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Construction and initial validation of an academic impostor syndrome measure

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Abstract
Impostor syndrome has been identified as a growing problem in professional and academic settings. It has been associated with diminished confidence and inhibited performance. In the context of education, it has been reported as maladaptive to enrolment, retention, integration, wellbeing, and academic performance. One inhibiting factor is the lack of validated measures specific to education. Hence, the primary aim and original contribution of this study is the construction and initial validation of such a measure. This construction process was initially informed by a trawl of the literature on general impostor syndrome, with ten domains emerging from the reviews to provide content validity. Items were constructed in consultation with students as end users and academics from national and international symposia and seminars. The studies were carried out at two UK higher education institutions, with $N = 339$ undergraduates. Through iterative processes including item analysis, principal component analysis, and factor analyses, ten items were selected from a pool of thirty. These covered the ten literature domains and associated with good factor loadings (> 0.45) and sound model fit indicators. Invariance testing of both student groups demonstrated equivalence of factor structure and factor loadings. To enhance the measure's validity, the Five-Factor Model of Personality, Self-esteem, and Self-efficacy were included. The moderate correlations of these factors with academic impostor syndrome in expected directions may respectively signpost the approach and avoidance behaviours that counter or nurture the problem. The new measure is commended as a potentially useful tool for research and practice.

Keywords Academic impostor syndrome · Students · Self-esteem · Self-efficacy · Personality

An overview of the literature and theoretical frameworks

Impostor syndrome is often applied to students, but it was initially developed as a general concept with wider applications that are evident in both professional and academic settings (Bothello, & Roulet, 2019). Impostor syndrome in the context of educational achievement has been defined as self-doubt with feelings of inadequacy (La Donna et al., 2018) and whenever its influence emerges, there may be enough disturbance to impair mental health and psychological well-being with feelings of uneasiness (Mullangi, & Jagsi, 2019). This inner disturbance may be at work long before outward symptoms manifest, but some might continue to manage the insidious symptoms covertly. Given that anxiety and mental health issues in higher education students have been exacerbated by the Covid-19 pandemic (Jehi et al., 2021), the development of a specific academic impostor syndrome measure to identify and counteract negative self-talk in students is timely.

Although impostor syndrome is not seen as a psychological disorder per se, it may trigger student perceptions of fraudulence (Breeze, 2018). Students may experience thoughts such as "I am out of place here", "I do not belong here", "I will be found out here", "I am out of my depth" or "if I ask a question, it will sound stupid". These represent maladaptive internal dialogue that might be fuelled by repetitive self-talk (von der Embse et al., 2015). One catalyst

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for disturbance is unfavourable comparison with others, as represented by Social Comparison theory, whereby individuals may naturally be attracted to being with those they consider "better" than themselves, but the comparison may lead to self-deflation (Gerber et al., 2018). Another is unfavourable comparison with one's own idealistic or unrealistic standards of perfectionism, which are strongly associated with demoralisation (Bender et al., 2022). These maladaptive perceptions may be explained by the above theory, but other theories that help individuals to navigate their inner dialogue adaptively are outlined below through Personality theory and Social Cognitive theory.

Some psychologists have preferred the use of the term "impostor phenomenon" to impostor syndrome (McDowell et al., 2015), as the kind of inner dialogue highlighted above in quotes may be transitory rather than entrenched. Such thoughts may arise, for example, for students around assessment time and then evaporate. However, the term impostor syndrome is widespread in the literature even though the effect may be mild and temporary for some. According to Bravata et al. (2020), academics prefer to use the term impostor phenomenon, whereas lay persons prefer impostor syndrome. The measurement of a construct, whatever its appellation, should allow for the full spectrum of individual differences ranging for example, from mild to severe. This is a key issue, so to be effective, a new academic impostor syndrome (AIS) measure must show a range of response patterns across the scale that underline individual differences.

Perceptions nurtured in diverse conditions

One perhaps unexpected finding to emerge is that high achievers may be most vulnerable to impostor syndrome (Holden et al., 2021), and may attribute their accomplishments to external factors (Bravata et al., 2020). Previous work has suggested that an external locus of control is not consistent with academic success (Bandura, 2001). This anomaly in the context of impostor syndrome may require further investigation. If an individual believes that their success is accidental, then their first sign of slump may support this maladaptive perception and undermine their Self-efficacy (Mcilroy et al., 2015).

Upbringing may influence impostor syndrome in different ways; on the one hand there may be the pressure of high expectations from a high achieving family, while at the other extreme is the challenge of being the first generation individual to encounter the university experience (Holden et al., 2021). Feeling like an impostor is frequently found in academic professionals across disciplines (Vázquez, 2022). Muradoglu et al. (2021) explored impostor syndrome in academics and found that those traditionally underrepresented in specific fields reported strong feelings of being an impostor, suggesting that impostor experiences may be a function of the contexts that people must navigate rather than an inherent psychological vulnerability. This demonstrates that students who feel like impostors because they are from underrepresented backgrounds may perpetuate these perceptions as they progress through academia. If context is a trigger for some individuals, understanding this may help in the prevention and remediation of the problem. It also accentuates the point that there is no scope for complacency through an individual assuming that they are forever safeguarded against inner intrusions.

Academic settings– why combating impostor symptoms is vital

An emerging consensus within the literature is that impostor syndrome is likely to debilitate confidence and undermine wellbeing (Collins et al., 2020) and lead to problems with enrolment, retention, progression, integration, and success (Chrousos & Mentis, 2020). Such a range of debilitating issues warrant continued attention to the issue, with the intention of raising awareness of the phenomenon within the student population. The imposter symptoms can be eased for those affected by being able to talk about their experiences (TES, 2018) and by becoming more aware of negative self-talk and amending the language used.

