sequence (Morin et al., 2011a, 2016): (i) configural invariance; (ii) weak invariance (loadings); (iii) strong invariance (thresholds); (iv) strict invariance (uniquenesses); (v) invariance of the latent variances/covariances; and (vi) invariance of latent mean factors. The same sequence was also used to assess the measurement invariance of the optimal solution over time, and the invariant model obtained across time points was then used to obtain estimates of temporal stability correlations. In these tests of measurement invariance, model comparisons (i.e., the preceding model served as comparison) were based on changes (Δ) in CFIs, TLIs, and RMSEAs. A sequence was considered as invariant when ΔCFIs/ΔTLIs were ≤ .01 and ΔRMSEAs ≤. 015 (Chen, 2007; Cheung & Rensvold, 2002).

Third, hybrid multiple indicators multiple causes (MIMIC) multiple-group models were used to examine (e.g., Morin et al., 2018): (a) associations between the predictors [i.e., sex (girls coded 0 and boys coded 1), age (standardized), and ID level (mild coded 0 and moderate coded 1)] and the GAS-ID latent factors; (b) possible DIF, that is direct associations between the predictors and the GAS-ID item responses over and above association between these predictors and the GAS-ID latent factors; and (c) the invariance of these associations across the English-Australian and French-Canadian participants. These models were developed from the most invariant multiple-group model identified in the second stage, to which the predictors were included.

More specifically, hybrid MIMIC models were estimated in the following sequence (Marsh et al., 2013; Morin et al., 2013): (a) null effects model (the paths from the predictors to the GAS-ID latent factors and item responses were constrained to be zero); (b) saturated model (the paths from the predictors to the GAS-ID item responses were freely estimated, while the paths from the predictors to the GAS-ID latent factors were constrained to be zero); and (c) factors-only model (the paths from the predictors to the GAS-ID latent factors were freely estimated, while the paths from the predictors to the GAS-ID item responses were constrained to be zero). A substantial improvement in model fit (ΔCFIs/TLIs >.01 and ΔRMSEAs>.015) associated with the factors-only and saturated models relative to the null effects model supports the presence of associations between the predictors and the GAS-ID item responses. However, an improvement in model fit associated with the saturated model relative to the factors-only model indicates the presence of DIF (Morin et al., 2018). These models were first specified with all relations freely estimated (or equally constrained to be zero) across the English-Australian and French-Canadian samples. Then, the most appropriate model was compared to an alternative model in which all associations were constrained to be equal across English-Australian and French-Canadian participants.

Finally, in the overall sample, the convergent validity of the GAS-ID subscales with the global self-esteem and school loneliness measures was examined using latent variable correlations.

3. Results

3.1 Factor Validity and Reliability of the Adapted Version of the GAS-ID

The goodness-of-fit of the alternative solutions are presented in Table 1. For the overall sample, the one factor CFA solution resulted in a poor (TLI < .90) to barely acceptable (CFI = .906; RMSEA = .074) level of fit, whereas the CFA and BCFA solutions resulted in an excellent level of fit (CFI-TLI > .95, RMSEA ≤.06). The ESEM and BESEM solutions also resulted in an excellent level of fit (CFI-TLI > .95, RMSEA ≤.06), and in a substantial improvement in fit relative to their CFA (ΔCFI = +.009, ΔTLI

= +.005, ΔRMSEA = -.003) and BCFA (ΔCFI = +.010, ΔTLI = +.008, ΔRMSEA = -.006) counterparts. Similarly, the fit of the BESEM solution was also improved relative to the ESEM solution (ΔCFI = +.008, ΔTLI = +.008, ΔRMSEA = -.006). Although these results lend preliminary support to the BESEM solution, we follow Morin et al. (2016) suggestions and first turn our attention to the parameter estimates obtained in the CFA and ESEM solutions.

The parameter estimates from the CFA and ESEM solutions in the overall sample are reported in Tables S2 and S4 of the online supplements, while those from the BCFA and BESEM solutions are reported in Tables S3 of the online supplements (BCFA) and in Table 2 (BESEM). In CFA, the factors loadings (λ = -.451-.844, M =.709) were all reasonably high, and resulted in excellent coefficients of composite reliability for all factors (ω= .897-.912, M_{ω}= .903). Likewise, the ESEM solution also resulted in reasonably high main factor loadings (λ=.463-.869, M= .628) and estimates of composite reliability (ω= .881-.885, M_{ω}= .833), coupled with reasonably small, yet non-negligible, cross loadings ($|\lambda|$= .003-.337, $M_{|\lambda|}$= .119). However, the elevated latent correlations observed between the factors in the CFA solution (r=.738-.830, M_r=.780) calls into question their distinguishability. In contrast, latent factor correlations were substantially reduced in ESEM (r=.596-.689, M_r=.643), supporting the presence of more differentiated, yet inter-related, factors. For all these reasons, the ESEM solution was retained and contrasted with its BESEM counterpart.

The BESEM solution revealed a well-defined and reliable G-factor (λ=-.380-.784, M_{λ}=.620; ω= .959), consistent with the ability of the GAS-ID to assess participants' global levels of anxiety. These results revealed two reasonably well-defined S-factors related to worries (λ=.196-.569, M_{λ}=.373, ω=.740) and fears (λ=.245-.567, M_{λ}=.377, ω= .743), although the physiological symptoms S-factor was slightly more weakly defined (λ= .104-.491, M_{λ}=.278, ω= .605). This last observation suggests that the items forming this last S-factor mainly define the G-factor (Morin et al., 2020). However, taking into account that, in a bifactor model, construct-relevant variance is used to define two (G- and S-) factors rather than one, even this weaker S-factor seems to retain some non-negligible level of specificity, although this specificity may be limited to only a subset of items (Morin et al., 2020; Perreira et al., 2018). These results thus support the superiority of the BESEM solution for the adapted GAS-ID. As illustrated in Table 1, this BESEM model, when separately estimated across both linguistic samples, also resulted in an excellent level of fit, and in comparable standardized parameters estimates (reported in Tables S5 and S6 of the online supplements).

3.2 Measurement Invariance: Linguistic Versions

The goodness-of-fit statistics of BESEM measurement invariance models estimated across the two linguistic samples are reported in Table 1 (models 2-1 to 2-6). These results supported the configural, weak, strong, strict, and latent variance-covariance invariance of this solution. These results also revealed the presence of significant latent mean differences (Model 2-6 was not supported), showing that English-Australian youth, compared to their French-Canadian counterparts, tended to have significantly higher scores on the anxiety G-factor (.850, $p < .01$), and lower scores on the fears (-.462, $p < .05$) and physiological symptoms (-1.144, $p < .01$) S-factors.

3.3 DIF and Latent Mean Differences

Results from hybrid MIMIC models used to test DIF are reported in Table 1. These models were estimated starting from the most invariant measurement model from the previous sequence (model 2-5: invariance of latent variances/covariances). These results showed that the saturated model (model 3-2), but not the factors-only model (model 3-3), resulted in a meaningful improvement in model fit relative to the null effects model (model 3-1). These results thus suggest DIF as a function of one or more of the predictors (i.e., participants' sex, age, and ID level), coupled with a lack of association between predictors and scores of the GAS-ID latent factors. Examination of modification indices from the factors-only model suggested that direct paths of sex on item #15 ("I am scared of spiders") and #25 ("When I am nervous or uncomfortable, I need to go to the toilet more often than usual.") needed to be added to this model of the English-Australian sample. Therefore, a fourth model of partial DIF was estimated (model 3-4) and was found to present a level of fit comparable to that of the saturated model. The results showed that English-Australian boys with ID tended to score significantly lower on item #15 (-.169, p = .007) and higher on item #25 (.219, $p < .001$) than English-Australian girls with ID. This model also supports a lack of DIF within the French-Canadian sample, and a lack of effect of the predictors on the factors among both samples.

3.4 Convergent Validity

The structural equation model including the adapted GAS-ID latent factors and the convergent measures of global self-esteem and school loneliness resulted in a good level of fit to the data (Table 1). The composite reliability coefficients of the global self-esteem (ω = .927) and school loneliness (ω = .881) measures were both satisfactory. Latent correlations are reported in Table 3 and reveal that the global self-esteem measure is significantly and negatively related to the G-factor and positively related to the worries, fears, and physiological symptoms S-factors. Additionally, results showed that the school loneliness measure was significantly and positively related to the G-factor.

3.5 Measurement Invariance Over Time and Temporal Stability

The goodness-of-fit statistics of the BESEM model (models 1-8) estimated using participants' Time 2 responses, and of the longitudinal tests of measurement invariance (models 4-1 to 4-6) are reported in Table 1. All of these solutions achieved an excellent level of fit, lending support to the complete measurement invariance of this solution over time. Parameter estimates from the Time 2 BESEM solution are reported in Table 2 and match those obtained at Time 1. Finally, the results from the most invariant longitudinal model (i.e., latent mean invariance) revealed a one-year correlation of .437 for the worries S-factor, .518 for the fear S-factor, .649 for the physiological symptoms S-factor, and .661 for the G-factor.

4. Discussion

The first objective of this study was to examine the factor validity and reliability of English and French versions of an adapted GAS-ID among a sample of youth with ID. The results provided support for a BESEM representation of participants' ratings on the adapted GAS-ID, consistent with the idea that this instrument can be used to obtain global estimates of anxiety levels among youth with ID. However, beyond this global factor, the results also suggest that enough specificity remained at the subscale level to support the use of the adapted GAS-ID to assess fear, worries, and physiological symptoms in addition to youth's global level of anxiety, although the physiological symptoms S-factor retained far less specificity than the other two S-factors. This last observation suggests that the items forming this S-factor mainly serve to define the global anxiety factor.

Our second objective was to examine the measurement invariance of the factor structure of the adapted GAS-ID across linguistic versions. In this regard, our results supported the full invariance (i.e., weak, strong, strict, and latent variances/covariances invariance) of the BESEM factor structure. More precisely, these results indicate that both linguistic versions of the adapted GAS-ID can be considered fully equivalent and can be confidently used with samples of English- and French-speaking youth with ID. However, these results also revealed latent mean differences between our samples of English-Australian and French-Canadian youth, showing that the former tended to present higher global levels of anxiety than the latter, but lower levels fears and physiological symptoms. Although the exploration of this latent mean difference was not part of our main objectives, it does raise some interesting questions regarding the drivers of this difference (i.e., cultural differences, differences related to the school system, etc.). Unfortunately, this question cannot be investigated in the present study, given the lack of equivalence between the samples collected in both countries (i.e., non-representative convenience samples).

Our third objective was to examine DIF and latent mean differences as a function of several predictors. Results from the present study revealed a lack of DIF or latent mean differences of the adapted version of the GAS-ID responses as a function of age and ID level across both linguistic samples of participants, a lack of DIF as a function of sex in the French-Canadian sample, and a partial DIF limited to two items as a function of sex in the English-Australian sample. More precisely, our results showed that English-Australian girls tended to be more frequently afraid of spiders (item #15) than English-Australian boys irrespective of their scores on the GAS-ID factors, whereas English-Australian boys were more likely to report having to go to the toilet more often than usual (item #25) relative to English-Australian girls with similar scores on the GAS-ID factors. In relation to item #15, this difference might be explained by the fact that spiders are far more prevalent and dangerous in Australia than in Canada, possibly increasing a more normative reaction of fear of spiders among English-Australian girls with ID. However, in relation to item #25, future research would need to more specifically consider the source, and replicability, of this difference to ensure that it is not simply an artefact of random sampling variations. In sum, scores on the adapted version of the GAS-ID scales can be confidently used among English and French speaking populations to assess youth with ID irrespective of their age and ID level, and to compare these youth as a function of these characteristics.

Likewise, although the whole scale seems to function adequately to contrast French-Canadian boys and girls with ID, two items (#15 and #25) might need to be excluded, or their DIF controlled for, when comparing English-Australian boys and girls with ID.

These results are generally consistent with other studies conducted among youth with ID, who generally report similar levels of anxiety among males and females adolescents with ID (Chester et al., 2013; Rodas et al., 2020; Rojahn et al., 2011) and similarly demonstrate a lack of association between youths' ID levels and their levels of anxiety (Hermans et al., 2013; Rojahn et al. 2011). Moreover, studies investigating developmental trends indicate that anxiety increases from childhood to adolescence, but then stabilizes when approaching adulthood (Rodas et al., 2020; Vasey et al., 2014). As this study focused on adolescents and young adults, observing that age was not related to anxiety levels is also consistent with these developmental trends.

Our fourth objective was to examine the convergent validity of the adapted GAS-ID in relation to measures of global self-esteem and school loneliness. In conformity with previous results obtained among TD youth (Byrne, 2000; Maes et al., 2019; Sowislo & Orth, 2013), the present results showed that youth with ID presenting higher global levels of anxiety also tended to present lower levels of global self-esteem and higher levels of school loneliness. These observations also generally match results from previous studies conducted among individuals with ID (Bond et al., 2020; Chester et al., 2013; Klein et al., 2018). However, the associations obtained in relation to the S-factors suggested higher specific levels of worries, fears, and physiological symptoms. When considering this last set of correlations, it is important to take into account the bifactor nature of the adapted GAS-ID measurement model, which means that these S-factors, rather than reflecting commonalities among the items forming each of these subscales, reflect these commonalities once the shared variance explained by the G-factor is taken into account (Morin et al., 2020). In other words, these S-factors reflect deviations in worries, fears, and physiological symptoms over and above participants' global levels of anxiety. As such, they could be interpreted as possibly more normative levels of unease and concerns, as well as physiological symptoms not directly related to these global levels of anxiety. Although future studies will be needed to more carefully understand the mechanisms underpinning these unexpected correlations, these results clearly suggest that caution needs to be used when interpreting the meaning of these S-factors as deviations from global levels of anxiety rather than as pure indicators of worries, fears, and physiological symptoms.

Our last objective was to examine measurement invariance of the BESEM factor structure of the adapted GAS-ID over time. In this regard, results provided support for a full invariance of the factor structure of the adapted GAS-ID across a one-year interval, and revealed moderate levels of temporal stability, ranging between .437 and .661. It should be noted that these correlations do not provide pure estimates of test-retest *reliability*, which needs to be measured over a much shorter time period (i.e., one week to a month) over which scores are expected to stay unchanged. Rather, these coefficients reflect temporal stability and the extent to which ratings on the adapted GAS-ID demonstrate stability (encompassing both a lack of random measurement error and a lack of true change) over time. What these results suggest, in a way that is consistent with the known state-trait nature of anxiety levels which are known to fluctuate over time (e.g., Allan et al., 2014; McLaughlin & King, 2015; Morin et al., 2011b), is that these ratings are only moderately stable over a one-year period. This observation highlights the need to incorporate measures of anxiety at all time points in the context of longitudinal studies in order to best capture these fluctuations.

Despite its strengths, the present study has limitations that should be considered when interpreting the results. First, the adapted GAS-ID was validated using a single sample of English-Australian and French-Canadian youth with ID. The extent to which these results would generalize to other samples of youth from other English and French speaking countries, or to other linguistic versions, thus remains unknown. Therefore, it would be important for future studies to investigate the replicability of our results within more diversified samples of youth with ID. Second, testing was realized individually or in small groups of up to eight youth with ID. It is therefore possible that these different conditions of administrations might have influenced the results by inducing more, or less, social desirability among participants, or by allowing participants to benefit from varying level of support. Therefore, future research should more clearly examine whether and how testing conditions may influence the psychometric properties of scores on the adapted GAS-ID. Third, tests of the convergent validity of the adapted GAS-ID were incomplete. More precisely, additional analyses remain to be conducted in

relation to physiological measures of anxiety (e.g., measure of salivary cortisol, pulse rate) and to other questionnaires adapted to youth with ID and measuring anxiety. Fourth, the discriminant validity of the adapted GAS-ID was not examined in the present study. It is thus unknown whether clinically anxious youth with ID scored significantly higher than their peers not suffering from anxiety on the different dimensions of the questionnaire. Moreover, given that the sensitivity and specificity of the adapted GAS-ID have not been examined, no cut-off scores are currently available to help in the identification of youth with ID presenting a high risk of anxiety. Future research should be realized to document the most appropriate cut-off score for this instrument.

One last issue must be noted. In practical settings, measurement instruments are often scored manually. However, the use of observed scale scores (obtained by summing or averaging items) is inconsistent with the bifactor (BESEM) structure of the adapted GAS-ID (Brown et al., 2011; Maïano et al., 2021). A first solution is to rely on BESEM latent variable models as in the present study (Maïano et al., 2021). A second solution is to use the FSCORE algorithm available in *Mplus* statistical package to estimate global and specific latent factor mean scores from a BESEM solution (Maïano et al., 2019; Perreira et al., 2018). These factor scores reflect the parameter estimates of the BESEM solution, and can be used as observed scores in conjunction with other observed scores from other measures (Maïano et al., 2019; Perreira et al., 2018). However, for practical applications, this means that the proper scoring of individual responses will require the development of a computerized scoring algorithm comparable to that used for many other broadband questionnaires.

In conclusion, the results from the present study support the psychometric properties of the English-Australian and French-Canadian versions of the adapted GAS-ID. Both versions can be used in the context of group-based comparisons as functions of age and ID level, although two items seemed to function differently as a function of sex among English-Australian participants. This source of DIF might need to be controlled as part of research involving similar participants and seeking to achieve sex-related comparisons. Finally, based on the aforementioned limitations it is presently premature to recommend the use of the adapted version of the GAS-ID as a screening instrument of anxiety and in other cultures and languages other than English-Australian and French-Canadian.

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Table 1

Goodness-of-Fit for the Alternative Measurement Models for the Adapted GAS-ID

Models	Nº	Description	$W\chi^2$(df)	CFI	TLI	RMSEA	RMSEA 90% CI	CM	$\Delta W\chi^2$ (df)	ΔCFI	ΔTLI	ΔRMSEA
Measurement models	1-1	CFA-T1 - 1 Factor- Total sample	942.403(324)*	.906	.898	.074	.068-.079	-	-	-	-	-
	1-2	CFA-T1 - 3 Factors - Total sample	537.902(321)*	.967	.964	.044	.037-.050	-	-	-	-	-
	1-3	BCFA-T1 - 3 Factors - Total sample	469.671(297)*	.974	.969	.041	.034-.048	-	-	-	-	-
	1-4	ESEM-T1 - 3 Factors - Total sample	429.990(273)*	.976	.969	.041	.033-.048	-	-	-	-	-
	1-5	BESEM-T1 - 3 Factors - Total sample	357.134(249)*	.984	.977	.035	.027-.043	-	-	-	-	-
	1-6	BESEM-T1 - 3 Factors - Canadian sample	292.301(249)*	.979	.970	.039	.013-.056	-	-	-	-	-
	1-7	BESEM-T1 - 3 Factors - Australian sample	369.366(249)*	.970	.957	.045	.035-.055	-	-	-	-	-
	1-8	BESEM-T2 - 3 Factors - Total sample	381.857(249)*	.970	.958	.047	.038-.057	-	-	-	-	-
	1-9	Convergent validity	1253.932(776)*	.957	.949	.041	.037-.045	-	-	-	-	-
MI: Linguistic versions	2-1	Configural invariance	677.352(498)*	.968	.955	.045	.036-.054	-	-	-	-	-
	2-2	Weak (λs) invariance	737.050(590)*	.974	.969	.038	.028-.046	2-1	108.645(92)	+.006	+.014	-.007
	2-3	Strong (λs, νs) invariance	843.659(667)*	.969	.967	.039	.030-.047	2-2	122.850(77)*	-.005	-.002	+.001
	2-4	Strict (λs, νs, δs) invariance	867.912(694)*	.969	.969	.038	.029-.046	2-3	40.703(27)	.000	+.002	-.001
	2-5	Latent variances-covariances (λs, νs, δs, ξs/φs) invariance	855.190(704)*	.973	.973	.035	.026-.043	2-4	24.019(10)*	+.004	+.004	-.003
	2-6	Latent means (λs, νs, δs, ξs/φs, ηs) invariance	1028.831(708)*	.943	.944	.051	.044-.058	2-5	50.462(4)*	-.030	-.029	+.016
DIF: Age, ID-level, and sex	3-1	Null effects	1068.380(866)*	.965	.965	.036	.028-.043	-	-	-	-	-
	3-2	Saturated	835.017(704)*	.978	.972	.032	.022-.040	3-1	241.029(162)*	+.013	+.007	-.004
	3-3	Factors only	1012.981(842)*	.971	.970	.034	.025-.041	3-1	51.427(24)*	+.006	+.005	-.002
	3-4	Partial DIF	999.255(840)*	.973	.972	.032	.024-.040	3-2	172.225(136)	-.005	.000	.000
MI: Time	4-1	Configural invariance	1327.541(1184)*	.986	.983	.018	.012-.024	-	-	-	-	-
	4-2	λs invariance	1430.820(1276)*	.985	.983	.018	.012-.023	4-1	126.948(92)*	-.001	.000	.000
	4-3	λs, νs invariance	1506.412(1353)*	.985	.984	.018	.011-.023	4-2	84.593(77)	.000	+.001	.000
	4-4	λs, νs, δs invariance	1523.486(1380)*	.986	.986	.017	.010-.022	4-3	29.359(27)	+.001	+.002	-.001
	4-5	λs, νs, δs, ξs/φs invariance	1540.848(1390)*	.985	.985	.017	.011-.022	4-4	17.095(10)	-.001	-.001	.000
	4-6	λs, νs, δs, ξs/φs, ηs invariance	1583.106(1394)*	.982	.981	.019	.014-.024	4-5	17.854(4)**	-.003	-.004	+.002

Notes. * $p \leq .01$; $W\chi^2$ = robust weighed least square (WLSMV) chi-square; λ = loading; ν = thresholds; δ = uniqueness; ξ = variance; φ = covariance; η = factor mean; $\Delta W\chi^2$ = WLSMV chi square difference test (calculated with the Mplus DIFFTEST function); Δ = change from the previous model; B = bifactor; CFA = confirmatory factor analyses; CFI = comparative fit index; df = degrees of freedom; DIF = differential item functioning; ESEM = exploratory structural equation modeling; GAS-ID = Glasgow Anxiety Scale - Intellectual Disability; ID = intellectual disability; MI = measurement invariance; RMSEA = root mean square error of approximation; 90% CI = 90% confidence interval of the RMSEA; T1 = Time 1; T2 = Time 2; TLI = Tucker-Lewis index. The fact that $W\chi^2$ values are not exact, but "estimated" as the closest integer necessary to obtain a correct *p* value explains the fact that the $W\chi^2$ and the resulting CFI values can be non-monotonic with model complexity.

Table 2

Standardized Parameters Estimates from the Bifactor Exploratory Structural Equation Model of the Adapted GAS-ID in the Overall Sample

Items	Worries (λ)	Fears (λ)	Physiological symptoms (λ)	G-factor (λ)	δ
GAS1	.321 (.398)	-.053 (-.013)	-.082 (-.028)	.601 (.566)	.527 (.520)
GAS2	.278 (.527)	-.018 (-.019)	-.111 (.250)	.498 (.284)	.662 (.579)
GAS3	.407 (.549)	-.105 (.045)	-.141 (.093)	.527 (.506)	.525 (.432)
GAS4	.487 (.591)	-.072 (-.074)	-.185 (-.012)	.602 (.506)	.361 (.389)
GAS5	.391 (.485)	-.045 (-.118)	.036 (-.096)	.710 (.692)	.340 (.264)
GAS6	.260 (.557)	-.072 (-.063)	.048 (.134)	.711 (.478)	.420 (.439)
GAS7	.534 (.428)	.168 (.127)	.151 (-.081)	.518 (.604)	.395 (.429)
GAS8	.569 (.472)	.197 (.212)	.208 (-.066)	.525 (.519)	.319 (.458)
GAS9^{R}	-.282 (-.328)	-.002 (-.224)	.110 (-.189)	-.380 (-.092)	.764 (.798)
GAS10	.196 (.386)	-.098 (-.178)	-.015 (.078)	.619 (.556)	.568 (.505)
GAS11	-.060 (-.047)	.354 (.597)	-.025 (-.104)	.602 (.522)	.508 (.359)
GAS12	-.130 (.168)	.287 (.489)	-.241 (.055)	.646 (.498)	.426 (.481)
GAS13	-.001 (.027)	.545 (.465)	.059 (-.055)	.571 (.577)	.374 (.447)
GAS14	-.005 (-.237)	.567 (.337)	.074 (-.016)	.426 (.349)	.491 (.709)
GAS15	-.149 (-.004)	.245 (.409)	-.019 (.161)	.584 (.417)	.576 (.633)
GAS16	-.020 (.054)	.343 (.492)	.229 (.168)	.541 (.448)	.537 (.526)
GAS17	.197 (-.174)	.327 (-.004)	-.037 (-.201)	.673 (.701)	.400 (.438)
GAS18	.145 (-.146)	.345 (-.012)	.013 (-.070)	.719 (.825)	.343 (.294)
GAS19	.099 (-.169)	.378 (-.114)	.145 (.058)	.707 (.843)	.326 (.244)
GAS20	.026 (.033)	.053 (.040)	.171 (.406)	.693 (.591)	.487 (.483)
GAS21	-.023 (.153)	-.028 (.080)	.242 (.481)	.742 (.636)	.389 (.334)
GAS22	-.089 (.103)	-.091 (.081)	.104 (.500)	.784 (.630)	.357 (.335)
GAS23	-.018 (.047)	-.172 (-.004)	.242 (.630)	.666 (.471)	.468 (.380)
GAS24	-.045 (-.064)	.129 (.027)	.491 (.237)	.643 (.763)	.328 (.357)
GAS25	.060 (.013)	.173 (.065)	.413 (.337)	.564 (.599)	.478 (.524)
GAS26	.065 (.147)	.064 (-.185)	.292 (.201)	.716 (.713)	.395 (.396)
GAS27	-.074 (.134)	.048 (-.027)	.268 (.241)	.771 (.767)	.326 (.334)
ω	.740 .822	.743 .673	.605 .745	.959 .950	

Notes. ^{R}*:* Reverse-scored item; λ = factor loadings; δ = Uniquenesses; ω = McDonald's omega coefficient of composite reliability; G-factor = global factor; GAS-ID = Glasgow Anxiety Scale - Intellectual Disability; Time 1 λ and ω are reported first, Time 2 λ and ω are reported second in parenthesis.

Table 3

Latent Factor Correlations from the Convergent Validity Analyses of the Adapted GAS-ID and Global Self-Esteem and School Loneliness

Adapted GAS-ID	Global Self-esteem	School Loneliness
G-factor	-.285**	.300**
Worries	.263**	-.091
Fears	.272*	-.096
Physiological symptoms	.400**	-.136

Notes. * $p \leq .05$; ** $p \leq .01$; G-factor = global factor; Glasgow Anxiety Scale - Intellectual Disability; ω = McDonald's omega coefficient of composite reliability.

Online Supplements for:

Validation of an Adapted Version of the Glasgow Anxiety Scale for People with Intellectual Disabilities (GAS-ID)

S1. *Scale Development*

Objectives

The first objective was to examine the appropriateness of the format and clarity of the original version of the Glasgow Anxiety Scale for People with Intellectual Disabilities (GAS-ID). Following this initial verification, the GAS-ID was adapted to increase its clarity and ease of application based on recommendations related to the use of self-report questionnaires among people with intellectual disabilities (ID) (Finlay & Lyons, 2001, 2002). Then, this adaptation of the GAS-ID was translated into French. This preliminary adaptation was then tested among a first sample of youth with ID, which led to further adaptations. The final adaptation was then tested again among a second sample of youth with ID.

Method

Participants and Procedures

A sample of 34 youth (aged between 13 to 21 years; 35% girls) with mild to moderate-severe ID, including 20 English-speaking Australians and 14 French-speaking Canadians. A first subsample of 18 youth (N = 10 in Australia and 8 in Canada) was solicited to evaluate the format and clarity of a preliminary adaptation of the GAS-ID. A second subsample of 16 youth (N = 10 in Australia and 6 in Canada) was solicited to assess the format and clarify of the final adapted version the GAS-ID. The procedures used in this pilot study were identical to those used in the main study, and received approval from the same research ethics committees. However, in this pilot process, the GAS-ID was administered individually, at school, by trained research assistants using a read-aloud assisted procedure to maximise youth's understanding and to facilitate discussion. This administration was mainly focused on assessing the level of understanding of the youth and the ease with which they could respond to the items.

Measures

A preliminary assessment of the appropriateness of the format and clarity of the items was conducted by all members of the research team familiar with the use of self-report questionnaires among youth with ID. This preliminary assessment revealed that the item format was potentially problematic for use as a self-reported questionnaire (rather than as an individually-administered questionnaire) among youth with ID. A first concern was related to the interrogative format of the questions (e.g., *Do you worry a lot?*), which could potentially inflate youth tendencies to respond in an extreme either-or manner (i.e., Yes or No), rather than as a matter of degree. This imprecision was reinforced by the limited three-point response scale associated with this instrument (*Never*, *Sometimes*, *Always*). For this reason, the questions were reformulated in an affirmative manner (e.g., *I worry a lot*). To increase youth's understanding of the sentences, words from the items were also associated with pictograms (presented above the words). In addition, to increase the precision of the ratings, the original response scale was replaced by a Likert-style graphical bucket scale (Argus et al., 2004). In this response scale, "*Never*" was thus associated with an empty bucket, whereas "*Always*" was associated with a bucket full of water, and the intermediate points (*Rarely*, *Sometimes*, *Often*) were associated with buckets containing increasing amounts of water. Additionally, a "do not understand the statement" option was added for use for situations in which respondents remained unable to understand the item.

Once this process was completed, the adapted English version of the GAS-ID was translated into French by two bilingual members of the research team. Then, this preliminary French version was back translated into English by two other bilingual members of the research team, and compared with the adapted English version, and discrepancies were resolved by adapting the French items. During this process, decisions were taken and discussed by the research team members in committee until a consensus was reached. This process was conducted in collaboration with school personnel (i.e., teachers, psychologists, and psycho-educators) familiar with youth with ID.

Results

The responses provided by the first subsample of youth with ID revealed that some words, sentences or negative formulations used in some of the items were hard to understand (e.g., item 2:"thoughts that go round in your head", item 3: "happen in the future"; item 5: "awful might happen"; item 6: "do not feel well"; item 19: "open spaces"; item 24: "feel breathless") or lacked precision (e.g., item 9: "stop worrying"; items 20-27 measuring physiological symptoms: "feel very

hot or sweaty", "heart beast faster", etc.). Moreover, several participants had difficulties understanding the association between the Likert terms and the buckets containing different amount of water. As a result, slight changes were made in some item formulations. Second, the response scale was adjusted by adding Yes and No before each response: "*No, never*", "*Yes, rarely*", "*Yes, sometimes*", "*Yes, often*" and "*Yes, always*" Additionally, the water inside the bucket was replaced by four timepieces pictograms (see Table S1 of these supplements). The first bucket was empty. In the second bucket an arrow pointing at the first timepiece was added. For each of the next three buckets, an additional arrow was added. Finally, a template comprising graphical displays and pictograms was developed to explain to the youth how to use the answer scale. This revised version was administered to the second subsample of youth with ID. Results supported the adequacy of the final English and French versions of the GAS-ID and their suitability for use as self-report instruments among youth with ID.

References

Argus, G.R., Terrya, P.C., Bramstona, P., & Dinsdale, S.L. (2004). Measurement of mood in adolescents with intellectual disability. *Research in Developmental Disabilities, 25*, 493–507.

Finlay, W.M.L., & Lyons, E. (2001). Methodological issues in interviewing and using self-report questionnaires with people with mental retardation. *Psychological Assessment, 13*, 319–335.

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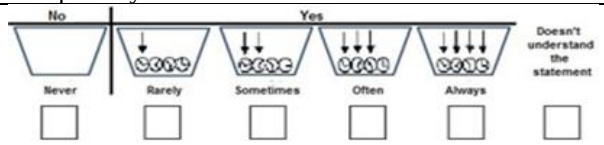
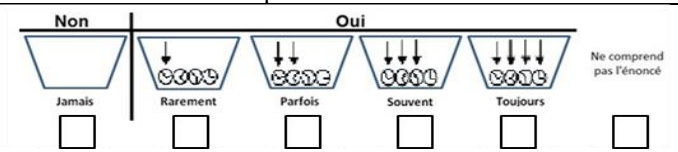
Table S1

Items and Answer Scales of the English and French Adapted Versions of the GAS-ID[a]

N°	Scales	English items	French items
1	WO	I worry a lot.	Je me fais beaucoup de souci.
2	WO	I think about many things at the same time.	Je pense à beaucoup de choses en même temps.
3	WO	I worry a lot about my parents or family.	Je me fais beaucoup de souci pour mes parents ou ma famille.
4	WO	I worry when I think about what will happen to me later.	Je me fais du souci quand je pense à ce qui va m'arriver plus tard.
5	WO	I am scared that something bad will happen to me.	J'ai peur que quelque chose de grave va m'arriver.
6	WO	I worry when I am unwell.	Je me fais beaucoup de souci quand je ne vais pas bien.
7	WO	I worry when I do something new.	Je me fais du souci lorsque je fais quelque chose de nouveau.
8	WO	I worry when I think about what I will do tomorrow.	Je me fais du souci quand je pense à ce que je vais faire demain.
9	WO	I can stop worrying when I want to*.	Je peux arrêter de me faire du souci quand je le souhaite*
10	WO	I worry when I think about death.	Je me fais du souci quand je pense à la mort.
11	FE	I am scared of the dark.	J'ai peur du noir.
12	FE	I am scared when I am high up.	J'ai peur quand je suis en hauteur.
13	FE	I am scared when I am in a staircase or an elevator.	J'ai peur quand je suis dans un escalier ou dans un ascenseur.
14	FE	I am scared of dogs.	J'ai peur des chiens.
15	FE	I am scared of spiders.	J'ai peur des araignées.
16	FE	I am scared to go to the doctor or the dentist.	J'ai peur d'aller chez le médecin ou le dentiste.
17	FE	I am scared of meeting new people.	J'ai peur lorsque je rencontre de nouvelles personnes.
18	FE	I am scared in places where there are many people.	J'ai peur dans les endroits où il y a beaucoup de personnes.
19	FE	I am scared when I am in big empty spaces.	J'ai peur quand je suis dans de grands espaces vides.
20	PS	When I am nervous or uncomfortable, I get hot or sweaty.	Quand je suis nerveux(se) ou mal à l'aise, il m'arrive d'avoir chaud ou de transpirer.
21	PS	When I am nervous or uncomfortable, my heart starts to beat very fast.	Quand je suis nerveux(se) ou mal à l'aise, il m'arrive que mon cœur batte très vite.
22	PS	When I am nervous or uncomfortable, my hands and legs shake.	Quand je suis nerveux(se) ou mal à l'aise, il m'arrive que mes mains et mes jambes tremblent.
23	PS	When I am nervous or uncomfortable, it feels like I have butterflies in my stomach.	Quand je suis nerveux(se) ou mal à l'aise, j'ai des sensations bizarres au ventre comme des papillons.
24	PS	When I am nervous or uncomfortable, I have difficulty breathing.	Quand je suis nerveux(se) ou mal à l'aise, il m'arrive d'avoir de la difficulté à respirer ou de manquer de souffle.
25	PS	When I am nervous or uncomfortable, I need to go to the toilet more often than usual.	Quand je suis nerveux(se) ou mal à l'aise, j'ai besoin d'aller aux toilettes plus souvent que d'habitude.
26	PS	When I am nervous or uncomfortable, I find it difficult to sit still without moving.	Quand je suis nerveux(se) ou mal à l'aise, j'ai de la difficulté à rester assis(e) tranquille sans bouger.
27	PS	I feel panicky.	Il m'arrive d'avoir très peur.
Answer scales			

Notes. [a] *for the Original English items see the Appendix 1 in Mindham, J., & Espie, C.A. (2003). Glasgow Anxiety Scale for people with an Intellectual Disability (GAS-ID): Development and psychometric properties of a new measure for use with people with mild intellectual disability. Journal of Intellectual Disability Research, 47, 22-30.* GAS-ID = Glasgow Anxiety Scale - Intellectual Disability; WO = worries; FE = fears; PS = physiological symptoms; * Reverse-scored item.

Table S2

Standardized Parameters Estimates from the 3-Factor Confirmatory Factor Model of the Adapted GAS-ID in the Overall sample

Items	Worries (λ)	Fears (λ)	Physiological symptoms (λ)	δ
GAS1	.679			.540
GAS2	.565			.680
GAS3	.618			.618
GAS4	.713			.491
GAS5	.828			.315
GAS6	.790			.376
GAS7	.724			.476
GAS8	.748			.440
GAS9[R]	-.451			.797
GAS10	.666			.557
GAS11	-	.675		.544
GAS12		.654		.572
GAS13		.712		.493
GAS14		.576		.668
GAS15	-	.616		.620
GAS16	-	.658		.568
GAS17	-	.788		.379
GAS18	-	.837		.299
GAS19	-	.844		.288
GAS20	-		.738	.455
GAS21	-		.778	.394
GAS22	-		.771	.405
GAS23	-		.678	.540
GAS24	-		.746	.444
GAS25	-		.682	.535
GAS26	-		.792	.373
GAS27	-		.815	.336
ω	.897	.901	.912	
Worries	-			
Fears	.738	-		
Physiological symptoms	.773	.830	-	

Notes. [R]*:* Reverse-scored item; λ = factor loadings; δ = Uniquenesses; ω = McDonald's omega coefficient of composite reliability; GAS-ID = Glasgow Anxiety Scale - Intellectual Disability. All correlations are statistically significant ($p \leq .01$).

Table S3

Standardized Parameters Estimates from the Bifactor Confirmatory Factor Model of the Adapted GAS-ID in the Overall Sample

Items	Worries (λ)	Fears (λ)	Physiological symptoms (λ)	G-factor (λ)	δ
GAS1	.379			.563	.539
GAS2	.347			.459	.668
GAS3	.509			.463	.527
GAS4	.567			.542	.384
GAS5	.412			.699	.342
GAS6	.301			.693	.430
GAS7	.406			.599	.476
GAS8	.409			.622	.445
GAS9^{R}	-.342			-.347	.762
GAS10	.250			.586	.594
GAS11	-	.408		.584	.492
GAS12		.346		.575	.549
GAS13		.544		.597	.348
GAS14		.579		.452	.461
GAS15	-	.292		.549	.614
GAS16	-	.263		.595	.577
GAS17	-	.169		.739	.425
GAS18	-	.217		.778	.348
GAS19	-	.231		.781	.336
GAS20	-		.103	.716	.477
GAS21	-		.271	.726	.400
GAS22	-		.244	.724	.416
GAS23	-		.362	.611	.496
GAS24	-		.431	.666	.370
GAS25	-		.292	.625	.524
GAS26	-		.214	.748	.394
GAS27	-		.347	.748	.320
ω	.749	.691	.601	.957	

Notes. ^{R}*:* Reverse-scored item; λ = factor loadings; δ = Uniquenesses; ω = McDonald's omega coefficient of composite reliability; G-factor = global factor; GAS-ID = Glasgow Anxiety Scale - Intellectual Disability.

Table S4

Standardized Parameters Estimates from the Exploratory Structural Equation Model of the Adapted GAS-ID in the Overall Sample

Items	Worries (λ)	Fears (λ)	Physiological symptoms (λ)	δ
GAS1	.624	-.009	.095	.534
GAS2	.541	.034	.017	.672
GAS3	.748	-.097	-.018	.532
GAS4	.869	-.042	-.091	.376
GAS5	.680	-.008	.192	.340
GAS6	.532	-.033	.328	.421
GAS7	.662	.242	-.138	.457
GAS8	.655	.263	-.125	.430
GAS9^{R}	-.504	-.044	.077	.767
GAS10	.467	-.063	.292	.578
GAS11	-.003	.610	.109	.527
GAS12	.064	.537	.095	.579
GAS13	-.052	.850	-.042	.373
GAS14	-.119	.853	-.129	.495
GAS15	-.069	.463	.255	.614
GAS16	-.088	.529	.252	.549
GAS17	.337	.549	-.034	.404
GAS18	.261	.581	.058	.345
GAS19	.127	.603	.171	.330
GAS20	.146	.153	.494	.488
GAS21	.099	.039	.687	.388
GAS22	.129	.006	.682	.398
GAS23	.133	-.181	.757	.464
GAS24	-.133	.208	.709	.387
GAS25	-.017	.252	.493	.538
GAS26	.133	.148	.567	.404
GAS27	.007	.154	.703	.326
ω	.885	.881	.884	
Worries	-			
Fears	.596	-		
Physiological symptoms	.643	.689	-	

Notes. ^{R}: Reverse-scored item; λ = factor loadings; δ = Uniquenesses; ω = McDonald's omega coefficient of composite reliability; GAS-ID = Glasgow Anxiety Scale - Intellectual Disability. All correlations are statistically significant ($p \leq .01$).

Table S5

Standardized Parameters Estimates from the Bifactor Exploratory Structural Equation Model of the French-Canadian Version of the Adapted GAS-ID

Items	Worries (λ)	Fears (λ)	Physiological symptoms (λ)	G-factor (λ)	δ
GAS1	.147	-.120	-.311	.631	.469
GAS2	.155	-.098	-.031	.606	.598
GAS3	.319	-.180	-.128	.694	.367
GAS4	.512	-.069	-.028	.622	.346
GAS5	.392	.005	.130	.698	.342
GAS6	.093	-.101	.024	.799	.343
GAS7	.705	.116	.113	.541	.184
GAS8	.604	.146	.101	.473	.380
GAS9^{R}	-.171	.096	.006	-.424	.782
GAS10	.224	.078	.189	.614	.531
GAS11	-.021	.278	-.213	.733	.339
GAS12	-.150	.323	-.085	.699	.377
GAS13	.001	.529	-.199	.651	.257
GAS14	.002	.491	-.020	.389	.607
GAS15	-.265	.109	-.252	.680	.392
GAS16	-.257	.318	.093	.642	.413
GAS17	.247	.485	.116	.643	.277
GAS18	.102	.447	.290	.683	.240
GAS19	.065	.546	.273	.665	.181
GAS20	-.052	.065	.270	.756	.349
GAS21	-.125	-.130	.277	.803	.245
GAS22	.052	-.041	.173	.787	.346
GAS23	.015	-.053	.208	.754	.385
GAS24	.056	.105	.442	.670	.341
GAS25	.181	.131	.430	.647	.346
GAS26	.194	.173	.337	.734	.279
GAS27	-.022	.111	.096	.789	.355
ω	.775	.801	.653	.969	

Notes. ^{R}*:* Reverse-scored item; λ = factor loadings; δ = Uniquenesses; ω = McDonald's omega coefficient of composite reliability; G-factor = global factor; GAS-ID = Glasgow Anxiety Scale - Intellectual Disability.

Table S6

Standardized Parameters Estimates from the Bifactor Exploratory Structural Equation Model of the English-Australian Version of the Adapted GAS-ID

Items	Worries (λ)	Fears (λ)	Physiological symptoms (λ)	G-factor (λ)	δ
GAS1	.427	-.043	.061	.522	.539
GAS2	.378	.047	-.080	.386	.699
GAS3	.493	.021	.018	.303	.665
GAS4	.580	-.015	-.048	.473	.437
GAS5	.539	.061	.212	.594	.307
GAS6	.338	-.074	.074	.640	.465
GAS7	.249	.062	-.163	.611	.534
GAS8	.340	.129	-.107	.642	.444
GAS9^{R}	-.294	-.032	.082	-.301	.815
GAS10	.247	-.177	.019	.538	.618
GAS11	-.089	.284	-.059	.621	.523
GAS12	-.151	.121	-.262	.621	.508
GAS13	-.004	.574	.105	.553	.353
GAS14	.021	.616	.108	.458	.399
GAS15	-.160	.161	-.051	.598	.588
GAS16	-.025	.298	.140	.554	.584
GAS17	.126	.223	-.020	.669	.486
GAS18	.178	.265	.013	.706	.399
GAS19	.082	.300	.103	.720	.375
GAS20	.009	-.073	.015	.710	.490
GAS21	.081	.014	.284	.694	.430
GAS22	-.101	-.240	.107	.779	.314
GAS23	.090	-.159	.458	.503	.504
GAS24	-.029	.256	.575	.589	.255
GAS25	-.021	.239	.350	.525	.545
GAS26	-.011	.018	.315	.671	.450
GAS27	-.016	.002	.383	.756	.281
ω	.732	.657	.654	.950	

Notes. ^{R}*:* Reverse-scored item; λ = factor loadings; δ = Uniquenesses; ω = McDonald's omega coefficient of composite reliability; G-factor = global factor; Glasgow Anxiety Scale - Intellectual Disability.