

Loneliness in Children and Adolescents With and Without Attention-Deficit/Hyperactivity Disorder

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Abstract Although there have been developments in understanding loneliness in children and adolescents, there is still very limited understanding of the construct in children and adolescents diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD). The Perth A-Loneness scale (PALs), which comprises 24 items measuring four dimensions of loneliness in young people, was administered to 84 children and adolescents who had been clinically diagnosed as meeting criteria for ADHD. Eighty four individually age and gender matched non ADHD Community Comparisons with no diagnosed neurological deficits also completed the PALs. Competing measurement models were evaluated using confirmatory factor analysis and a first-order model represented by four correlated factors (Friendship Loneliness, Isolation, Negative Attitude to Solitude, and Positive Attitude to Solitude) was superior: CMIN/DF ratio (1.644), CFI (0.90), and RMSEA=0.056 (90 % CI: 0.05, 0.07). A multivariate analysis of variance revealed no significant multivariate interactions or main effects of Group (ADHD/Non ADHD) or Sex (Male/Female). Overlap of 90 to 98 % between the ADHD and non ADHD samples in their 95 % Confidence Intervals for each of the four loneliness scores along with very small Effect Sizes further strengthened the finding of a non-significant main effect.

Keywords ADHD · Children and adolescents · Loneliness · Confirmatory factor analysis

Attention Deficit/Hyperactivity Disorder (ADHD) is the most prevalent neurobiological disorder in childhood and adolescence (Hoza et al. 2005; Rowland et al. 2002) that affects between 3 and 8 % of youth (AAP 2011). It is a disorder with a heterogeneous presentation that is characterized by symptoms that typically include excessive impulsivity, hyperactivity, and inattention (American Academy of Pediatrics [AAP] 2011; Lee et al. 2011). The distinguishable symptoms and behaviors of ADHD can present during childhood, adolescence, and adulthood (Glass et al. 2010; Sibley et al. 2012), although as specified in DSM 5 several of the individual's ADHD symptoms must be present prior to age 12 years (American Psychiatric Association 2013). In approximately 70 % of cases, ADHD is a life-long impairing disorder (Biederman et al. 2011). Hence, ADHD is a major clinical and public health concern (Perwien et al. 2006).

Although regarded as a distinct disorder, between 70 and 80 % of children with ADHD have at least one comorbid psychopathology (Brown 2000; Becker et al. 2011; Wehmeier et al. 2010), with Conduct Disorder, Oppositional Defiant Disorder, Tourette's Syndrome, Depression, Anxiety Disorder, and Learning Disabilities all frequently diagnosed with ADHD (see Barkley 1996; Hoza et al. 2005; Lee et al. 2011; Rowland et al. 2002). A longitudinal study from birth to age 19 years of 343 individuals with ADHD (and 712 controls without ADHD), found that 62 % of those with ADHD had one or more comorbid psychiatric disorder by 19-years of age, compared to only 19 % of those without ADHD (Yoshimasu et al. 2012).

It is also well-documented that children and adolescents with ADHD are more likely to experience peer relationship difficulties (Becker et al. 2012), with some studies reporting

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that up to 50 % of young people with ADHD have significant problems in their social relationships (for a review see McQuade and Hoza 2008). Many of these individuals also perceive themselves as having few, or no friends, and as experiencing distinct difficulties in establishing and maintaining friendships (Barkley 2000; Hoza 2007; Nijmeijer et al. 2008). Moreover, the research evidence is unequivocal that children and adolescents diagnosed with ADHD are more frequently rejected by their peers than typical individuals of their age (Glass et al. 2010; Hoza et al. 2005). This is further substantiated by parents, who also frequently rate their children and adolescents with ADHD as more frequently rejected by others, compared to those without ADHD (Bagwell et al. 2001; Galanaki 2004; Hoza et al. 2000; Wehmeier et al. 2010). Even in cases where the symptoms of ADHD decrease from childhood to adolescence, difficulties with social interactions typically persist (Lee et al. 2011). These well documented peer relationship problems are pervasive, long lasting and resistant to treatment (Pelham and Fabiano 2008).