Feelings of being an impostor has been reported across the academic lifespan from undergraduates (Maftei et al., 2021), through postgraduates (Chakraverty, 2020), and onto professionals working in academia (Muradoglu et al., 2021), yet there is no specific academic measure of impostor syndrome. General impostor syndrome measures have been applied in education rather than academically specific ones. For example, in Bravata et al.'s (2020) systematic review that enveloped 62 studies, measurement was not one of the primary headings addressed. Nevertheless, this is a useful review that informed the current study with reference to content validity, along with Mak et al. (2019), who concluded that the conceptual classification of existing constructs needs to be addressed. These key systematic reviews exposed the 10 key terms that were used to develop the measure in the present study. Given that imposter syndrome is domain specific whereby an individual may only experience the phenomenon in specific circumstances, the need for the present study also pivots on the specificity of measurement that captures the academic domain exclusively. Bandura (2001) had argued for the validity of specificity in measurement unless a broad range of domains were being explored.

Rationale for developing the measure

Mak et al.'s (2019) systematic review examined the methodological quality of the four most frequently used measures of Impostor Phenomenon: Clance Impostor Phenomenon Scale (Clance, 1985), Harvey Impostor Scale (Harvey, 1981), Perceived Fraudulence Scale (Kolligian & Sternberg, 1991) and Leary Impostor Scale (Leary et al., 2000). There were 18 studies, including 12 with a student sample, and they found that there were many issues including confusion over whether the measures were multidimensional or unidimensional and a lack of criterion validity across the measures, so they concluded that there was no gold standard measure. Indeed, Mak et al. (2019) noted that even when two subscales were found, researchers used a single score, contradicting their own conceptualisation. Moreover, Bravata et al. (2020) conducted a systematic review of the literature that incorporated 66 articles describing 62 studies, and in studies that utilised these impostor syndrome diagnostic measures, they found considerable variation in how researchers interpreted the scores.

While all four measures assessed broadly the same content in respect of feeling fraudulent and being self-critical, there were some differences in how this manifests more broadly across the measures. The Clance Impostor Phenomenon Scale (Clance, 1985) included fear of evaluation, feeling less confident than peers, and discounting success; the Harvey Impostor Scale (Harvey, 1981) included feelings of uncertainness, and inadequacy; the Perceived Fraudulence Scale (Kolligian & Sternberg, 1991) included achievement pressure, negative emotions, self-monitoring, and impression management; and the Leary Impostor Scale (Leary et al., 2000) included fear of discovery, and difficulty internalising success. Therefore, conceptual clarification of the constructs is warranted.

To develop the content of the proposed new AIS measure, the content of all four existing measures were combined and duplications removed, resulting in ten clear themes: fraudulent ideation, less capable than peers, fear of being discovered, self-criticism, achievement pressure, impression management, difficulty internalising success, self-monitoring, self-sabotaging, and fear of evaluation. Specificity of measurement is an advantageous approach when a particular domain is envisaged (Bandura, 2001), so the ten themes were contextualised to an educational setting to generate the items for the new academic-specific measure.

The novelty in this study is that (a) the measure is specific to academia and that (b) the measure aggregates the content from four different impostor syndrome measures, none of which have covered the full range exhaustively.

Established constructs in educational settings

To validate the new measure, its relationships with individual difference constructs already developed in the educational context was explored. A starting point for this is personality theory as represented by the Five Factor Model (FFM, Goldberg et al., 2006). The five factors or traits are Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Traits encapsulate behavioural consistency over time and across situations and are likely to be stable and enduring (Goldberg et al., 2006). A series of meta-analyses have shown that these are related to academic performance (Poropat, 2009; Vedel, 2014). However, these have also been related more broadly to the processes and pathways of learning and achievement (Mcilroy et al., 2015) and the transition to higher education, and the application to academic impostor syndrome (AIS) is an aspect of that extension. It is expected that four of the personality traits would generally act as protectors from AIS; Extraversion, Agreeableness, Conscientiousness, and Openness, while Neuroticism would be a risk factor.

Two facets of self-concept and their protective role

Another factor implicated in academic performance is Self-concept and two of the important aspects of this are Self-efficacy and Self-esteem (Marcionetti & Rôssier, 2016). Various meta-analyses over three decades have shown that Self-efficacy is significantly associated with academic performance (Honicke & Broadbent, 2016) and remains useful in explaining the processes of success (Morelli et al., 2023) as individuals with high Self-efficacy are able to exercise control over environmentally challenging demands that required adaptive action. This is consistent with the operational definition of Self-efficacy that includes adaptive beliefs, agentic action, mastery processes and regulatory control (Bandura, 2001; Honicke & Broadbent, 2016). Self-efficacy links to Social Cognitive theory which provides a good framework for addressing academic imposter syndrome because it postulates a new beginning in which the individual is the agent who can restructure their thinking and reorientate their behaviours (Bandura, 2001). Self-efficacy has previously been applied to impostor syndrome in the context of perceived organisational support (McDowell et al., 2015), so the relationship exists.

