The Multidimensional Anxiety Scale for Children (MASC): A further validation with Australian adolescents with and without Attention-Deficit/Hyperactivity Disorder

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Abstract

Objective: To examine the factor structure of the Multidimensional Anxiety Scale for Children (MASC) with Australian adolescents with and without Attention–Deficit/Hyperactivity Disorder (ADHD). **Method**: The MASC was administered to 210 high school aged adolescents (109 males, 101 females), 115 of who were clinically diagnosed as ADHD (86 males, 29 females). The remaining 95 were non ADHD Community Comparisons. **Results:** Analyses supported a three-factor model, with a reduced item pool, which combined the Harm Avoidance and Separation Anxiety scales together. This model was invariant across younger and older participants, and across boys and girls. The model was largely invariant across ADHD and non-ADHD groups. The ADHD group had significantly higher Physical Symptom factor scores than the non-ADHD group. **Conclusion:** The MASC is useful for assessing anxiety in adolescents with and without ADHD but items reflecting the Harm Avoidance and Separation Anxiety scales may need revising.

Attention-Deficit/Hyperactivity Disorder (ADHD) is characterised by developmentally inappropriate symptoms of inattention, hyperactivity, and impulsivity (American Psychiatric Association, APA: 2000), which can affect many aspects of children's and adolescents' functioning and development (Bell, 2011). It is the most pervasive psychological disorder in children in their schooling years (Woo & Keatinge, 2008) affecting 3-7% of school-aged children (APA, 2000). Studies have reported prevalence rates for children and adolescents with ADHD in the United States as ranging from 3-11% (Barkley & Biederman, 1997), 4.2-6.3% (Mash & Barkely, 2003), 5.9% (Rohde, 2008) and up to 16.1% (see Lecendreux, Konofal, & Faraone, 2011). In Australia prevalence has been reported to range from 3% to 9% (Graetz, Sawyer, Hazel, Arney, & Baghurst 2001; Mental Health Division of Western Australia, 2000; National Institute of Health, 2000) to as high as 14% (Sawyer, Arney, Baghurst, Clark, Graetz, Kosky et al., 2000).

Of those with ADHD, 20-60% will continue to experience it during late adolescence and adulthood as an incomplete or full syndrome (see Barkley, 1996; Spencer, Biederman, Wilens, & Faraone, 2002). Hence, ADHD is a major clinical and public health concern (Perwien, Kratochvil, Faries, Vaughan et al., 2008) that affects health care costs significantly (Chan, Zhan, & Homer, 2002; Leibson, Katusic, Barbaresi, Ranson, & O'Brien, 2001).

ADHD is also highly comorbid with a range of psychiatric disorders (Baldwin & Dadds, 2008; Jarrett & Ollendick, 2008) and one of the most consistent findings in ADHD research over the past 25 years has been the high prevalence rates of comorbid anxiety (see Sorenson, Plessen, Nicholas, & Lundervold, 2011). Studies (Alqahtani, 2010; Jensen, Martin, & Cantwell, 1997; Pliszka, 1998; Tannock, 2000; Vloet, Konrad, Herpertz-Dahlmann, Polier, & Gunther, 2010) have reported 25% to 50% of children with ADHD as exhibiting an anxiety disorder and/or meeting the Diagnostic

and Statistical Manual of Mental Disorders-Version IV-Text Revision (DSM-IV-TR; American Psychiatric Association, 2000) criteria for an anxiety diagnosis. This relationship between ADHD and anxiety, which exists across international populations (Souza, Pinheiro, Denardin, Mattos, & Rohde, 2004), is in excess of the 10-21% and 5-15% reported in normative samples of school-aged children (Thaler, Kazemi, & Wood, 2010; Pliszka, Carlson, & Swanson, 1999). If left untreated pediatric anxiety disorders predict adult anxiety disorders and depression (Kendall, Compton, Walkup, Birmaher et al., 2010).