These data are of grave concern since research shows that children and adolescents *in general* who have limited friendships are more likely to experience poor school adjustment, mental health problems, and involvement with the juvenile justice system, compared to those who have friends (Rose and Asher 2000). Furthermore, during early adolescence young people without friends report greater levels of loneliness (Parker and Asher 1993), and because loneliness is a barrier to social development, it can have an impact on mental and physical health later in life (Krause-Parello 2008). Indeed, the adverse physical, psychological, social, and mental health outcomes of loneliness during childhood and adolescence *per se*, are well documented (see Doman and Roux 2010; Krause-Parello 2008; Lasgaard et al. 2011). These include, for example: depression, recreational drug use, suicide ideation and violence (McWhirter et al. 2002); parasuicide and self-harm (Yang and Clum 1994); eating disturbances, obesity and sleep disturbances (Cacioppo et al. 2000); neuroticism (Asher and Paquette 2003); adolescent alcohol use, general health problems, less than optimal wellbeing, somatic complaints (Krause-Parello 2008); cessation of regular exercise (Allgower et al. 2001; Rozanski et al. 1999); more frequent involvement in high risk behaviors (Carroll et al. 2009) and delinquency (Houghton et al. 2008); and poor personality integration (Overholser 1992).

Hawkey and Cacioppo (2003) argued that while the impact of loneliness on health may not become evident until later in life, the thoughts, feelings and behaviors associated with these social factors place individuals at risk very early in life. This may be even more pertinent for children and adolescents with ADHD, who have fewer reciprocated friendships (Hoza et al. 2005), and lower levels of direct contact between friends (Marton et al. 2012) than their non ADHD peers. This may put them at increased risk for loneliness. While much is known

about the social-behavioral and peer relationship difficulties of children and adolescents with ADHD (for a review see McQuade and Hoza 2008) and their increased risk towards comorbid mental health problems and global psychosocial impairment (see Lee et al. 2011; Mrug et al. 2012), little if anything, is known about the construct of loneliness in this vulnerable population. The objective of the present study was to examine the construct of loneliness in children and adolescents with ADHD.

Adolescent Loneliness

Although a significant body of loneliness research has emanated from adults or “young adults” (for a review see Heinrich and Gullone 2006), comparatively little has stemmed from children and adolescents, and seemingly less from children and adolescents diagnosed with ADHD. During childhood and (especially) adolescence, loneliness is normative (Sippola and Bukowski 1999) and up to 80 % of young people report feelings of loneliness at some time (see Hall-Lande et al. 2007). However, the potential for this to become chronic and in some cases pathological (Asher and Paquette 2003; Miller 2011) is particularly evident during late childhood and adolescence (Galanaki et al. 2008); 15–30 % of young people in this age range describe their feelings of loneliness as persistent and painful (see Brennan 1982; Heinrich and Gullone 2006). Thus, loneliness can be a debilitating psychological condition, characterized by a deep sense of social isolation, emptiness, worthlessness, lack of control and personal threat (VanderWeele et al. 2012).

Synonymous with perceived social isolation (Hawkey and Cacioppo 2010), loneliness has been defined as a negative, or distressing feeling, that accompanies the perception that one’s social needs are not being met by the quantity or *especially* the quality of one’s social relationships (Perlman and Peplau 1981). An individual may have few, if any, friends and not be lonely, but conversely, another may have many friends and still be lonely. Indeed, feelings of loneliness can result for some young people when they are part of a social group, but do not feel connected. For others, however, it occurs when they are by themselves and wanting to be with others (Chipuer 2001).

The construct of loneliness has been measured either unidimensionally (i.e., loneliness is the same for everyone across circumstances and causes, and can be measured by means of a single scale e.g., Asher and Wheeler 1985; Russell 1996; Russell et al. 1980), or multidimensionally (i.e., varying in intensity and across causes and circumstances, and where different social relationships give rise to different forms of loneliness e.g., Dahlberg 2007; Goossens et al. 2009; Hawkey et al. 2005; Hawkey et al. 2012; Houghton et al. 2014). Of the limited research with young people, Goossens

et al. (2009) utilized a multidimensional approach and tested competing factor models on data collected from 534 Dutch 15 to 18 year olds using 9 different instruments (comprising a total of 14 subscales). A four factor model of loneliness and solitude (i.e., peer or friendship related loneliness, family loneliness, positive attitude to solitude and negative attitude to solitude) was clearly superior.

A similar four factor model was proposed by Houghton et al. (2014) from data obtained from over 1,000 adolescents (aged 10 to 18 years): Friendship Loneliness (i.e., positive behaviors relating to having reliable, trustworthy supportive friends); Isolation (i.e., having few friends or believing that there was no one around offering support); Negative Attitude to Solitude (i.e., the negative aspects of being alone); and Positive Attitude to Solitude (i.e., the positive aspects of being alone). When testing for moderators of loneliness Houghton et al. (2014) reported significant main effects for geographical location (rural/metropolitan), Age and Sex. Specifically, adolescents in rural/remote schools reported higher levels of Negative Attitude to Solitude compared to those in Metropolitan schools. As adolescents got older Negative Attitude to Solitude declined while Positive Attitude to Solitude increased. Finally, females scored higher than males on Friendship Loneliness.