A second aspect of Self-concept is Self-esteem and that entails self-respect, self-acceptance and feelings of personal value and self-worth (Orth et al., 2018; Rosenberg, 1965). The evidence on whether Self-esteem directly predicts

academic performance has been inconsistent and inconclusive, however, it is related clearly to wellbeing (Marcionetti & Rôssier, 2016) and to developing good social relationships (Harris & Orth, 2020), and these are relevant to the overall student experience. Moreover, Self-esteem may provide a buttress against depression (Orth et al., 2014), and may also counter imposturous intrusions and disturbances.

Aims and hypotheses

The aims of this study include the construction of an original academic impostor syndrome measure (AIS) in the specific context of education. The items of the new measure are derived from the ten themes previously identified in the literature. A salient aim was to construct a parsimonious measure with adequate and representative item content that would capture the key domains of impostor syndrome within the academic context.

The analysis tests the underlying latent structure of the data after exploring the intercorrelations of the items. The first hypothesis explores whether participants responded in the higher parameters of the AIS measure (i.e., above the midpoint), to ascertain if there is a tendency toward AIS within the sample.

A second hypothesis tests the psychological constructs that may predispose individuals to protection from or risk of AIS. The hypotheses within this are: (a) that Neuroticism will be positively associated with AIS and provide a risk factor, (b) the other four factors of personality (Openness to experience, Conscientiousness, Extraversion, and Agreeableness) will negatively associate with AIS and provide a protective factor, and (c) the two Self-concept measures (Self-efficacy and Self-esteem) will also negatively associate with AIS and provide a protective factor.

Method

Participants

These were opportunistically sampled undergraduate psychology students from two universities, one in the Northwest of England ($n=166$) where participants were pooled from a large cohort at a city campus, and the other in West Wales ($n=173$) where participants were pooled from a relatively small cohort at a rural campus. These sites were chosen because they are broadly representative of the different types of universities in the UK; the site in England is a large former polytechnic that attracts large cohorts of diverse students, including first generation students, while the site in Wales is a long-established university that attracts smaller cohorts of mainly traditional students, so diversity is represented within the overall student sample. Of the participants that responded to the question about whether they were the first higher education student in their family ($N=242$), there was an even split between first generation students ($n=121$) and traditional students ($n=121$), but as predicted, first generations students were more prevalent at the site in England ($n=74$; 57%) and traditional students were more prevalent at the site in Wales ($n=67$; 58%).

Participation was voluntary and the students were chiefly in their first year of study and were given course credit (i.e., shorter portfolio) for participation in the project. Study programmes at both institutions are accredited by the British Psychological Society and therefore follow a similar curriculum. The study was hosted on an online platform (JISC) alongside other studies that the students could participate in for course credit. Students self-selected the study for participation using SONA software which generates course credits, but this is not linked to individual responses on the survey, so anonymity is guaranteed.

When participants accessed the survey, they were provided with a detailed Participant Information Sheet, followed by a Consent Form which they needed to complete before they had access to the survey. If participants did not give informed consent, they were directed to an exit page rather than the survey, and course credit was still available to them.

Data were collected from both universities at two points in time to maximise the sample, with the first tranche of data collection yielding 171 respondents and the second tranche yielding 168 respondents. Across the sample, Mage$=20.33$, sd$=4.15$, with ages ranging from 18 to 56, and 86.1% of the sample aged 18–21. The gender split reflected the gender bias in undergraduate psychology students, with females forming the largest group ($n=250$), followed by males ($n=66$), and a further 23 participants who prefer not to disclose their gender. Participant profiles in respect of the measures used were consistent across both samples as evident from descriptive statistics (see Table 1).

Design

This was a cross-sectional, correlational design with administrations at two HE institutions. A range of explanatory variables included the FFM of personality and 2 Self-concept measures: Self-esteem, and Self-efficacy. The outcome variable was the newly constructed measure of academic impostor syndrome (AIS). This was tested by confirmatory factor analysis in the combined samples. The range of these covariates were used to augment the validity of the new measure.

Table 1 Descriptive statistics, skewness and kurtosis for the academic imposter syndrome measure, the five factor model of personality, self-esteem, and self-efficacy for students studying in England and Wales (in brackets)

	Mean	SD	Skewness	Kurtosis
AISM	38.92 (44.07)	8.02(10.91)	0.05 (−0.02)	−0.71 (0.04)
Extraversion	30.96 (30.98)	8.02 (6.56)	0.04 (0.63)	−0.15 (−0.30)
Conscientiousness	31.12 (34.19)	6.77 (5.92)	0.17 (0.31)	−0.19 (−0.55)
Neuroticism	35.51 (38.73)	6.98 (7.50)	−0.30 (=0.38)	−0.64 (−0.58)
Openness	34.30 (35.15)	6.55 (5.30)	−0.05 (0.20)	−0.30 (−0.61)
Agreeableness	40.99 (40.65)	5.44 (6.03)	−0.67 (−0.85)	0.29 (0.36)
Self-esteem	30.90 (31.69)	6.38 (4.78)	0.02 (0.29)	−0.33 (0.00)
Self-efficacy	27.37 (27.06)	4.33 (4.95)	−0.18 (−0.07)	0.36 (−0.36)

Measures

Academic impostor syndrome measure

This measure was constructed as a collaborative activity between two UK universities, one in England and one in Wales. It is comprised of 10 items, each with a seven-point Likert response format ranging from one=*Strongly Agree* to seven=*Strongly Disagree*. A sample item is, "I believe that when I do well, it is an accident". The measure was constructed based on the configuration of general impostor syndrome as developed in the literature. The ten components used in this study were derived from relevant systematic reviews (Mak et al., 2019; Bravata et al., 2020) with the academic content applied (Fig. 1).

Rosenberg self-esteem scale (Rosenberg, 1965)

This measure is comprised of a 10-item self-reported measure of Self-esteem. The items are endorsed on a five-point scale ranging from one=*Strongly Agree* to five=*Strongly Disagree*. A sample item is: "I certainly feel useless at times." Previous reliabilities were typically high for this measure, and that is supported in the present study for Alpha but lower for Omega (α=0.71, ω=0.61). This measure has been extensively used in a wide range of applied contexts and the consensus favours a one-factor solution as originally envisaged by Rosenberg.

General self-efficacy scale (Jerusalem, & Schwarzer, 1992)

This 10-item psychometric scale was used to capture a general perceived sense of one's Self-efficacy. The responses are represented along a 4-point Likert response format ranging from one=*Not at all true* to four=*Exactly true*. A

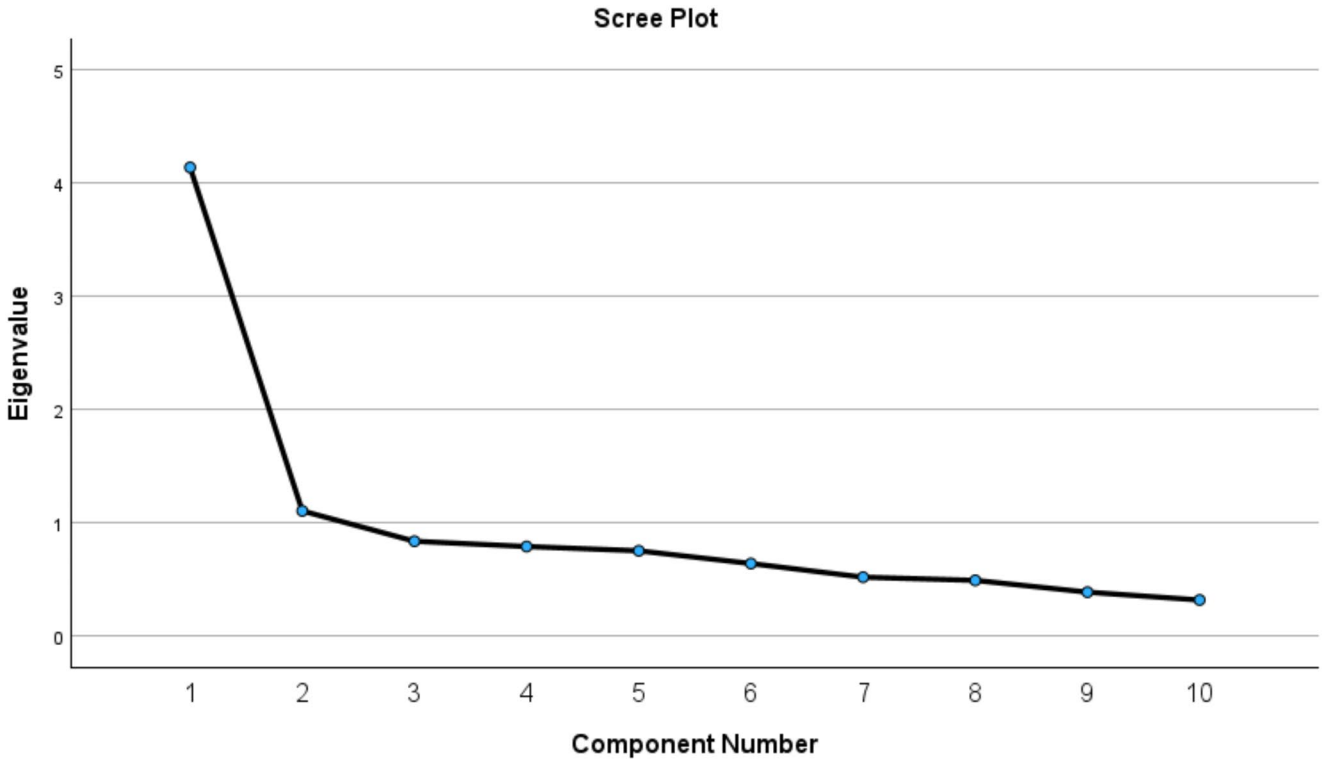

Fig. 1 Scree Plot to demonstrate the unidimensional structure of the academic impostor syndrome measure

sample item is: "I can usually handle whatever comes my way." The high reliabilities reported in previous studies are also supported here (α = 0.91).

Five factor model of personality (Goldberg et al., 2006)

This measure assesses five main personality traits: Agreeableness, Conscientiousness, Extraversion, Neuroticism and Openness to Experience. This measure consists of 50 items, with 10 items for each trait. The responses are represented along a 5-point Likert response format ranging from one = *Very inaccurate* to five = *Very accurate.* A sample item is: "I am the life of the party." The version used in the current study is known to have sound psychometric properties and the reliabilities reported here support that conclusion (α's = 0.82 to 0.92).

Ethics

Ethical approval was granted at both academic institutions independently and the BPS Code of Human Research Ethics (2021) was strictly adhered to. Participation was voluntary and data collection was anonymous, so there was no pressure to participate. Participants could also change their minds and withdraw their data without penalty, up until the point of submission when their data became anonymous.