Stimulants are effective medications for treating the core symptoms of ADHD (American Academy of Pediatrics Committee on Quality Improvement, Subcommittee on Attention-Deficit/Hyperactivity Disorder, 2001) however, ADHD and anxiety disorders have different treatment needs and pharmacological interventions (Hammerness, Geller, Petty, Lamb, Bristol, & Biederman, 2010). Furthermore, children with comorbid anxiety respond differently to treatments (Baldwin & Dadds, 2008), and when stimulant medication is employed the response of the individual with ADHD is often less robust (Ter-Stepanian, Grizenko, Zappitelli, & Joober, 2010).

Developing a better understanding of the association between ADHD and anxiety is therefore critical both from a clinical and scientific perspective. To achieve this there is a need for a reliable instrument to measure levels of anxiety symptoms (and to monitor progress of treatment). Perceiving the internal world of their children is often difficult for parents however, and likewise confessing anxiety problems to parents may be uncomfortable for children (Baldwin & Dads, 2007). Children are consistent within themselves across measures of anxiety (Barbosa, Tannock, & Manassis, 2002) and therefore, self-report measures may be advantageous for facilitating a young person's reporting of symptoms of anxiety.

One of the most commonly used, empirically driven, self-report measures for anxiety is the Multidimensional Anxiety Scale for Children (MASC: March, 1998). The MASC was developed as a state measure of anxiety because of the need for such a measure that was appropriate for use with children and adolescents and which had specific or pure anxiety items or subscale scores (Osman, Williams, Espenschade, Guiterrez, Bailey, & Chowdhry, 2010). Suitable for assessing broad dimensions of anxiety in 8 to 19 year olds, the MASC was developed using a "bottom up" approach whereby the 39 items (comprising the MASC) were adopted from a 104 item pool, (see March, 1998). Exploratory and confirmatory factor analyses (March, Parker, Sullivan, Stallings, & Connors, 1997; March, Sullivan, & Parker, 1999) identified four correlated factors during instrument development: Physical Symptoms (12 items), Social Anxiety (9 items), Harm Avoidance (9 items), and Separation Anxiety/Panic (9 items) with internal consistencies ranging from .74 to .90. Each of the items on these domains is rated on a four-point scale ranging from "never true about me" (score 0) to "often true about me" (score 3).

The MASC factor structure has been cross validated with community and clinical samples of children and adolescents in the United States (see Grills-Tacquechel, Ollendick, & Fisak, 2008; March, Sullivan, & Parker, 1999; Rynn, Barber, Khalid-Khan, Siqueland et al, 2006), Iceland (Olason, Sighvatsson, & Smari 2004), Sweden (Ivarsson, 2006), Australia (Baldwin & Dadds, 2007), Taiwan (Yen, Yang, Wu, Hsu, & Cheng, 2010) and South Africa (Fincham, Schickerling, Temane, De Roover, & Seedat, 2008) and has been shown to be invariant across gender. Acceptable levels of convergent and divergent validity and test-retest reliability have also been reported for the MASC (see Baldwin & Dadds, 2007). Additional research conducted with adolescent psychiatric in-patient samples (Osman et al., 2009) also supports the four-factor structure. However, Osman et al. (2009) suggested that some MASC items from

the Harm Avoidance and Separation Anxiety subscales may need to be revised. Kingery, Ginsburg and Burstein (2009) also identified problems with the Harm Avoidance and Separation Anxiety subscales, with none of the items from these loading on to any of the factors. Overall, the four-factor model provided a poor fit with a community sample of 118 African American adolescents and a three-factor solution was supported.

Although evaluations of the psychometric properties of the MASC have been positive, a validation of its factor structure with adolescents diagnosed with ADHD appears missing from the literature. March, Connors, Arnold, Epstein et al. (1999) conducted a confirmatory factor analysis of data provided by 579 pre-adolescent children (ages 7 to 9 years) "with DSM IV ADHD Combined Type" (p. 86) and found an excellent fit of the four factor model. Additional information on the structure of the MASC among adolescents presenting with ADHD would be valuable, particularly given Baldwin and Dadds' (2007, p. 253) conclusion that it is "most clinically useful self-report anxiety measure for children available".