When individuals experience loneliness they are likely to have difficulties in building effective communication and friendship skills (Heinrich and Gullone 2006), the latter being clearly observable problems in children and adolescents with ADHD. The consequences of poor friendship skills can lead to greater levels of pessimism and fear of being critiqued negatively (Cacioppo et al. 2006). While it is clearly evident that young people with ADHD experience greater communication and friendship difficulties than their typically developing peers, what is not known is whether they experience greater levels of loneliness.

This current study tested the fit of the factor structure that was established previously in samples of typically developing adolescents (see Houghton et al. 2014), with children and adolescents with ADHD. We also tested the hypothesis that children and adolescents with ADHD would experience greater levels of loneliness than their typically developing counterparts due to their rejection by others, and their difficulties in peer interactions. To achieve this, we administered a self-report multidimensional measure of loneliness to male and female children and adolescents with and without ADHD. Young people in late childhood and adolescence were recruited because this developmental period has been identified as *the* peak period of high risk for loneliness (Hall-Lande et al. 2007). Furthermore, failure to resolve loneliness prior to moving out of adolescence can have significant adverse outcomes (for a review see Heinrich and Gullone 2006; Witvliet et al. 2010) and given the known negative outcomes for young

adults with ADHD, late childhood through to adolescence is clearly a critical period for examination.

A self-report measure was chosen for the study as researchers are now recognizing that loneliness is a personal experience and as such self-report measures are a justifiable technique of obtaining reliable insight into an individual's affective states of loneliness (Becker et al. 2011). Moreover, self-report measures are easy to administer, are cost and time effective (Declercq et al. 2009; Lynam et al. 2011), and are an effective means of obtaining an accurate insight into the subjective dispositions that can be difficult to obtain from third parties such as teachers and parents (Andershed 2010; Frick et al. 2009). The reliability of self-report inventories for measuring psychopathology in youth has also been found to increase from childhood to adolescence, while the validity of teacher- and parent-reports decreases as children become older (Frick et al. 2009; Kamphaus and Frick 2002).

Method

Participants and Settings

The sample consisted of 168 children and adolescents (147 males, 21 females) recruited from Grades 4 through 12 (ages 9.5 to 18 years, $M=15.3$ years, $SD=2.4$). Of these, 84 (74 males, 10 females, $M=15.2$ years, $SD=2.43$) were clinically diagnosed by a pediatrician as meeting DSM-IV-TR (APA 2000) criteria for ADHD and 84 were individually age and gender matched non ADHD Community Comparisons ($M=15.3$ years, $SD=2.49$) who had no diagnosed neurological deficits. The *ADHD sample* was recruited from two specialist ADHD clinics that provide assessment, counseling and educational services to children and adolescents diagnosed with ADHD (and their families). Children and adolescents who receive a diagnosis of ADHD from local pediatricians are referred to these clinics. ADHD subtype information was available for 68 of the 84; of these, 65 presented most prominently with Combined type symptoms and three presented with Inattentive symptoms only. Of the total sample ($n=84$), 49 % had a reported comorbid disorder, predominantly Oppositional Defiant Disorder, and all were receiving concurrent pharmacotherapy at the time of the study. Checks on the participants revealed none were diagnosed with depression or symptoms of depression which is significant given the association between loneliness and depression (and its consequences).

The majority of participants (63 %) indicated no ethnic affiliation. Amongst the 37 % with an ethnic affiliation, 71 % were from Anglo Saxon/European descent, with 11 % from the Asian region and 18 % from a range of other countries. Overall, 91 % of participants indicated English was spoken fluently in their household.

The age (within 6 months) and gender matched *non ADHD community comparison group* was recruited from four schools located across different socio-economic status (SES) areas as indexed by their postal codes from the Socio-Economic Indexes for Areas within Western Australia (Australian Bureau of Statistics 2008). Two high schools were in low-middle SES areas, while two primary schools were also located in low-middle SES areas. The non ADHD community comparisons had no diagnosed neurological deficits and no identified problems based on the annual screening conducted by the schools, in accordance with criteria stipulated by the Education Department of Western Australia to identify students at risk of educational failure.