Procedure

To develop a scale of academic impostor syndrome, existing general measures were examined, and following elimination of overlap, ten domains were identified. Three academic specific items were developed for each domain, resulting in an initial thirty-item measure. In addition to the literature review to ensure content validity, students as end users were consulted to ensure that item content was relevant and clear. Thus, the initial 30-item version was piloted in a focus group with very small volunteer student sample ($N = 10$) who provided qualitative verbal feedback on the wording of the measure and experience of participation. Following this, several amendments were made to the measure to ensure clarity of meaning for each item, and the original domain of "self-handicapping" (which was a term derived from previous literature) was replaced with "self-sabotaging" to reflect current language conventions.

To reduce the thirty items to ten items, the principles of content validity and measurement processes were followed, resonating with the recommendations of Stanton et al. (2002). The ten-item measure contained one item from each cluster of three, to ensure breadth of content while removing the possibility of redundant duplication. Item selection was based on identifying the items that cohere with each other most effectively. Data were analysed using SPSS and AMOS (both version 29).

Data analytic strategy

For the item analysis, the ten items were developed based on the ten themes identified from the literature in the context of impostor syndrome. The approach taken was consonant with Stanton et al.'s (2002) strategic guiding principles related to item choice or reduction: (1) Internal reference points such as coherence between the items and each item's discriminatory potential. (2) External reference points for the collective items in terms of their relationship with constructs outside the measure. (3) Subjective judgement aspects guided not only by the content validity from the literature, but also by the endorsement of students as end users as well as experienced academics.

At the statistical level this involved running means, standard deviations, reliability, skewness, kurtosis, and corrected item total correlations to test the coherence and uniqueness of the items. With reference to the descriptive statistics, the response pattern in both groups for means and standard deviations were very similar on all eight constructs tested. Moreover, skewness and kurtosis values in both groups were indicative of sound distribution, with acceptable reliabilities. To obtain parsimony, thirty original items were reduced to ten, using the combination of appropriate content and statistical testing, ensuring that all ten impostor syndrome domains were represented by one item. All thirty items satisfied the content validity and preliminary statistical criteria for descriptive statistics: skewness, kurtosis and reliability. However, an exploratory factor analysis demonstrated that some items were deficient in the criterion for factor loadings (> 0.40), but all ten final items selected were above this. The item with the highest factor loading in each domain within the construct was selected, because this provides statistical and conceptual coherence across the measure.

The process was carried forward by a principal component analysis in approximately half of the sample. When this gave a preliminary indication of construct validity by good loadings, this was then tested within the context of a confirmatory factor analysis through the remaining half of the sample. The next step was to explore the potential of the new AISM measure for convergent and discriminant validity with reference to external constructs that had been developed in relation to the student experience. These included the five-factor model of personality and two facets of Self-concept (Self-efficacy and Self-esteem). Finally, invariance testing was employed to ascertain whether the construct would hold equivalence across the two student groups by

testing the configural model, the factor loadings and the means/intercepts compared across the groups.

Results

In general, the trends presented in Table 1 are comparable across the two student groups with means typically within one point of each other and standard deviations also usually within a one-point variation between the groups. Measures of skewness and kurtosis are all <1 and well within the parameter suggested by Osbourne and Costello (2005) for sound data distribution (<3). However, exceptions to the mean pattern comparing across the two groups are on the AISM and on Neuroticism. In both cases the students studying in Wales reported higher levels and showed stronger spread of responses on the AISM than students studying in England, although the spread differential does not relate to Neuroticism. On reliability indicators, Alpha values ranged from (α=0.71 to 0.88) on the eight constructs, and these were identical or close to identical in seven of McDonald's Omega values with only Self-esteem being lower (α=0.71, ω=0.61).

When the midpoint of the AISM is considered (i.e. 40) for the students in Wales, it is evident that >50% students reported impostor syndrome perceptions in the upper parameters of the scale and the students in England are not far from the midpoint, although individual differences are evident in both groups, spread across upper and lower scale parameters. This response trend addresses the first hypothesis in demonstrating the prevalence of impostor tendencies among the student sample.

Although it was not part of the initial study aims, gender differences were examined and it was found that females reported higher levels of impostor syndrome (mean=42.17, sd=11.28, n=250) than males (mean=38.17, sd=12.04, n=66): t (314)=2.46, p=.014 (two-sided); Levene's F-test=1.04, p>.05, which is consistent with gender differences found in previous studies (Price et al., 2024). Some respondents preferred not to declare their gender and a limitation was that the sample had fewer males.

Item analysis

When the 30 original items of the AISM were entered into reliability and item analyses they emerged with a high reliability (α=0.922 & ω=0.920). Mean scores for each item ranged between 3 and 5, and SDs between 1.23 and 1.85. There was one exception (mean=6.39, SD=0.85). However, it's deletion would not depress the reliability although that was true of all items (alphas ranged from 0.917 to 0.920). Moreover, when the discriminatory function of each item in relation to the overall scale was tested, each demonstrated statistical significance (r=.27 to 0.71) - all but one>0.30. Therefore, on a purely statistical basis, all but one of the 30 items could potentially have been selected.

Further refinement of the scale was informed by: (1) Alpha can be artificially inflated with too many items - e.g. fifteen or above (Loewenthal, 1996); (2) The aim of parsimony and elimination or reduction of redundant repetition may be made on the grounds of subjective judgement (Stanton et al., 2002). From the ten content areas across the general impostor syndrome literature, one item was selected from the original three in each area, to reduce the number of items from thirty ten. Along with relevant content, the strength of the loadings from the exploratory factor analysis was taken into account. Some items selected did not meet the required factor loading criterion (>0.40, Hair et al., 2018), so these were replaced by items with similar content that did meet the criterion. For example, in the category of Impression Management, the item "I try to fit in with my peers" (loading=0.21) was initially selected, but this was replaced by "I make sure no one can see how hard I try" (loading=0.61). Likewise, in the category of Self-Monitoring, the item "I watch what I say in front of my peers" (loading=0.39) was replaced by "I am not capable of doing as well as other students, so there is no point in trying" (loading=0.64).