Despite the excellent psychometrics of the MASC there is limited research with adolescents diagnosed with ADHD. The primary aim of this study therefore was to examine the factor structure of the MASC with adolescents with and without ADHD. A secondary aim was to compare fit across younger and older adolescents, and across male and female participants.

Method

Participants and Settings

The sample consisted of 210 high school aged adolescents (109 males, 101 females) recruited from Grades 8 to 12 (ages 13 to 17.7 years). Of these, 115 were clinically diagnosed by pediatricians as meeting DSM-IV-TR (American Psychiatric Association, 2000) criteria for ADHD (86 males, 29 females) and 95 were non ADHD

Community Comparisons (23 males and 72 females) who had no known diagnosed neurological deficits. The distribution according to school grade levels was: Grade 8 (13 years of age; *N* = 52, Males 30, Females 22), Grade 9 (14 years; *N* = 49, Males 16, Females 33), Grade 10 (15 years; *N* = 30, Males 18, Females 12), Grade 11 (16 years; *N* = 43, Males 22, Females 21), and Grade 12 (17-18 years; *N* = 36, Males 23, Females 13).

The ADHD sample was recruited in one of two ways: (i) from the database of families with children diagnosed with ADHD stored at a University based clinic for psychological assessment (*N* = 89 adolescents); and (ii) from four ADHD support groups in Western Australia (*N* = 26 adolescents). The non ADHD community comparisons were recruited by requesting the parents of adolescents with ADHD to each invite a parent who had an adolescent (in the same school grade level) without ADHD or any other known diagnosed neurological disorder to participate. The non ADHD comparisons attended nine separate high schools located in low to middle (*N* = 6) and high (*N* = 3) socio-economic status areas (as determined by an index defined at the postcode level from the Australian Bureau of Statistics, 2003) in the metropolitan area of Perth, Western Australia.

The *Multidimensional Anxiety Scale for Children* (MASC: March, 1998) was completed by all participants (ADHD/Non ADHD) in their home setting. The researchers requested that for all test administrations rooms should be quiet, free from extraneous distracters and that testing be conducted in the morning, to control for diminished persistence noted in children with ADHD (see Houghton, Douglas, West, Whiting, et al., 1998; Lawrence, Houghton, Tannock, Douglas, et al., 2002). Verbal checks with parents affirmed that these requests had been adhered to.

Instrumentation

The *Multidimensional Anxiety Scale for Children* (MASC: March, 1998) is a self-report instrument developed to assess the major dimensions of anxiety in children and adolescents aged 8 to 19 years. A standardised child version (used in this study) and a research based parent version are available, the items being fundamentally identical. Respondents rate each of the 39 items separately using a four-point scale anchored with the response options: "*never true about me*" (score 0), "*rarely true about me*" (= 1), "*sometimes true about me*" (= 2) and "*often true about me*" (=3). Completion of the MASC takes approximately 15 minutes.

Procedure

Permission to conduct the research was initially obtained from the Human Research Ethics Committee of the administering institution. Following this, the parents of potential participants with ADHD held on the university based clinic database (n = 160) and in the ADHD support groups (n = 40) were all sent personalised letters of introduction, information sheets describing the research, consent to participate forms and reply paid envelopes. Parents who agreed to allow their son(s)/daughter(s) to participate subsequently received a package via the mail containing two copies of the MASC, written instructions describing how the instrument should be completed (to ensure standardisation of procedures), and a reply paid envelope. Overall, the 115 completed MASCs represent a positive response of 57.5% for the ADHD group.