Instrumentation

The 24-item Perth A-Loneness Scale (PALs: Houghton et al. 2014) was administered to all 168 participants. The PALs, which has a Grade 4.5 readability level (Flesch-Kincaid Grade Level; age 9.5 years and above), utilizes a six point scale represented by the descriptors “never”, “rarely”, “sometimes”, “often”, “very often”, and “always”, with higher scores suggestive of higher levels of loneliness. The psychometric properties of the PALs have been established, through exploratory factor analysis from data supplied by 694, 10–18 year olds ($M=13.01$ years). This yielded a 4 factor structure (Friendship Loneliness, Isolation, Negative Attitude to Solitude, and Positive Attitude to Solitude). The Cronbach’s alpha coefficient was acceptable for each subscale: Friendship ($\alpha=0.86$), Isolation ($\alpha=0.80$), Positive Attitude to Solitude ($\alpha=0.78$) and Negative Attitude to Solitude ($\alpha=0.77$).

Competing measurement models evaluated using confirmatory factor analysis with data from 380 10 to 18 year olds provided strong support for the superiority of the four factor model (CFI=0.92, RMSEA=0.05). A subsequent study involving 235 adolescents (ages 10.0–16 years, $M=13.8$ years) confirmed the superiority of the first-order model (CFI=0.92, RMSEA=0.06) represented by the four correlated factors (for a full description of the development of PALs see Houghton et al. 2014). The Cronbach’s alpha coefficients were again acceptable for each subscale Friendship $\alpha=0.91$; Isolation $\alpha=0.80$; Positive Attitude to Solitude $\alpha=0.86$; and Negative Attitude to Solitude $\alpha=0.80$. Main effects were evident using the PALs according to the moderators of age, sex and location (metropolitan versus rural). Repeated administration of the PALs (9 months apart) with 250 participants to examine the stability of the loneliness dimensions over time revealed correlation coefficients of: Friendship 0.61, Isolation 0.59, Negative Attitude to Solitude 0.67 and Positive Attitude to Solitude 0.64 (all $p<0.01$).

Procedure

Permission to conduct the present research was obtained from the Human Research Ethics Committee of the administering institution. Following this, the parents of potential participants with ADHD at the specialist ADHD clinics were approached via personalized letters of introduction (through the specialist clinics) with information sheets describing the research. The letter stressed that no identifying information was required and anonymity of responses was assured. Consent forms were also included with the information. The children and adolescents of parents who agreed to allow their sons/daughters to participate were subsequently administered the PALs by clinic personnel during their next appointment. The positive response rate from parents at the clinics was 87 %.

The recruitment of the non ADHD community comparisons involved the principals of four randomly selected schools being contacted to ascertain their interest in participating in the research. All four agreed to be involved and so information sheets explaining the research, along with consent forms for parents, were delivered to the schools. These were distributed to randomly selected classes comprising students at similar age levels to the ADHD group. A positive response of 80 % was obtained and from these the matched sample was generated. Specifically, from the 298 responses received, 84 children and adolescents were individually matched by age and gender to an ADHD group participant.

The PALs was administered to the non ADHD community comparisons in groups of approximately 10–15 students (during a specified regular school time) by school personnel who had been nominated by the principals to liaise with the researchers. Each scale administrator was provided with a written set of instructions to ensure standardization of administration. Prior to completing the instrument, participants were verbally informed of the nature of the research and were assured of the anonymity of their responses.

Data Analysis

AMOS 21.0 (Arbuckle 2010) was used to evaluate competing measurement models using confirmatory factor analysis. First, a confirmatory factor analysis of the full four factor PALs model (Friendship, Isolation, Positive Attitude to Solitude, and Negative Attitude to Solitude) was conducted. Four latent variables, each representing a factor, were modelled to be independent but correlated. Then, competing models were tested: A one factor model where all items loaded on a single factor was included to test for Loneliness and Solitude being a common emotional state (cf. Goossens et al. 2009). Next we assessed a two factor model which conceptualized items as belonging to either Loneliness or Attitudes to Solitude. Then two alternative three factor models with three correlated factors representing a) Friendship, Positive Attitude to Solitude,

and Negative Attitude to Solitude; and b) Friendship, Isolation, and Attitudes to Solitude were tested.