With these ten items, reliability scores of α=0.838 and ω=0.835 were obtained. Mean values ranged from 3 to 5 with standard deviations from 1.44 to 1.96. Output indicated that with the removal of any item the variation in Alpha would be minute (α=0.813 to 0.829). Furthermore, when each item was correlated with the scale total, the discriminatory value of each item was >0.3 (r=.55 to 0.72, p<.001). This was supported by the corrected item total correlations of r=.42 to 0.64 (p<.001).

Principal component analysis

With approximately half the sample, a principal component analysis was run, and the ten items emerged suggestive of a one-factor solution. The findings in Table 2 address the aim with reference to uni-dimensionality of the latent factor structure. Bartlett's test of sphericity was applied, and this assumption was met as the correlation matrix was not an identity matrix (χ^2 [45]=525.892, p<.001). Also, the Kaiser-Meyer-Olsin measure of sampling adequacy demonstrated a value of 0.84, above the 0.5 criterion. The scree plot was then applied with a clear Eigenvalue above the minimum criterion of 1 (=4.14) and although a second was marginal at 1.11, the factor loadings were invariably higher on factor one, and on factor two the loadings were consistently below the criterion (<0.40). Costello and Osbourne

Table 2 Standardised loadings for the academic impostor syndrome measure: principal component analysis ($N=173$)

		(PCA)
Item 1	I do not feel I belong at university	0.68
Item 2	I am not as clever as many other students on my course	0.62
Item 3	I am scared that others will see me as I am	0.67
Item 4	I am not good enough	0.66
Item 5	I worry that I will fail my assessments	0.56
Item 6	I make sure no one can see how hard I try	0.61
Item 7	I believe that when I do well, it is by accident	0.68
Item 8	I monitor my student behaviour to ensure it is the same as others	0.57
Item 9	I am not capable of doing as well as other students, so there is no point in trying	0.64
Item 10	I fear my tutor will inform me that this course is not a good match for me	0.73

All loadings were statistically significant: $p<.001$. *PCA* Principal component analysis

Table 3 Standardised factor loadings for the academic impostor syndrome measure: confirmatory factor analysis ($N=166$)

		CFA
Item 1	I do not feel I belong at university	0.65
Item 2	I am not as clever as many other students on my course	0.52
Item 3	I am scared that others will see me as I am	0.61
Item 4	I am not good enough	0.62
Item 5	I worry that I will fail my assessments	0.46
Item 6	I make sure no one can see how hard I try	0.57
Item 7	I believe that when I do well, it is by accident	0.61
Item 8	I monitor my student behaviour to ensure it is the same as others	0.51
Item 9	I am not capable of doing as well as other students, so there is no point in trying	0.60
Item 10	I fear my tutor will inform me that this course is not a good match for me	0.67

All factor loadings were statistically significant: $p<.001$. CFA = Confirmatory Factor Analysis

(2005) concluded that when five items or more are present with loadings > 0.5, this indicates a solid factor.

Confirmatory factor analysis

A confirmatory factor analysis was conducted with the remainder of the sample ($N=173$) and Table 3 shows a similar pattern of factor loadings to the exploratory factor analysis and the principal component analysis. A multivariate test supported the assumption of multivariate normality, with the AMOS test for multivariate normality yielding a value of 13.85. When Mardia's formula was applied: p ($p+2$) = 120, this demonstrated that the value was within the cut off point for normality: 120 > 13.85, allowing the use of the Maximum Likelihood estimator. Before the model was modified (as suggested by the Modification Indices in AMOS) the following fit indices were obtained: χ^2 (35) = 93.013, $p<.001$; χ^2/df = 2.66; CFI = 0.87; RMSEA = 0.10 (CIs = 90%, 0.076 to 0.125). After the insertion of two correlated errors, this improved to within satisfactory boundaries (Hu & Bentler, 1999; Pendergast et al., 2019): χ^2 (33) = 69.397, $p<.001$; χ^2/df = 2.10; CFI = 0.92; RMSEA = 0.08 (CIs = 90%, 0.055 to 0.109). The first correlated error was between items two and five from Table 2, and this resonates with the test anxiety literature in that worry about assessment may coincide with perceptions of incompetence. In the second, the two items, seven and ten, combine to suggest a perceived belief that luck will run out. Common content between items provides a justification for correlated errors. In general, the findings in this study support a single dimension for the AISM.

Invariance testing

Given the above support for underlying latent structure for the AISM, the next step was to ascertain whether the measure functioned similarly across the two student groups. When the two were compared in the context of invariance testing, a one-factor solution emerged as a good fit as shown by the indicators in Table 4, and therefore the configural model is invariant. Satisfactory fit is shown by χ^2 /df ratio < 3, CFI > 0.90, and RMSEA < 0.08. The measurement weights show that the factor loadings are equivalent across the groups ($p>.05$). In addition to the factor loadings, the structural covariances, incorporating the means/intercepts, are also non-significant ($p>.05$) and are therefore equal. However, with only one factor this is strictly a measurement rather than a structural model. Nevertheless, the factor variances are equal across the groups ($p>.05$). Finally, the measurement residuals are also non-significant and are therefore equal across the groups ($p>.05$). The aim was to address the configuration of the factor structure and measurement weights as there was no known precedent to compare with in terms of academic impostor syndrome. This analysis

Table 4 Fit indices for invariance testing across the two student groups

	χ^2	df	p	χ^2 /df	CFI	RMSEA
One Factor Solution	155.029	66	0.000	2.35	0.91	0.63 (90% CI: 0.05–0.76)
Measurement Weights	5.71	9	0.77			
Structural Covariances	5.98	10	0.82			
Measurement Residuals	32.45	22	0.07			

Table 5 Correlation coefficients for the academic impostor syndrome measure, the five factor model of personality, self-esteem, and self-efficacy measures

	1	2	3	4	5	6	7
1. AISM	1						
2. Extraversion	−0.25**	1					
3. Conscientiousness	−0.15*	0.05	1				
4. Neuroticism	0.48**	−0.17**	−0.04	1			
5. Openness	−0.27**	0.29**	0.11	−0.06	1		
6. Agreeableness	−0.18*	0.18**	0.18**	−0.02	0.37**	1	
7. Self Esteem	−0.45**	0.42**	0.41**	−0.41**	0.33**	0.23**	1
8. Self-efficacy	−0.35**	0.41**	0.31**	−0.34**	0.33**	0.05	0.54**

Code: The numbers across the top relate to the numbered factors in the first column, * $p < .05$. ** = $p < .01$ (one-sided), AISM = Academic Impostor Syndrome Measure

tested equivalence with the expectation of invariance across the two groups, and this was upheld.

Convergent and discriminant validity

Table 5 presents the associations of personality traits (FFM) with Self-concept (Self-esteem and Self-efficacy) with the AISM. In relation to traits, Neuroticism correlates positively with AISM, supporting hypothesis 2a, suggesting a predisposition toward risk of impostor syndrome. By contrast, Extraversion, Conscientiousness, Agreeableness and Openness correlate negatively with AISM, supporting hypothesis 2b, suggesting a predisposition toward protection from impostor syndrome. The two Self-concept measures provide the strongest negative associations with the AISM, indicating protection and supporting hypothesis 2c.

These constructs have been widely used over several decades in the education context in relation to achievement, retention and progression, and therefore provide an appropriate network of constructs in relation to the new measure with further explorations envisaged in future studies in relation to other constructs. Convergent validity for the AISM is suggested with reference to Neuroticism and the latter is reported generally as being maladaptive to the student experience. Moreover, discriminant validity for the AISM is suggested by the negative associations with all the remaining constructs (Extraversion, Conscientiousness. Openness, Agreeableness, Self-esteem, and Self-efficacy), although Conscientiousness and Agreeableness are weak. These may therefore serve to counter impostor syndrome in students and improve the overall student experience.

Discussion

The primary aim of this study was to develop a new psychometrically robust measure of impostor syndrome in the specific domain of higher education. The secondary aim was to establish whether there was a tendency towards academic impostor syndrome within the sample, and to explore the measure in relation to established psychological constructs widely used in education research, the Five Factor Model of personality and two Self-concept measures: Self-esteem and Self-efficacy. Academic impostor syndrome was evident within the sample, with mean scores that clustered around the mid-point of the scale (and clear dispersion from the mean in both groups), providing further evidence that impostor syndrome warrants attention in educational settings. The predictions that Neuroticism would be a risk factor for impostor syndrome and the remaining personality factors (Openness to experience, Conscientiousness, Extraversion, and Agreeableness) along with the two Self-concept measures (Self-efficacy and Self-esteem) would provide a protective role were upheld. The strongest associations were with Neuroticism and the two Self-concept measures, suggesting that future research to support students to manage academic impostor syndrome should focus on these domains.

After attention to the content validity processes, the factor loadings from the exploratory factor analysis were applied to inform item reduction with a minimum criterion of >0.4 (Hair et al., 2018). From the exploratory analysis there was a preliminary indication that the measure developed represented an underlying one-dimensional latent structure. These findings were supported by a good pattern of loadings from the principal components analysis (>0.5), as well as robust outcomes from Bartlett's test of sphericity, a scree plot, and the Kaiser-Meyer-Olsin measure of sampling adequacy (Osbourne & Costello, 2005). Reliability for the AISM was supported by alpha and omega values in the first iteration of the study and this was consolidated by the second iteration. This was further supported by the confirmatory factor analysis, with a similar pattern of factor loadings and acceptable indicators of model fit including the χ^2/df ratio, the CFI, and the RMSEA (Hu & Bentler, 1999; Pendergast et al., 2019). Because there appears to be no existing measure of academic impostor syndrome, there is no direct frame of reference to compare with. There are measures

of general impostor syndrome, but Mak et al. (2019) concluded that the available measures present a mixed picture and from the ones that are presented with subscales, the researchers invariably used a composite score, appearing to violate their own conceptualisation. Moreover, Bravata et al. (2020) did not grapple with measurement issues in their work. Therefore, it seems that the trend in the general literature ultimately favours a one-dimensional approach, and the findings of this study are consistent with this.

The summary of the above findings focusses primarily on the internal properties of the items. Stanton et al. (2002) argued that their collective validity should also be tested with reference to external variables in a network of relationships. Again, the present study is somewhat limited by the lack of existing specific academic impostor constructs. Therefore, the study has incorporated a cluster of variables that have been widely used in relation to the overall student experience and these include the five-factor model of personality (Poropat, 2009) as well as Self-efficacy (Honicke & Broadbent, 2016) and Self-esteem (Orth et al., 2014, 2018). The AISM was found to be associated positively and moderately with Neuroticism, and this synchronises with convergent validity as both are likely to impair the quality of the student experience. All other constructs diverge from the AISM through negative relationships and represent processes likely to enhance the student experience and protect from or counteract academic impostor syndrome. They therefore provide the basis for discriminant validity, but future studies should test a range of variables within the nomological network to enhance convergent and discriminant validity. In addition, previous findings in gender research on general impostor syndrome are inconsistent, but a recent meta-analysis found that females reported higher levels than males, albeit to different levels depending on the measure used (Price et al., 2024). Gender differences was not a key aim of the current study, but a similar pattern of gender differences was found. However, this would need to be explored further with a larger sample of males and by controlling for other covariates to ascertain whether this is a robust finding.

Finally, invariance testing was conducted across the two student groups and the basic measurement model held firm as a configural model across the two groups and demonstrated equivalence with factor loadings, means/intercepts and even with residuals. This marks an advancement of previous work as Mak et al. (2019) bemoaned deficiency of any serious or rigorous attempt to grapple with the challenges of measurement in the context of impostor syndrome.

Application in pedagogical settings

One practical application for the ten items of the new measure would be to use it in group tutorials for students. Guiding students through the scoring and interpretation of the measure could be kept simple with each item as a reference point for discussion. For example, scores above the midpoint of each item (i.e., > 4) tend toward impostor perceptions as does scores for the measure overall (>40). Strategies for adaptive action could be inculcated with the basic proposition that mindsets can be transformed through cognitive restructuring. Moreover, negative emotions can be channelled into constructive reactions (Barańczuk, 2019), and behaviours can be adapted to align with attainment pathways. In the context of Self-efficacy for example, it is concluded that higher beliefs mean that tasks are perceived as challenges rather than threats (Honicke & Broadbent, 2016). However, all work around sensitive issues with students should be pursued in the letter and spirit of ethical principles and procedures.

Strengths, limitations, and future directions

The solid foundation for this study was provided by the theoretical perspectives that underpin it. Social Comparison theory was called upon to explain in part the dynamics of academic impostor syndrome through negative comparison with peers. Personality theory suggests a predisposition toward ruminative and maladaptive cognition, emotion, and behaviours through Neuroticism. However, the other four factors may provide protection to counter maladaptive internal dialogue. Moreover, Social Cognitive theory through Self-efficacy highlights empowerment, beliefs, and Self-regulation through personal agency to navigate the challenges of the academic life. Other strengths include the strong factor loadings, good fit indices, quality indicators around normality and reliability, the finding of invariance across two different student groups and consistent associations in expected directions from the analyses.

Limitations of the study include the cross-sectional nature of the data, which cannot definitively establish causality between the factors, the exclusive use of psychology student participants, which limits external validity, and the monomethod use of correlated self-report data, which may lead to conclusions that are less robust than they seem (Bornstein, 2022). Given that impostor syndrome includes self-doubt with feelings of inadequacy that those affected try to hide (La Donna et al., 2018), participants vulnerable to impostor syndrome may also be more prone to conforming to social desirability bias, so the AIS measure would benefit from being augmented with other methods of assessment, such as a social desirability measure.

Future directions for this research to cover the limitations would include replication of the findings in a variety of settings with larger and more diverse samples and could include cross-cultural invariance testing to complement the invariance outcome found in the present study. In addition, a multimethod approach could be adopted whereby the measure is implemented alongside other forms of assessment, such as the Rorschach method, which has growing endorsement for integrating different forms of data to gain a more balanced understanding of the person (Andronikof, 2023) and is less prone to social desirability bias.

Bornstein (2022) argues that the Rorschach taps a different set of psychological processes than interviews or self-reports by combining stimulus characteristics with an individual's motives, emotions, need states and cognitive styles. This along with a social desirability indicator would provide more clarity through comparison across outcome dimensions.

The consistency of the measure could be assessed using a longitudinal test-retest approach, and normative data could be established within specific educational settings to provide interpretive benchmarks for users. Alongside this, the measure could be used in conjunction with behavioural indicators of academic success, which are known to be influenced by impostor syndrome (Chrousos & Mentis, 2020), as well as alternative covariates such as stress, coping or perceived personal competence.

When the AIS measure was constructed, it was not envisaged primarily as a predictor of academic performance as there is already a plethora of measures that do this. However, a future investigation may find that it does offer unique and incremental variance when controlling for established predictors. Moreover, the added value of the measure may be its association with student transition to Higher Education. In this context related aspects might include adjustment and adaptation to the Higher Education environment and secure student identity through integration with the academic community as well as establishing rapport with peers and tutors to enable students to flourish.

Conclusion

The concept of impostor perceptions is likely to resonate with many, even those who have attained high standards (Holden et al., 2021). In the present study a substantial minority of students reported personal perceptions of AIS in the upper parameters of the scale. When maladaptive affectivity, behaviours and cognition are left unchecked they may deteriorate and debilitate commitment and attainment. Individual vigilance is required to prevent the nurturance of inner impostor dialogue, and a strong sense of supportive academic community will reinforce this. Consciousness of internal dynamics is facilitated by measurement that is specific and captures the range of the AIS construct. The new measure may facilitate this process, and research around its covariates may signpost adaptation and navigation through the academic environment.

Data availability Data is available in PURE at Aberystwyth University DOI: https://doi.org/10.20391/b5f69b03-01dc-42cd-9c25-f2ec07c5fd1c.

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