The non ADHD community comparisons (n = 95) were recruited by requesting the parents of adolescents with ADHD to each invite a parent who had an adolescent (in the same school grade level) without ADHD or any other known neurological disorder to participate. If a parent of an adolescent without ADHD agreed to participate then the second copy of all information along with the MASC was provided. Overall, the 95 completed MASCs represent a positive response of 82.6% for the non ADHD community comparisons.

Results

Many item responses were skewed, therefore bootstrapping with maximum likelihood estimation was employed (Byrne, 2010). In order to enable bootstrapping using AMOS 19.0 it was necessary to work with a complete data set. Listwise deletion of cases with missing data on MASC items reduced the sample size from 210 to 199 (5.3% deletion). There were no differences in whether cases did or did not have missing data when comparing the ADHD and non ADHD groups, χ^2 (df = 1) = 1.51, p = .219.

Goodness of fit in all models was assessed using the Comparative Fit Index (CFI: above .95 indicates good fit, above .90 indicates adequate fit), the root mean-square error or approximation (RMSEA: .05 or less indicates good fit, .08 or less indicates adequate fit), the CMIN/DF (lower than 2-3 indicates good fit: Carmines & McIver, 1981), Standardized Root Mean Square Residual (SRMR: less than .08 reflects good fit: Hu & Bentler, 1999) and chi-square (non-significant values represent good fit). This was to confirm the hypothesized relationships between item indicators and latent variables. The number of bootstrap samples was set at 2000.

A confirmatory factor analysis of a first-order model using AMOS 19.0 (Arbuckle, 2010) was conducted. This model viewed the four latent variables as independent but correlated. This revealed a model which had mixed results from the goodness of fit indicators: χ^2 (df = 696) = 1254.02, p < .001, CMIN/DF ratio = 1.80, CFI = .76, RMSEA = .06 (90% confidence interval [CI]: .06, .07), SRMR = .08. In order to improve the fit of the model, we refined the model by iteratively deleting those items with the lowest loadings, until we reached the point where no items loaded under .4. This meant we deleted 10 items in the following order: Item 21 ("*I try to do things other people will like*", factor loading = .20); item 11 ("*I try hard to obey my parents and teachers*", factor loading = .19); item 5 ("*I keep my eyes open for danger*", factor

loading = .24); item 26 ("*I sleep next to someone from my family*", factor loading = .25); item 33 ("*I get nervous if I have to perform in public*", factor loading = .30); item 2 ("*I usually ask permission*", factor loading = .33); item 13 ("*I check things out first*", factor loading = .31); item 32 ("*If I get upset or scared, I let someone know right away*", factor loading = .37); item 36 ("*I check to make sure things are safe*", factor loading = .36); and item 28 ("*I try to do everything exactly right*", factor loading = .38).

This final adjustment resulted in a not positive definite covariance matrix. In this instance, the correlation between Harm Avoidance and Separation Anxiety latent variables was 1.067, which signals a multicollinearity problem (Byrne, 2010). Following Byrne (2010) these two factors were therefore combined into a single factor. This resolved the multicollinearity issue, and the fit of the model was better than the original model, but still remained unsatisfactory: χ^2 (df = 374) = 620.36, $p < .001$, CMIN/DF ratio = 1.66, CFI = .87, RMSEA = .06 (90% confidence interval [CI]: .05, .07), SRMR = .07.

Next, we examined the MASC items to identify similarities in order to amend the model by correlating the errors associated with those items. We therefore correlated the following error terms: Items 4 ("*I get scared when my parents go away*") and 9 ("*I try to stay near my mom or dad*"); items 1 ("*I feel tense or uptight*") and 27 ("*I feel restless and on edge*"); items 8 ("*I get shaky or jittery*") and 35 ("*My hands shake*"); and items 18 ("I have pains in my chest") and 24 ("My heart races or skips a beat"). These refinements led to acceptable model fit: χ^2 (df = 370) = 550.76, $p < .001$, CMIN/DF ratio = 1.49, CFI = .90, RMSEA = .06 (90% confidence interval [CI]: .04, .06), SRMR = .07. The final items, the scales they belong to, and the factor loadings are shown in Table 1. As shown in Table 1, all three scales had good internal reliability (all Cronbach's alphas ≥ .78).

Table 1 about here.

Invariance of the measurement model across group (ADHD/Non ADHD), school-stage, and gender

Invariance across ADHD and non ADHD groups. Our baseline model was one in which the factor loadings, correlations between latent factor scores, and variance in factor scores were allowed to vary across groups. A second model, which additionally constrained all factor loadings to be equal across groups, was then compared to the baseline model. Change in chi-square between the two models was non-significant, $\Delta\chi^2$ (df = 26) = 20.78, p = .753, indicating that factor loadings were invariant across groups. Our third model, compared to the second model, added the constraint that correlations between latent factor scores also had to be equal across groups. Again, the two models did not differ significantly, $\Delta\chi^2$ (df = 3) = 1.07, p = .785. Finally, a fourth model was compared against the third model, and the fourth model added the constraint that factor variances also be equal. These two models did differ significantly, $\Delta\chi^2$ (df = 3) = 13.77, p = .003. Using the critical ratios of differences, this showed that there was a difference for the Physical symptoms factor (z = -2.25) but not the Social Anxiety (z = -1.25) or Separation Anxiety Harm Avoidance (z = -1.01) factors. For the Physical Symptoms factor there was greater variation in factor scores among the ADHD group (.17, SE = .054) than among the non ADHD group (.10, SE = .033).

Invariance across gender. The same incremental procedure as above was used to assess invariance across gender. The model was invariant with respect to factor loadings, $\Delta\chi^2$ (df = 26) = 26.79, p = .420, correlations between factors, $\Delta\chi^2$ (df = 3) = 1.77, p = .621, and the variances of the factors, $\Delta\chi^2$ (df = 3) = 1.53, p = .675. Thus, there were no gender differences in the fit of the model.

Invariance across school-stage. We created roughly equal sized groups of students by splitting the sample into Grades 8 to 9 (N=94) and Grades 10 to 12 (N=105). This allowed us to conduct the multi-groups analysis in AMOS19.0. However, as was the

case for gender, there were no differences across these two groups: factor loadings were equal, $\Delta\chi^2$ (df = 26) = 34.47, p = .124, factor correlations were equal, $\Delta\chi^2$ (df = 3) = 4.89, p = .181, and factor variances were equal, $\Delta\chi^2$ (df = 3) = 2.27, p = .519.

Effects of gender, age, and status as ADHD/Non ADHD on factor scores

We computed factor scores for each of the factors using the factor score weightings calculated by AMOS 19.0 using the formula $W = BS^{-1}$, where B is the matrix of covariances between the unobserved and observed variables, and S is the matrix of covariances among the observed variables. To use these, each participant's score on each item is multiplied by the factor score weight for that item, and this is then added to a similar score for the following item, and so on (see Table 1 for factor score weights). Three separate three-way independent groups ANOVAs were conducted, one for each factor score. Each ANOVA had Group (ADHD vs non ADHD), Grades (Grades 8 to 9 vs Grades 10 to 12) and Gender as between-groups variables (see Table 2 for means and standard deviations). These revealed only one significant effect, which was large in magnitude, revealing that the ADHD group had significantly higher scores on the Physical Symptoms factor (Mean = 0.59, S.D. = 0.37) than the non ADHD group (M = 0.33, SD = 0.28), F (1,191) = 24.70, p < .001, η_p^2 = .12.

Table 2 about here

In summary, our analyses suggest that the MASC is better conceptualized as a three-factor rather than a four-factor measure when applied to adolescent participants. The measure was equivalent across younger and older participants and across male and female participants with respect to factor loadings, correlations between factors and factor variances. Factor loadings and correlations between factors also were invariant across the ADHD and non ADHD groups, though there was greater variation in Physical Symptoms factor scores among the ADHD group than the non ADHD group. In terms of mean scores on the three factors, there were no differences according to

school-stage or gender, and the only difference between the ADHD group and the non ADHD group was on the Physical Symptoms factor where the latter group displayed lower scores.

Discussion

The aim of this research was to address the limited research examining the psychometric properties of the Multidimensional Anxiety Scale for Children in adolescents with ADHD. As pointed out by Tannock (2003) "comorbidity is the rule rather than the exception in ADHD" (p. 759) and there is converging literature documenting the considerable overlap between anxiety and ADHD in both referred and community samples (see Hammerness et al., 2010; Kollins, 2007; Mayes, Calhoun, & Crowell, 2000; Schatz & Rostain, 2006). To date, many studies examining anxiety in children and adolescents with ADHD have tended to report "internalizing disorders" or "global anxiety", rather than examining its multidimensional nature. Given that young people with ADHD and comorbid anxiety experience greater cognitive impairment (Hammerness et al., 2010; Schatz & Rostain, 2006), and respond differently (Baldwin & Dadds, 2008) or experience less robust effects of treatment (Ter-Stepanian, Grizenko, Zappitelli, & Joober, 2010), it is important to identify reliable instrumentation for use in clinical and educational contexts.

The present study did not confirm the four factor model (i.e., Physical Symptoms, Social Anxiety, Separation Anxiety, and Harm Avoidance) reported in the research conducted with children with DSM IV ADHD Combined Type (see March et al., 1999), or with the majority of studies using community and clinical samples (e.g., Grills,Tacquechel, Ollendick, & Fisak, 2008; Olason, Sighvatsson, & Smari 2004; Rynn, Barber, Khalid-Khan, Siqueland, Dembiski, McCarthy, & Gallop, 2006; Yen, Yang, Wu, Hsu, & Cheng, 2010). Rather, a three-factor model with

satisfactory reliabilities comprising Physical Symptoms (α = .84), Social Anxiety (α = .88), and a combined Separation Anxiety/ Harm Avoidance (α = .78) scale produced the best-fit. Kingery et al. (2009) also reported a similar three-factor model in their adolescent sample whereby none of the Separation Anxiety items loaded on to any factor. The reason put forward by the authors for this was that the Separation Anxiety items did not appear relevant to the African American adolescents in their study and therefore may not have accurately captured how anxiety is manifested in this population. The suggestion made was that a broader range of items may be needed on the MASC to adequately assess the various types of anxiety with African Americans.

Other researchers have also suggested the need to revise some of the items from the Harm Avoidance and Separation Anxiety subscales of the MASC. Osman et al. (2009) suggested that in their study this might have been due to the nature of the anxiety disorder symptoms seen in adolescent psychiatric inpatients referred for high rates of internalizing disorders. Rynn et al. (2006) also highlighted issues relating to the Harm Avoidance subscale, particularly its poor correlation with self-report anxiety measures. Specifically, the features of Harm Avoidance (e.g., to avoid or reduce conflict, a desire to please others, and to do everything exactly right) may be related more to generalized anxiety (see March et al., 1997) especially in those reporting feelings of apprehension and the need for constant reassurance (see Masi, Millepiedi, Mucci, Poli et al., 2004). Baldwin and Dadds (2007) further argued that the Harm Avoidance subscale may capture young people who are perfectionist and those who seek to present themselves in a favorable light (e.g., "I usually ask permission", "I try hard to obey my parents and teachers"). By way of clarification, Baldwin and Dadds (2007) hypothesized that their findings regarding the weakness of the Harm Avoidance scale may have been the result of social desirability

characteristics specific to community samples. In the present study, both clinical and community samples were recruited and weaknesses were still evident, which led to the Harm Avoidance and Separation Anxiety factors being combined into a single factor.

The only significant difference evident between the adolescents with ADHD and without ADHD was for Physical Symptoms, with the former recording higher scores than the latter. Although this concurs with Baldwin and Dadds' (2008) findings, it appears that the children and adolescents in their study had not been diagnosed with ADHD, rather "ADHD symptoms" were measured in a community sample. Our findings pertaining to Physical Symptoms is supportive of the research documenting that children and adolescents with ADHD worry about their performance and behaviour, their susceptibility to embarrassment and future events (Strauss et al., 1988), and as a result manifest overt signs and symptoms of anxiety (see Jensen, Hinshaw, Swanson, Greenhill, et al., 2001; Molina, Hinshaw, Swanson, Arnold, et al., 2009).

It is well documented that 30-40% of those with ADHD referred to clinics meet the diagnostic criteria for more than one form of comorbid anxiety (see Tannock, 2000). That there were no differences between adolescents with ADHD and those without ADHD on Social Anxiety and the combined Separation Anxiety/Harm Avoidance scale appears contrary to these data and other research (see Last, Perrin, Hersen, & Kazdin, 1992; Spencer, Biederman, & Wilens, 1998). The relative lack of differences in anxiety must also be considered in terms of pharmacological intervention. The adolescents with ADHD in the present study had received a formal diagnosis from a primary care physician and it is therefore highly likely that at the time of the study they were receiving pharmacological intervention. This may have masked the true extent of any anxiety.

No age (Grades 8 and 9 vs Grades 10 to 12) and/or gender differences were found in the present study. With reference to no gender differences, this is somewhat surprising given the evidence to date (see Gershon, 2002; Rucklidge, 2010, for a comprehensive review). Cross sectional and prospective studies show adolescent girls with ADHD display higher levels of internalizing behavior problems, more multiple anxiety disorders, and more specific anxiety disorders than boys (e.g., Gershon, 2002; Hammerness, Geller, Petty, Lamb, Bristol, & Biederman, 2010; Levy, Hay, Bennett, & McStephen, 2005; Rucklidge, 2010). Many previous studies have used teacher and/or parent ratings of ADHD and anxiety, which according to Schatz and Rostain (2006) may be less reliable in gauging anxiety accurately. Thus, self-report instruments, such as the MASC, may be a more effective means of obtaining an accurate insight into the subjective dispositions that can be difficult to obtain from third parties.

Generally, this present study supports the utility of the MASC as a measure of anxiety in adolescents with ADHD. However, the present study also indicates that items in the Separation and Harm Avoidance subscales may need to be re-examined and perhaps revised and as such a degree of caution may be warranted when interpreting these subscales. For example, some of these items (e.g*., "I try hard to obey my parents and teachers", "I usually ask permission"*, and *"I try to do everything exactly right"*) may not resonate with today's young people, irrespective of whether they have ADHD or not. Nevertheless, the identification of Physical Symptoms as particularly problematic for adolescents with ADHD provides direction for future research and treatment focus in the ADHD population.

As with most research there are some limitations associated with the present research and these need to be acknowledged. For example, the sample size was relatively small and replication with a much larger sample of adolescents is

warranted. Self-report was the single source of data collection for anxiety and therefore other methods such as semi-structured interviews for validating responses on the MASC should be considered in future. Furthermore, multiple informants such as parents and teachers may be beneficial. Although the adolescents in the ADHD group had received a formal diagnosis, their ADHD subtypes were unknown. Given that research has shown anxiety is more likely to occur with ADHD (Inattentive Type) the absence of sub typing information limits the findings to some extent. Finally, it was not known whether the adolescents with ADHD were receiving medication at the time of administration of the MASC, which may have had the effect of masking the true extent of their anxiety.

In conclusion, Souza, Pinheiro, Denardin, Mattos, and Rohde (2004), and Hammerness et al. (2010) affirm that the relationship between ADHD and anxiety appears to be robust, existing in international populations of children and adolescents seen by primary care paediatricians. Therefore, there is a need for reliable instrumentation with which to measure anxiety. This present study has led to an increased understanding of the psychometric properties of the MASC, an instrument currently used extensively by clinicians worldwide, dealing with adolescents who present with ADHD.

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Table 1.

Factor structure, item loadings (factor score weightings), and Cronbach's alphas.

Item	Factor loadings		
	Physical (α = .84)	Social (α = .88)	Separation/Harm (α = .78)
1. I feel tense or uptight	.52 (.039)		
8. I get shaky or jittery	.59 (.056)		
12. I get dizzy or faint feelings	.51 (.051)		
15. I'm jumpy	.54 (.053)		
18. I have pains in my chest	.49 (.038)		
20. I feel strange, weird, or unreal	.71 (.119)		
24. My heart races or skips beats	.62 (.067)		
27. I feel restless and on edge	.62 (.063)		
31. I feel sick to my stomach	.61 (.085)		
35. My hands shake	.53 (.037)		
38. My hands feel sweaty or cold	.48 (.045)		
3. I worry about other people laughing at me		.69 (.095)	
10. I'm afraid that other kids will make fun of me		.82 (.178)	
14. I worry about getting called on in class		.59 (.061)	
16. I'm afraid other people will think I'm stupid		.69 (.091)	
22. I worry about what other people think of me		.76 (.116)	
29. I worry about doing something stupid or embarrassing		.77 (.112)	
37. I have trouble asking other kids to play with		.62 (.068)	
39. I feel shy		.57 (.055)	
4. I get scared when my parents go away			.57 (.057)
7. The idea of going away to camp scares me			.55 (.091)
17. I keep the light on at night			.49 (.083)
19. I avoid going to places without my family			.59 (.105)
23. I avoid watching scary movies and TV shows			.45 (.043)
30. I get scared riding in the car or on the bus			.43 (.097)
34. Bad weather, the dark, heights, animals, or bugs scare me			.46 (.052)
6. I have trouble getting my breath			.56 (.083)
9. I try to stay near my mom or dad			.58 (.068)
25. I stay away from things that upset me			.48 (.060)

Table 2.

Means (standard deviations) for factor scores by Grade, Gender and Group.

			Factor		
Grade	Gender	Group	Physical	Separation/Harm	Social
8 & 9	Male	ADHD (N=28)	0.60 (0.33)	0.56 (0.43)	1.06 (0.50)
		Non-ADHD (N=16)	0.24 (0.20)	0.37 (0.23)	0.81 (0.64)
	Female	ADHD (N=11)	0.66 (0.44)	0.58 (0.43)	0.90 (0.64)
		Non-ADHD (N=39)	0.34 (0.33)	0.56 (0.36)	0.98 (0.61)
10, 11, 12	Male	ADHD (N=54)	0.57 (0.32)	0.38 (0.29)	0.99 (0.63)
		Non-ADHD (N=7)	0.38 (0.23)	0.44 (0.23)	0.99 (0.23)
	Female	ADHD (N=14)	0.65 (0.53)	0.46 (0.39)	1.02 (0.65)
		Non-ADHD (N=30)	0.36 (0.28)	0.46 (0.29)	0.88 (0.39)
		Total (N=199)	0.47 (0.36)	0.47 (0.34)	0.96 (0.57)

Biographies

Professor Stephen Houghton is a Registered Psychologist and Director of the Centre for Child and Adolescent Related Disorders at the University of Western Australia. His research activities focus on childhood and adolescent psychopathology particularly in relation to ADHD and executive functions, conduct disorder, developmental trajectories to delinquency and the affective and interpersonal traits constituting juvenile psychopathy.

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Annemaree Carroll, PhD, is Associate Professor in the School of Education at The University of Queensland, Brisbane, Australia. Her research focuses on the establishment of a new theoretical perspective and social-cognitive model for predicting at-risk and delinquent behaviours that incorporates two major motivational determinants for involvement in risky behaviour – goal and reputational orientations.