Indices used to assess the goodness of fit included: the comparative fit index (CFI) and the Normed Fit Index (NFI): (above 0.95 indicates good fit, above 0.90 indicates adequate fit), the root mean-square error of approximation (RMSEA: 0.05 or less indicates good fit, 0.08 or less indicates adequate fit: Hu and Bentler 1999), the CMIN/df (lower than 2–3 indicates good fit) (Carmines and McIver 1981), and χ^2 (non-significant values represent good fit). This was to confirm the hypothesized relationships between item indicators and latent variables. Finally, because invariance across ADHD/Non-ADHD groups could not be tested using AMOS (because of the limited sample size), differences in mean levels of the four Loneliness factors were examined across ADHD/Non ADHD status and Sex using Multivariate Analysis of Variance (MANOVA). A post hoc power analysis to determine the sample size needed to detect a specific effect size and the power of the test procedure was also conducted to address any potential issues associated with this approach. To further avoid the risk of making a type II error (β), 95 % Confidence Intervals (CI) were also examined. Finally, effect sizes were calculated and interpreted in terms of the percentage of overlap of the two group's (ADHD and non ADHD) scores.

Results

The structure of the five models tested is shown in Table 1. On the basis of the model fit criteria cited earlier, the 4 factor model provided the best fit. The CFI (0.92), NFI (0.91) and RMSEA=0.056 (90 % CI: 0.054, 0.059) were all in favour of the four factor model. The standardised factor loadings of the final confirmatory model are reproduced in Fig. 1. The estimates of reliability for the four factors were estimated using coefficient alphas and were found to be satisfactory: Friendship $\alpha=0.88$; Negative Attitude to Solitude $\alpha=0.79$;

Isolation $\alpha=0.79$; and Positive Attitude to Solitude $\alpha=0.78$. As shown in Table 1 the model fit indices showed no support for the single factor model or the two factor model (Loneliness and Attitudes). For the two separate three factor models evaluated, the fit indices showed some support for Loneliness+ Isolation, Positive Attitude to Solitude, Negative Attitude to Solitude; and for Friendship, Isolation, and Attitudes (i.e., Positive Attitude to Solitude + Negative Attitude to Solitude). The greater level of support being for the first of the two three factor models tested. Therefore, the four factor model was adopted to test for differences between children and adolescents with and without ADHD.

Testing for Group Differences

A multivariate analysis of variance (MANOVA) was conducted to investigate participants' Loneliness (4 variables) for Group (ADHD/Non ADHD status) and Sex (male and female). The Pillai's Trace criterion was used to evaluate multivariate significance with a Bonferroni adjusted alpha level of 0.0125 and below, given its robustness when the assumption of homogeneity of variance-covariance matrices is violated, as reflected in the measures (Tabachnick and Fidell 2007). Univariate *F* values were considered as significant utilising Bonferroni adjusted alpha levels of 0.0125, respectively, to control for Type 1 errors (Tabachnick and Fidell 2007). Effect sizes and power estimates are reported.

A 2×2 (Group × Sex) between-subjects MANOVA was performed on the four dependent variables of the PALs. Using a Bonferroni adjusted alpha level of <0.0125, there was no significant multivariate interaction effect of Group × Sex *F* (4, 155)=0.301, *p*=0.877, partial $\eta^2=0.008$. Although the ADHD group scored higher than the non ADHD group on all four Loneliness variables there was no significant multivariate main effect of Group *F* (4, 155)=1.480, *p*=0.211, partial $\eta^2=0.037$ or Gender *F* (4, 155)=0.1.27, *p*=0.284, partial $\eta^2=0.032$. Table 2 shows the Univariate *F* statistics and mean scores (and standard deviations) for each of the

Table 1 Fit indices for the competing models

Model	χ^2	df	<i>p</i>	CMIN	CFI	RMSEA	CI	
Four factor model: (Friendship, isolation, positive attitude to solitude, negative attitude to solitude)	1,396.257	246	0.000	3.62	0.92	0.056	0.054	0.059
One factor model	920.930	252	0.001	3.654	0.54	0.126	0.117	0.135
Two factor model: (Friendship + isolation, positive attitude to solitude + negative attitude to solitude)	708.103	251	0.001	2.821	0.69	0.104	0.095	0.114
Three factor model								
a) Friendship + isolation, positive attitude to solitude, negative attitude to solitude	479.051	249	0.001	1.924	0.84	0.074	0.064	0.084
b) Friendship, isolation, positive attitude to solitude + negative attitude to solitude	608.880	249	0.001	2.445	0.75	0.093	0.084	0.102

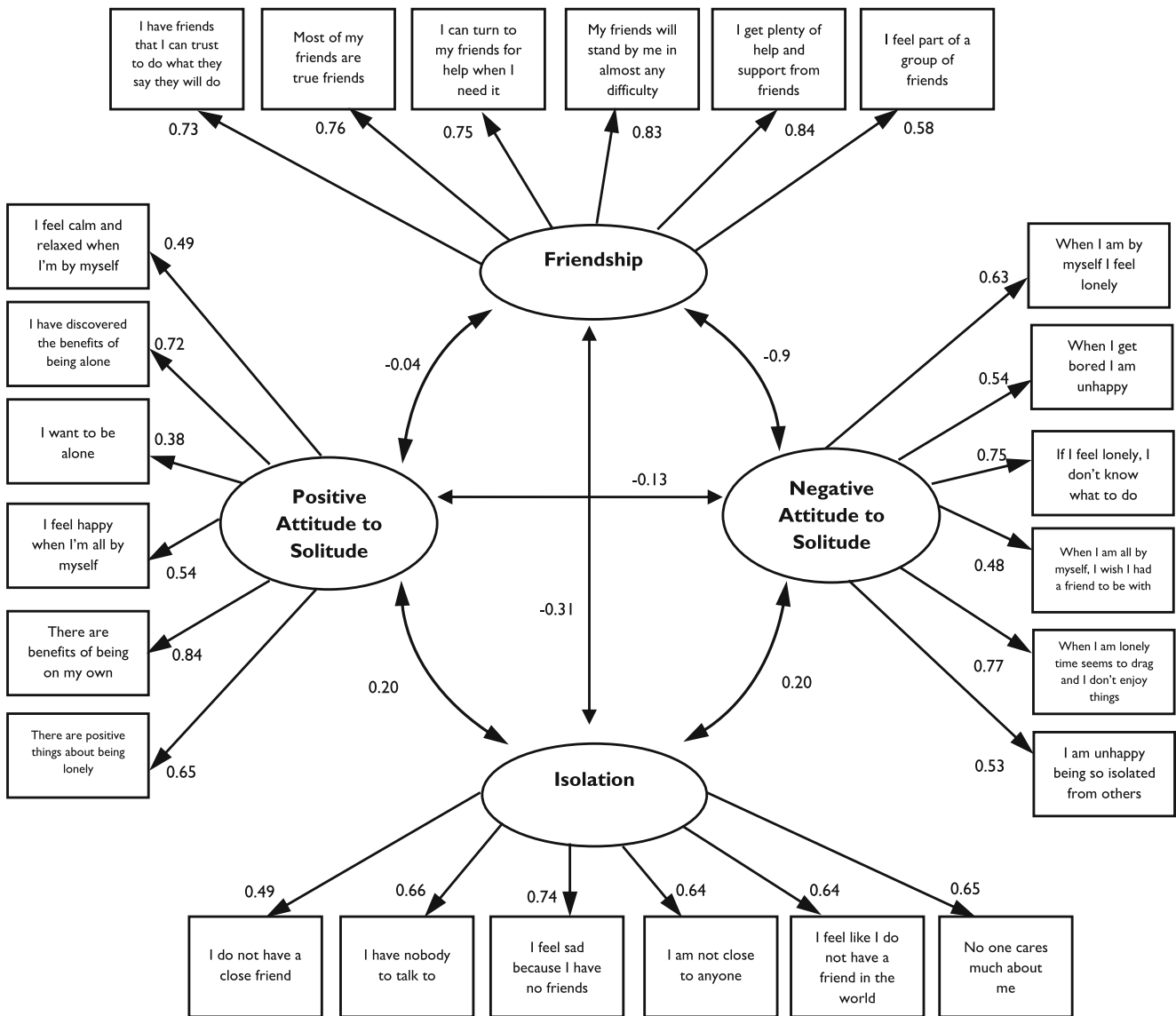


Fig. 1 Measurement model specifying four factors

Table 2 Univariate F statistics, observed means (and standard deviations) for loneliness with group as the independent variable

Loneliness category	F	p	Partial η ²	ADHD		*CI	
				Mean (SE)	Non ADHD	Lower	Upper
Friendship	0.012	0.914	0.001	4.53 (0.16)	4.52 (0.15)	4.22	4.84
Negative attitude to solitude	0.269	0.605	0.002	3.08 (0.16)	2.82 (1.02)	4.23	4.82
Isolation	1.41	0.236	0.009	1.77 (0.12)	1.69 (0.11)	2.77	3.39
Positive attitude to solitude	3.16	0.079	0.020	3.45 (0.14)	3.10 (0.13)	2.52	3.13
						1.53	2.01
						1.47	1.92
						3.18	3.72
						2.85	3.36

*95 % CI for ADHD sample shown first (top line) followed by 95 % CI for Non ADHD

Loneliness factors according to Group Status (ADHD/Non ADHD status).

A post hoc power analysis (PASS 13.0 2013) revealed that a sample size of $n=168$ has sufficient power (0.89) to detect an effect (Cohen's $d=0.5$, $p<0.05$). Therefore, the finding of no significant differences between the mean scores of the ADHD and non ADHD groups cannot be rejected. To further avoid the risk of making a type II error (β) and to critically analyse the non-significant findings, 95 % Confidence Intervals (CI) were examined (see Arztebl 2009; Trout et al. 2007). As is evident in Table 2, the 95 % CI revealed a large amount of overlap between the ADHD and non ADHD samples in the intervals, further strengthening the non-significant finding (see Cohen 1988; Sauro 2012). Specifically, the Effect Size (ES) and percentage of overlap for each of the four loneliness scores of the two groups were: Friendship ES=0.02, 98 % overlap; Negative Attitude to Solitude ES=0.05, 96 % overlap; Positive Attitude to Solitude ES=0.14, 90 % overlap; and Isolation ES=0.11, 92 % overlap.

Discussion

Adolescence and immediately prior to it, is a developmental period marked by closer ties with peers and peer groups (Chipuer and Pretty 2000) and a time where peer relationships assume greater intimacy (Teppers et al. 2013). For young people with ADHD, however, childhood and adolescence is often characterized by having few or no friends, peer relationship problems (see Barkley 2000; Becker et al. 2012; Hoza 2007; Nijmeijer et al. 2008) and frequent rejection by others (Glass et al. 2010). That children and adolescents with ADHD also perceive themselves as having fewer positive features and more negative features in regards to their friendships (Normand et al. 2011) may make them more vulnerable than children and adolescents without ADHD to feelings of loneliness. Research has shown that even young people who are well liked by their peers, feel more lonely if they do not have a friend (Parker and Asher 1993). Thus, friendships are important, especially for providing emotional support.

The adverse consequences of loneliness among typically developing youth are well documented (e.g., depression, recreational drug use, suicide ideation and violence, parasuicide and self-harm, eating disturbances, obesity and sleep disturbances, alcohol use, general health problems, and somatic complaints). If children and adolescents with ADHD are at greater risk of loneliness and therefore an increased propensity to adverse physical, psychological, social and mental health problems (Lasgaard et al. 2011; Mrug et al. 2012), then developing an understanding of loneliness in this more vulnerable population is crucial.

The current findings, which appear to be the first from a study examining loneliness in children and adolescents with ADHD, can be viewed in a positive light. That is, the present study demonstrates that children and adolescents with ADHD report similar levels of loneliness to their non ADHD counterparts with respect to the four dimensions measured by the PALs. Thus, while children and adolescents with ADHD may experience greater levels of peer related problems and rejection by others (Glass et al. 2010; Hoza 2007; Nijmeijer et al. 2008) this does not seem to translate into greater levels of self-reported loneliness. Indeed, children and adolescents with ADHD report they have supportive friends they can trust and depend on, which while appearing to be antithetical to previous research findings, may reflect that the supportive friends they turn to may also be diagnosed with ADHD or Oppositional Defiant Disorder, as suggested by Normand et al. (2011) and Wehmeier et al. (2010).

It also appears that young people with ADHD are no different to their non ADHD peers in that they have similar affinity for spending time alone (i.e., having a positive attitude to solitude) (see Marcoen et al. 1987). Spending time away from others and enjoying solitary activities is said to predict psychological wellbeing (see Leary et al. 2003) and as providing children and adolescents with pleasurable positive opportunities to become more thoughtful and reflective and to engage in self-reflection (Leary et al. 2003). Moreover, Goossens et al. (2009) asserted that “attitudes toward being alone might affect one’s vulnerability to feeling lonely when alone” (p. 890). Certainly, the present findings appear to support this contention, in that children and adolescents with ADHD have similar levels of positive attitude to spending time alone and similar levels of loneliness, as their non ADHD counterparts. What is not known, however, is whether the time spent alone is used productively in solitary activities and therefore any conclusions drawn at this point must be tentative.

Since boys with ADHD exhibit more overly aggressive and hyperactive behaviors and are less tolerated than girls (Diamantopoulou et al. 2005; Gaub and Carlson 1997), it can be postulated that they (i.e., boys) will be rejected by others more readily and hence may experience greater levels of loneliness. The findings from the present study revealed no sex differences between children and adolescents with and without ADHD in any of the four loneliness dimensions. Although no other research appears to have investigated differences in loneliness according to ADHD/Non ADHD status, there is mixed support from studies using community samples of children and adolescents in general. For example, a review undertaken by Koenig and Abrams (1999) found no differences between boys’ and girls’ reports of loneliness. Similarly, Goossens et al. (2009) reported that their four-factor model was invariant across gender. In a study measuring loneliness in children and adolescents across seven countries, de Jong-

Gierveld and Van Tilburg (2010) *did* find differences, with females being less socially lonely than their male peers. Houghton et al. (2014) also found that female adolescents reported significantly higher levels of Friendship (i.e., they had reliable, trustworthy supportive friends) than males. Conversely, Qualter and Munn (2005) found more females (60 %) than males (40 %) identified themselves as lonely.

Overall, the present findings show that children and adolescents with ADHD do not experience loneliness any differently to their non ADHD peers, even though it is known that they experience greater difficulties with peer friendships. Nevertheless, those with ADHD may, like other children and adolescents, still develop negative views about themselves, expect and fear negative evaluations from others, feel powerless to change their predicament, and view others unfavorably, less trustworthy, less communicatively competent, less supportive, and less accepting (Heinrich and Gullone 2006). The early identification of potential loneliness is therefore important, particularly in the ADHD child and adolescent populations, which are more prone to harmful sequelae, such as mental health problems. In doing so it might allow for more effective preventive intervention and a reduction in such adverse outcomes. This current validation of the PALs with an ADHD population also means that psychologists, educators, school counsellors and allied professionals now have access to an easily administered self-report instrument that measures multidimensional loneliness in a vulnerable population.

It must be acknowledged that a relatively small sample size ($n=168$, ADHD=84, Non ADHD=84) was recruited. However, matching individuals by age decreases the error variance and prevents the matching variables from becoming competing causal factors of any effects (Kirk 1995.) Nevertheless, the risk of making a type II error (β) (i.e., the risk of concluding that there is no significant difference between groups when in fact such a difference exists) is a distinct possibility in the present study given the type of analysis used. A post hoc power analysis suggested there was sufficient power. However, it has been argued that post hoc power calculations can underestimate the prospective power of a study and therefore 95 % CI should be used instead. The reason for this is that “CI incorporate the element of power and give more accurate representation of the findings of an analysis. CI tell the reader exactly the range of values with which the data are statistically compatible. That is, they define all of the potential results that are supported by the data (Trout et al. 2007, p. 196). According to Arztebl (2009) CI and p-values are complementary to each other in terms of the information they provide and so both were employed in the present study. Thus, the non-significant p-values on each of the four loneliness factors between the ADHD and non ADHD groups was further strengthened by the large amount of overlap in the 95 % CI intervals (see Sauro 2012). Specifically, the amount of overlap for each of the scores of the two groups was

between 90 and 98 %. Cumming and Finch (2005) and Sauro (2012) suggest that if there is a large overlap then the difference is not significant.

The ADHD subtype information was only available for 81 % ($n=68$) of the ADHD sample. Although 95 % of the known subtypes presented most prominently with Combined type symptoms, the heterogeneous nature of the symptom presentation in ADHD may differentially impact loneliness. Furthermore, comorbid disorders are the rule rather than the exception in ADHD (see Tannock 1998) and it may be that these also make differential contributions to loneliness. Indeed, the association between loneliness and depression (and its consequences) is well established in the adolescent research literature (see Gonda et al. 2012; Innamorati et al. 2011; Serafini et al. 2013). Importantly, none of the participants in the present study were diagnosed with depression or symptoms of depression. However, replication with a much larger sample of children and adolescents with and without ADHD, whose subtypes and comorbidities are known, is warranted.

The children and adolescents with ADHD in the present study had received a formal diagnosis from a pediatrician and were, at the time of the study, receiving pharmacological intervention. Information regarding medication regimes was limited and this may also have masked the true extent of any feelings of loneliness, thereby impacting on the participant's responses to the loneliness items in the PALs. This is an important and complex issue, since our results are based solely on self-report data. With reference to the issue of self-report, Goossens and Beyers (2002) argued that sole reliance on self-report can give rise to the issue of shared method variance. However, we argue that loneliness requires insight into the subjective dispositions that can be difficult to obtain from third parties. According to Baldwin and Dadds (2007), parents and teachers have great difficulty perceiving the internal world of their children, and children often have difficulty reporting their internal states to their parents and teachers. However, in the present study participants had a diagnosed psychopathology *and* were receiving pharmacological intervention. