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ORIGINAL ARTICLE

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Psychometric properties of the ABSI-id, an adapted measure for anger-related interoceptive awareness in individuals with mild intellectual disabilities or borderline intellectual functioning

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ABSTRACT

Background: The present study examined the psychometric properties of the Anger Bodily Sensations Interview – intellectual disabilities (ABSI-id), an adapted instrument to measure anger-related interoceptive awareness (IA) in individuals with mild intellectual disabilities or borderline intellectual functioning (MID-BIF).

Method: The ABSI-id was individually administered to 208 clients (51% male) with MID-BIF in residential facilities.

Results: An EFA and CFA showed a two-factor structure of the ABSI-id, including nine items. The ABSI-id had moderate to good reliability, with an internal consistency ranging from acceptable to good, a test–retest reliability ranging from moderate to good and an adequate convergent validity. There was no significant difference in ABSI-id scores between individuals with MID and BIF.

Conclusion: The ABSI-id is a promising instrument for measuring anger-related IA, additional research is needed on validity and sensitivity of change.

KEYWORDS

Psychometric properties; anger-related interoceptive awareness; aggression; mild intellectual disability; borderline intellectual functioning

Aggressive behaviour is a significant part of problem behaviours presented by individuals with mild intellectual disabilities or borderline intellectual functioning (MID-BIF; IQ 50–85) (Ali et al., 2015). This type of problem behaviour has the potential to adversely affect the victim, the aggressor and the family or support staff. Aggressive behaviour may lead to isolation, stigmatisation and mental health sequela (Hensel et al., 2014; Woods & Ashley, 2007). To understand the emergence of aggression, different models have been developed, all assuming that while being emotionally aroused in a social situation, a person has to act in an effective and adaptive way to prevent aggressive outbursts (e.g., the General Aggression Model, DeWall et al., 2011). A precondition is that one adequately interprets his or her own body signals associated with (increased) arousal to become aware of one's emotional state, such as while being angry (Mehling et al., 2009, 2018; Price & Hooven, 2018). Terasawa et al. (2013) noted that awareness of one's emotional state involves a balanced integration and interpretation of interoceptive information and the current situation. Gaining interoceptive information is a complex reciprocal and iterative process of sensations, experiences and expectations. Barrett and Simmons (2015) argued that more light has to be shed on the interplay between body signals and the conscious experience of the bodily state, as this might play an important role in this process and will be helpful when handling problems with emotion regulation and psychopathology.

The general sensibility to body signals is called interoceptive awareness (IA) or interoceptive sensitivity (Andersen, 2006; Craig, 2003; Mehling et al., 2018). IA is a key element to identify body signals (i.e., internal physiologic responses) related to affective feeling, and thus forms the base for an integration of bodily sensations, cognitive processes, and emotional feeling (Craig, 2015). It is known that limited IA is related to affective and psychosomatic disorders, possibly as a result of the complexity of the integration and a history of disturbed experiences (e.g., Khalsa & Lapidus, 2016; Van der Maas et al., 2015). Studies on the efficacy of treatments accentuating IA, including (mindfulness based) body-oriented elements in the approach, have shown a decrease in psychopathology (e.g., Fissler

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et al., 2016; Wupperman et al., 2009). An emphasis on IA may thus be supportive in enhancing effectiveness of treatments of problem behaviour such as aggressive behaviour. In clinical practice, body-oriented interventions are being used with the aim to increase IA, often in the broader context of emotional regulation (e.g., DuBois et al., 2016; Price & Hooven, 2018; Zwets et al., 2016).

A high level of anger-related arousal is considered to be a risk factor of aggressive behaviour, especially in combination with an impulsive character, because of its undermining effect on cognitive control processes (Olson & Fazio, 2009; Strack & Deutsch, 2004). This kind of arousal can be identified through body signals such as an increased heart rate (e.g., De Looff et al., 2019; Williams, 2017). From a therapeutic point of view, the assumption of awareness of body signals facilitating emotion regulation as formulated by Füstös et al. (2012) is considered important.

At present, there is limited research on topics concerning anger-related IA in individuals with MID-BIF. De Looff et al. (2019) showed that increased arousal levels, signalled by increased skin conductance, heart rate and heart rate variability, precede physical aggressive outbursts in 104 individuals with MID-BIF referred to a forensic treatment setting. In the study by Emck et al. (2012), children with MID-BIF and aggressive behaviour were significantly less aware of their body compared to non-aggressive peers. In line with these results, there is some evidence for body-oriented interventions aiming at decreasing aggression by reducing arousal preceding it (Bellemans et al., 2019; Didden et al., 2019; Singh et al., 2003). In psychomotor therapy, a therapy using physical activity and bodily experiences as cornerstones of its approach (Emck & Scheffers, 2019), IA is considered to be important when targeting anger and aggressive behaviour in individuals with MID-BIF. As for now, instruments to measure (anger related) IA in this population are lacking (Bellemans et al., 2018).

To measure the awareness of anger-related body signals (i.e., anger-related IA) during anger-provoking social situations, the Anger Bodily Signals Questionnaire (ABSQ) is an instrument for individuals without an intellectual disability (Zwets et al., 2014). This questionnaire consists of 18 statements to be answered on a 5-point Likert-type scale ranging from 1 = "not at all" to 5 = "very much," with low scores indicating low levels of awareness of body signals during anger. A psychometric analysis by Zwets et al. (2014) who investigated the ABSQ in 100 students in secondary vocational education and 70 offenders, a three-factor solution was shown the best fit: the first factor includes items on changes in respiration, heartbeat, body heat and transpiration, the second factor includes items concerning feeling light-headed, shaking and freezing and having a dry mouth, and the third factor includes items on muscle tension and adrenaline. The questionnaire had an excellent internal consistency and good test-retest reliability for the total score. Internal consistency of the sub scales ranged from questionable for factor 2 ($\alpha = .67$) over acceptable for factor 3 ($\alpha = .73$), to excellent for factor 1 ($\alpha = .90$). Test-retest reliability for the sub scales ranged from acceptable (factor 2) to good (factor 1 and 3). Concurrent validity was explored, supporting the ability of the ABSQ to assess the awareness of anger-related body signals.

The ABSQ was developed for individuals with an (above) average IQ. Individuals with MID-BIF might find completing the ABSQ difficult because of their deficiencies in reading and reflective reasoning, which may hamper their ability to fill in this self-report measure (Finlay & Lyons, 2002). Until now, no instruments are available measuring anger-related IA in individuals with MID-BIF. For that reason, the ABSQ was used as a starting point to develop an suitable instrument for measuring IA in individuals with MID-BIF. This study had two goals. First, to adapt the ABSQ for individuals with MID-BIF and evaluate its usability. Second, to evaluate this adapted version of the ABSQ: the ABSQ-id on its psychometric quality (factor structure, internal consistency, test-retest reliability and convergent validity).

Method

Participants and setting

This study was carried out in a non-probability sample of 208 adults with MID-BIF, since generating a random sample in this population was not possible in the light of including a sufficient number of participants (e.g., due to clients being somewhat tired of participating in research). All received care and treatment within Dutch facilities for individuals with intellectual disabilities (i.e., Abrona, Ambiq, Aveleijn, Frion, de Driesprong, 's Heerenloo, Reinaerde, and Sherpa). The sample included about the same number of males ($n = 106$, 51%) and females ($n = 102$, 49%) with a mean age of 35.9 years ($SD = 15.25$; range: 18–76 years), and a mean IQ of 63.5 ($SD = 9.14$; range 50-85).

Data were obtained from 152 participants with MID (73.1%) and 56 participants with BIF (26.9%). Seventy of the 208 participants had one or more types of comorbidity: genetic disorder (e.g., Prader Willi, Down; $n = 4$), autism spectrum disorder ($n = 31$), psychotic

vulnerability ($n = 6$), personality disorder ($n = 4$), ADHD ($n = 9$), anxiety disorder ($n = 13$), attachment problems ($n = 3$), aggressive behavioural problems ($n = 4$).

ABSQ adaptation: From ABSQ to ABSI-id

The ABSQ (Zwets et al., 2014) was adapted in a four-step procedure to better suit individuals with MID-BIF. This four-step procedure was based on previous studies aimed at the development and psychometric evaluation of self-reports for the target group (e.g., the Glasgow Anxiety Scale for individuals with MID (GAS-id) as developed by Mindham and Espie (2003)). In our case, the item pool consisted of items of the ABSQ and in the different steps evaluative information from both an expert therapist working with the target group and from an individual from that group were used.

First, the ABSQ was adapted in line with recommendations for this target group (e.g., Finlay & Lyons, 2002), and in cooperation with a small number of individuals with MID-BIF, in that statements were reformulated, an interview format was chosen instead of a full self-report version, and value judgement free symbols were added to the original 5-point Likert scale so as to visually support the meaning of the scores. Figure 1 presents the visual equivalent to the words of the 5-point Likert scale.

In the second step, a trial assessment (pilot study) with other individuals with MID-BIF ($n = 30$) took place and together alternatives per statement were formulated. In addition, an introduction was added to help focus on concrete situations when feeling angry before answering the questions. During the third step of the adaptation process, a qualitative assessment took place based on the experiences with a large group of participants. This led to the version without ambiguous items, a version that was used for the psychometric investigation, that formed the fourth step in this study. Based on the results of these statistical analyses with a focus on psychometrics, the final version of the adapted instrument: the "Anger Bodily Sensations Interview – intellectual disabilities" (ABSI-id) was formalised. See Appendix for the adaptations made in the four-step procedure. The current paper reports on the last two steps: qualitative assessment and psychometric statistical analysis, respectively.

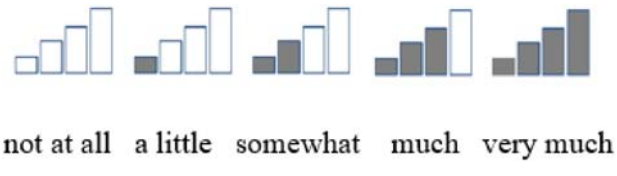

Figure 1. The visual equivalent to the words of the 5-point Likert scale.

Procedure

This study was approved by the Ethics Committee of the Faculty of Social Sciences (ECSS) of [Please ask authors to insert the name of the university] University (ECSW2017-005R3). The research committees or care managers of the participating facilities for individuals with intellectual disabilities gave permission to collect data at their organisation. Participants who met the inclusion criteria (18 years of age or older and IQ between 50 and 85) were individually approached by a research assistant and were invited for an information meeting. These meetings took place on the ward. The clients who lived there were informed and/or individual clients who asked to be informed as they heard from the study by one of the other clients. During the meeting, clients received information on the research topic, the voluntary nature of participation and anonymous processing of the data. Those who agreed to participate were asked to sign an informed consent form, and when necessary also their legal representative was asked to sign the informed consent form. We did not gather information on non-responders. For the qualitative assessment, comments on ambiguity of statements given by the participants during the actual interview were noted in a memo. These comments were discussed with three experts (two psychomotor therapists and one psychologist), all having extensive experience in working with clients with MID-BIF. When agreement occurred as to the ambiguity of a statement, this item was excluded from the psychometric statistical analysis. In order to assess test-retest reliability, the interviews were conducted twice with an interval of one to two weeks.

Data analyses

We used IBM SPSS Statistics (Version 20.0) to conduct the analyses on the psychometric quality based on the version of the instrument that resulted after the third step in the adaptation process, the qualitative assessment. First, the normal distribution of the items was examined. When skewness and kurtosis scores were outside the range −2 and 2, items were eliminated because too much deviation from normality may restrict the quantitative analysis (Field, 2018). Then, test-retest reliability per item was calculated. Items with an intra class correlations coefficient (ICC) and a Pearson Correlation coefficient (r) lower than .40 were deleted from

the item pool (Cicchetti, 1994). Then, sampling adequacy and the correlations between the items were verified by Kaiser-Meyer-Olkin measure and by Barlett's test of sphericity, respectively. Next, an exploratory factor analysis (EFA), using principal axis factoring (PAF), was conducted to identify possible subscales of the ABSQ-id collected data at the first assessment. We removed items with factor loadings < |0.30| and cross-loadings (items loading on more than one factor with a discrepancy < |0.20|). Based on the factor structure found, a confirmative factor analysis (CFA), using Mplus version 5.1 (Muthén & Muthén, 2008) was performed on the same data set to test the fit of the obtained factor model. Goodness of fit was evaluated by means of different fit indices: Comparative Fit Index and Tucker Lewis Index (CFI and TLI; Bentler, 1990). The CFI and TLI compare the sample covariance matrix with a null model of uncorrelated latent variables. CFI and TLI values between .90 and .95 suggest an acceptable model fit, and values exceeding .95 suggest a good fit (Browne, 2015). The normed chi square, the ratio of χ^2/df, less than 2 would represent an adequate model fit (Tabachnick & Fidell, 2007). The Root Mean Square Error of Approximation (RMSEA; Browne & Cudeck, 1993) represents the fit of the estimated covariance matrix to the populations covariance matrix. RMSEA values less than .08 indicate adequate model fit, whereas values below .05 indicate good model fit (Browne & Cudeck, 1993). The Standardised Root Mean square Residual (SRMR; Schermelleh-Engel et al., 2003) is the standardised square root of the difference between the residuals of the covariance matrix of the sample and the hypothesised covariance model. SRMR values between .05 and .10 suggest an acceptable fit and values less than .05 suggest good fit (Schermelleh-Engel et al., 2003).

The analyses as described led to the instrument in its definite form. Further examination included an assessment with Cronbach's α and McDonalds ω calculated for the internal consistency of the 9-item ABSI-id (both the total scale and the subscales) using the first assessment from all respondents. Cronbach's α was considered acceptable between .70 and .79, and good between .80 and .89 (Cicchetti, 1994). These criteria were also applied to McDonalds ω (Simsek & Noyan, 2013). Data on both test and retest were available in 91.8% of the participants ($n = 191$) and the stability over time of the total score and subscales were calculated by ICC and the Pearson correlation (r). Test–retest reliability values were assessed as follows: < .5 poor, between .5 and .75 moderate, between .75 and .9 good, and > .90 excellent (Koo & Li, 2016). With no instrument available that could be used as a gold standard, the Construct Reliability (CR) and the Average Variance Extracted (AVE) were calculated based on the Fornell-Larcker criterion, to examine convergent validity. AVE greater than 0.5 shows acceptable convergent validity, above 0.7 very good and CR above 0.7 is acceptable (Cheung & Wang, 2017). To explore the difference in scores between individuals with MID and those with BIF independent t-tests were used.

Results

Qualitative assessment (step 3 in adaptation process)

The average administration time for the total of 18 items was 10–15 min. Six items were deleted as they had initially more than 10% of non-responses. These items were difficult to answer in forty-two of the participants (9 BID, 33 MID) and were therefore further analysed on comprehension. A recurring comment of the participants during the interview was that four items ("My body freezes / becomes stiffened," "My body starts shaking / trembling," "My hands starts shaking / trembling," "I get a dry mouth / I get less spit") were not only difficult but also perceived by the participants as not relevant. Some items were mainly associated with being cold, namely "My body starts shaking / trembling" ($n = 32$, 15.38% initially non-response) and "My hands starts shaking / trembling" ($n = 42$, 20.19% initially non-response). The latter item was also often related to being afraid or nervous and not specifically to being angry. Clients related the item referring to "A dry mouth" to being thirsty ($n = 39$, 18.75% initially non-response). Associations with being frightened or being scared were mentioned as a reaction on the following item: "My body freezes / becomes stiffened" ($n = 21$, 10.18% initially non-response). Finally, two other items were difficult to answer as their original formulation was regarded as too abstract and needed much more additional information or explanation of the terms used: "I get an adrenaline kick, or I feel a rush of energy through my body" ($n = 35$, 16.83% initially non response), and "I get light-headed or I get dizzy" ($n = 28$, 13.46% initially non response). In the light of a concrete formulation of body signals, one participant mentioned that if body signals could not be pointed out, or that it could not be visualised in a cartoon (as hot headed or as a container under pressure), he was unable to feel these body signals or be aware of them. Figure 2 presents some remarks of the participants in response to the above mentioned six deleted items.

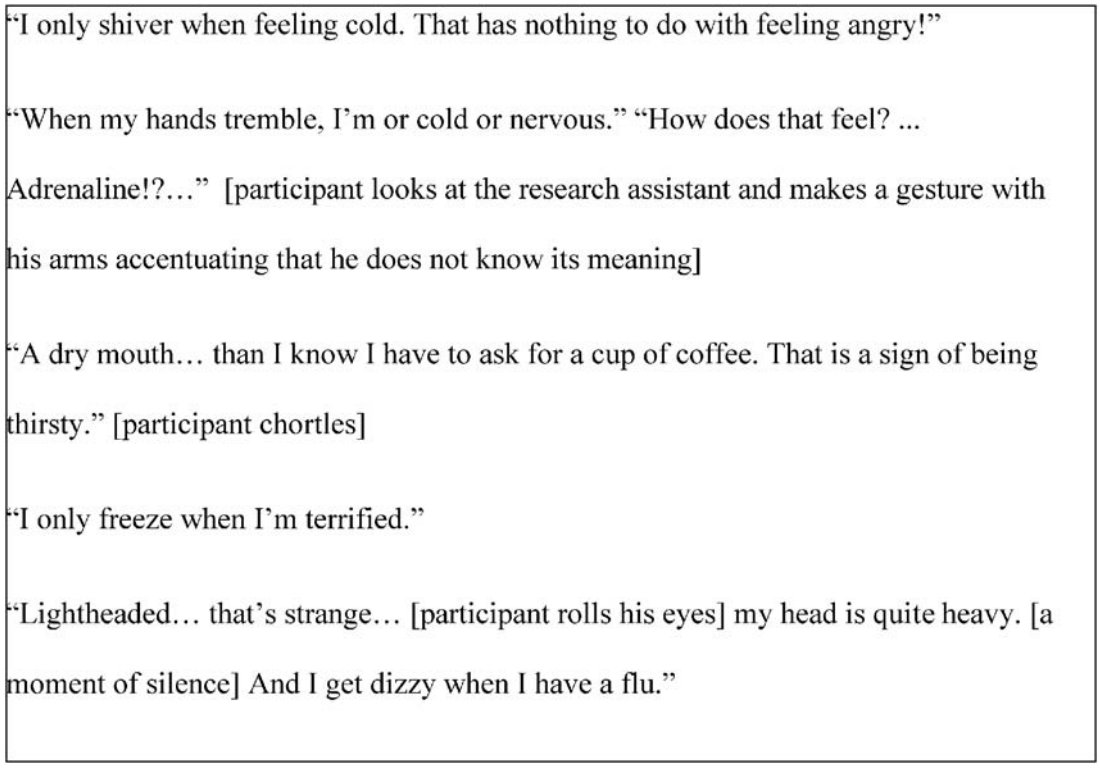

Figure 2. Citations of participants' remarks with regard to six items being difficult to understand and were thus deleted (in step 3).

Elimination of these six items led to an instrument of twelve items (see step 3 in Appendix) that formed the starting point for psychometric statistical examination.

Psychometric statistical analyses (step 4 in the adaptation process)

Factor structure

Of the twelve items of the questionnaire that remained following the qualitative assessment in step three, no items were removed based on the test-retest reliability (all ICCs and *r*s > 0.4).

The Kaiser-Meyer-Olkin test indicated that the sample of 208 participants was sufficient for an EFA based on scores on 11 items, with a sampling adequacy of .84. The Barlett's test of sphericity, $\chi^2(55) = 821{,}551$, $p < .001$, showed that the correlations between items were sufficiently large for the EFA. A PAF analysis revealed two factors based on eigen values and the scree plot. The two-factor solution, using Oblimin rotation due to correlation between the factors (i.e., $r = .59$), was the most readily interpretable from a clinical and empirical standpoint and was therefore further explored. Then, one item ("My jaw muscles become tense / I grind my teeth") was deleted due to low communality (0.11). Two cross-loading items were excluded ("My hands start sweating / transpiring more" and "My muscles become tensioned/ contracted"). This resulted in the final 9-item version of the instrument, now called the Anger Bodily Sensations Interview – intellectual disabilities (ABSI-id) (see step 4 in Appendix).

The two factors in the ABSI-id explained 58.36% of the total variance. The percentage of variance explained by each factor was 43.53 and 14.84 and the eigenvalues of the factors 3.92 and 1.34, for the factors one and two,

Table 1. Factor loading for adapted instrument ($n = 208$).

ABSI-id statements and item numbers	Item scores		Factor	
	Mean	*SD*	1	2
4. My breathing becomes faster / goes more frequent	2.24	1.26	**.75**	.01
2. My breathing becomes irregular / goes fast then slow	2.20	1.21	**.72**	.02
1. My heart starts beating faster / starts beating more frequent	2.62	1.36	**.69**	-.06
8. My breathing becomes deeper / I take a lot of air in my lungs	1.99	1.25	**.66**	-.05
7. My heart starts beating harder / starts pounding	2.54	1.36	**.66**	.06
9. I clench my fists / I squeeze my hands	2.11	1.42	**.39**	.10
6. My body starts feeling warmer / starts feeling hot	2.26	1.26	-.14	**.98**
5. I start sweating more / start transpiring more	2.18	1.32	.15	**.65**
3. My head starts feeling warmer / starts feeling hot	2.31	1.32	.08	**.55**

Note. The factor loadings in bold are considered as significantly contributing to the respective factor. Factor 1 = *activity*; Factor 2 = *body heat*.

respectively. The factor correlation (*r*) was .53. Factor one [items 1, 2, 4, 7, 8, 9], was labelled as the *activity* subscale and contained items on shifts in heartbeat, respiration and muscle activity. Factor two [items 3, 5, 6], was labelled as the *body heat* subscale and included items on shifts in body temperature and transpiration. Table 1 presents the mean scores per item as well as the factor loadings.

Skewness and kurtosis for the total scale as well as for the subscales met the criteria of normal distribution as all scores were between −1 and 1 (Hair et al., 2017).

A CFA of the two-factor structure including nine items was performed in the same sample. An adequate model fit was found with a normed chi-square of 1.78, a CFI of .94, a TLI of .92, a RMSEA of .061 (CI^{90} = .031-.090) and a SRMR of .046.

Internal consistency of the ABSI-id

Cronbach's Alpha of the total ABSI-id was good, that is .81. Alpha values for the two subscales *activity* and *body heat* were .81 and .77, respectively.

McDonald's Omega was .84 for the total ABSI-id. And Omega values were .82 for subscale *activity* and .79 for subscale *body heat*.

Internal consistency was considered good for the total scale and subscale *activity* and moderate for subscale *body heat* based on both Cronbach's Alpha and McDonald's Omega (Koo & Li, 2016; Simsek & Noyan, 2013).

Test–retest reliability of the ABSI-id

ICC on the total scores of the ABSQ-id between test and retest were .80 for the total score, and .71 and .80, for the subscale *activity* and for subscale *body heat*, respectively. Pearson correlations (*r*) were .80 for the total score and .72 for *activity*, and .80 for *body heat*. So, test-retest reliability was good for both the total scale as well as for subscale *body heat*, and moderate for subscale *activity* (Dancey & Reidy, 2007).

Convergent validity

Construct reliability was 0.77 and AVE was 0.68. The convergent validity of the ABSI-id was considered adequate based on the Fornell & Larkell criteria (see Cheung & Wang, 2017).

Table 2. Mean total scores and mean subscale scores of the ABSI-id for individuals with MID and individuals with BIF.

	MID (n = 156)		BIF (n = 53)	
	M	*SD*	*M*	*SD*
Total score ABSI-id	19.89	7.60	21.93	7.82
Subscale *activity*	13.33	5.53	14.65	5.88
Subscale *body heat*	6.56	3.20	7.28	3.30

Note: ABSI-id = Anger Bodily Sensations Interview for individuals with intellectual disabilities; total score ABSI-id ranging from 9 to 45, subscale score *activity* ranging from 6 to 30, subscale score *body heat* ranging from 3 to 15.

ABSI-id: Difference between individuals with MID and those with BIF

The mean total ABSI-id score was not significantly different for individuals with MID compared to those with BIF ($t(206) = -1.71$, $p = .089$; see Table 2). There were also no significant differences in the mean scores on the two subscales *activity* and subscale *body heat* between the two groups ($t(206) = -1.51$, $p = .13$ and $t(206) = -1.43$, $p = .15$, respectively). Table 2 presents the mean scores for the total scale and the subscales of the ABSQ-id.

Discussion

In this study, a 9-item adapted instrument was explored that aims to measure anger-related IA in individuals with MID-BIF. This instrument originated from an adaptation of the 18 items of the ABSQ. Adaptations were done based on both qualitative assessment with participants from the target group and a quantitative statistical analyses. The qualitative analysis led to the shift from questionnaire into an interview, the addition of an introduction, symbols to visually support the meaning of the Likert scales, extra examples, and six items that were most often misinterpreted by individuals with MID-BIF were deleted. During the psychometric statistical analysis, one item was deleted due to low communality, while two cross-loading items were deleted. The EFA and CFA with data from 208 participants revealed two subscales: the *activity* subscale, including six items on heartbeat, respiratory and muscle tension, and the *body heat* subscale, including three items on body temperature and transpiration. Internal consistency and test–retest reliability of the instrument were moderate to good (Koo & Li, 2016; Simsek & Noyan, 2013). These findings are generally in line with the results regarding the reliability of the ABSQ as applied in individuals without MID-BIF (Zwets et al., 2014). The convergent validity was acceptable. The total score and subscale scores of the ABSI-id showed no significant differences between individuals with MID and those with BIF.

A strength of this study is that, with this short instrument specifically adapted for individuals with MID-BIF, a need is met as there is a lack of reliable and valid instruments measuring IA. This is an important gap in the literature, as identified by for instance Khoury et al. (2018) and Mehling et al. (2009).

Several limitations of our study should also be mentioned as well as additional areas for future research.

First, this study focused on a range of psychometric characteristics of the ABSI-id, including factor analysis, internal consistency, test-retest reliability and a first indication of convergent validity, based on data from more than 200 participants, however, a CFA was conducted in the same sample and the ABSI-id was not compared to another instrument. In future research, emphasis should be given to further consolidation of the instrument: a CFA needs to be conducted in a different sample, as it often shows an adequate fit when done in the same sample. Besides that, the validation of the instrument needs further investigation. As no gold standard exists, the association between the ABSI-id with other measures of anger-related IA should be explored. In this light, it should be noted that subjective experiences, measured by self-report as in the ABSI-id, reflect another dimension of interoception than objective measurements like heartrate or skin conductance (see e.g., De Looff et al., 2019). Research on the correlation between these two dimensions is needed (Garfinkel et al., 2015). A possible strategy to do this and also to validate the ABSI-id would be to compare the subjective outcomes of the ABSI-id with data from both objective sources and information from interviews. Preferable this should be done in controlled situations that normally evoke anger.

Second, it should be mentioned that based on the normal distribution of IQ, prevalence of BIF is higher than MID, while in the current study individuals with MID were overrepresented. According to the Dutch clinical practice, in this study individuals with MID and those with BIF are considered as a single group based on their similarities concerning deficiencies in adaptive functioning and associated support needs (Woittiez et al., 2014; Woittiez et al., 2019). The overrepresentation of individuals with MID could have consequences for the (further) instrument development. The adaptations made to this instrument, fitted to the needs of a sample of individuals with MID. Assuming that individuals with more cognitive skills (individuals with BIF) would also not have problems in understanding the items. Future research should elaborate on this issue and not only explore differences between groups but also conduct a multiple group CFA to see whether the total scale and subscales are comparable in both groups.

With regard to clinical practice, the present data suggest that the ABSI-id has good potential for examining how this population assess awareness of anger-related body signals. Future research should however focus on (construct) validity and the scale's sensitivity to change. Such information should indicate whether this instrument might be a valid instrument for diagnostic and evaluation purposes to identify the awareness of specific shifts in body signals when being angry. Especially for body-oriented therapies such an instrument may be helpful in enabling clinicians to adequately refer individuals to mind–body interventions. Especially for body and movement-oriented therapies, such as psychomotor therapy (PMT), such an instrument may be helpful in enabling clinicians to adequately refer individuals to mind–body interventions. As described in the so-called Somatic Marker Hypothesis (Damacio, 1996), body signals may have an important function in guiding emotional and behavioural reactions. In the light of this, further research is needed to provide insight in their relation with aggressive behaviour in individuals with MID-BIF.

When the instrument has shown sensitivity to change, it can be also useful in the evaluation of efficacy of therapies aiming at improving IA in individuals with MID-BIF. This said, it should be noted though that there are limitations associated with the use of self-reports especially when explicit treatment goals are (too) congruent with the outcome measures. As mentioned by Mehling et al. (2018), using these kind of self-reports can distort the outcomes in a positive way as they resemble what people are told or learn in therapy. Instead of showing real change, the outcomes could then possibly merely echo these new ways of expressing oneself.

Conclusion

The ABSI-id is a promising instrument for measuring anger-related IA in research and clinical settings for individuals with MID-BIF. Further research, both cross-sectional and longitudinal studies, could help gain additional information on the validity of both the total scale and the subscales, its sensitivity to change and to test the assumptions of IA and its relation with aggression.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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Appendix 1. Changes throughout the adaptation process leading to the ABSI-id (9-item version)

Step 1: first adaptation	Step 2: trial assessment	Step 3: qualitative assessment	Step 4: psychometric statistical analysis
[Introduction to be read by the interviewer] Everybody can become tense as the result of the behaviour of someone else, such as during an argument. This questionnaire contains several statements about reactions of your body that arise when you become angry in such a situation. Please think whether these apply to you. You can answer choosing a score between not at all to very much, linked to a visual scale.	[Introduction to be read by the interviewer] Everybody can become tense as the result of the behaviour of someone else, such as during an argument. **Was there a situation in the last two weeks were you experienced being angry as a result of behaviour of someone else? [ask for at least 2 examples of the participant, possibly with help of a staff member].** This questionnaire contains several statements about reactions of your body that arise when you become angry in such a situation. Please think whether these apply to you. You can answer choosing a score between not at all to very much, linked to a visual scale.	[Introduction to be read by the interviewer] Everybody can become tense as the result of the behaviour of someone else, such as during an argument. Was there a situation in the last two weeks were you experienced being angry as a result of behaviour of someone else? [ask for at least 2 examples of the participant, possibly with help of a staff member]. This questionnaire contains several statements about reactions of your body that arise when you become angry in such a situation. Please think whether these apply to you. You can answer choosing a score between not at all to very much, linked to a visual scale.	[Introduction to be read by the interviewer] Everybody can become tense as the result of the behaviour of someone else, such as during an argument. Was there a situation in the last two weeks were you experienced being angry as a result of behaviour of someone else? [ask for at least 2 examples of the participant, possibly with help of a staff member]. This questionnaire contains several statements about reactions of your body that arise when you become angry in such a situation. Please think whether these apply to you. You can answer choosing a score between not at all to very much, linked to a visual scale.
Step 1: first adaptation	Step 2: trial assessment	Step 3: qualitative assessment	Step 4: psychometric statistical analysis
My heart starts beating faster	My heart starts beating faster **/ more frequently**	My heart starts beating faster / more frequently	**1:** My heart starts beating faster / more frequently
My hands start sweating more	My hands start sweating more **/ transpiring more**	My hands start sweating more / transpiring more	**[deleted: cross loader]**
My body freezes	My body freezes **/ becomes stiffened**	**[deleted: ambiguous]**	
I get light-headed	I get light-headed **/ woozy / dizzy**	**[deleted: ambiguous]**	
My breathing becomes irregular	My breathing becomes irregular **/ then fast then slow**	My breathing becomes irregular / then fast then slow	**2:** My breathing becomes irregular /then fast then slow
My body starts shaking	My body starts shaking **/ trembling**	**[deleted: ambiguous]**	
I get an adrenaline kick	I get an adrenaline **kick / a rush of energy through my body**	**[deleted: ambiguous]**	
My head starts feeling warmer	My head starts feeling warmer **/ hot**	My head starts feeling warmer / hot	**3:** My head starts feeling warmer / hot
My breathing becomes faster	My breathing becomes faster **/ more frequently**	My breathing becomes faster / more frequently	**4:** My breathing becomes faster / more frequently
I start sweating more	I start sweating more **/ transpiring more**	I start sweating more / transpiring more	**5:** I start sweating more / transpiring more
My muscles become tensioned	My muscles become tensioned **/ contracted**	My muscles become tensioned / contracted	**[deleted: cross loader]**
My hands start shaking	My hands start shaking **/ trembling**	**[deleted: ambiguous]**	
My body becomes warmer	My body becomes warmer **/ hot**	My body becomes warmer / hot	**6:** My body becomes warmer / hot
My heart starts beating harder	My heart starts beating harder **/ pounding**	My heart starts beating harder / pounding	**7:** My heart starts beating harder / pounding
My jaw muscles become tensioned	My jaw muscles become tensioned **/ I grind my teeth**	My jaw muscles become tensioned / I grind my teeth	**[deleted: low communality]**
My breathing becomes deeper	My breathing becomes deeper **/ larger**	My breathing becomes deeper / larger	**8:** My breathing becomes deeper / larger
I get a dry mouth	I get a dry mouth **/ I get less spit**	**[deleted: ambiguous]**	
I clench my fists	I clench my fists **/ I squeeze my hands**	I clench my fists / I squeeze my hands	**9:** I clench my fists / I squeeze my hands

Note: The introduction and description of the statements concerning anger-related body signals during the different stages of the adaptation process leading to the definitive ABSI-id. Changes are marked in bold. In the final column the items are numbered from 1 to 9.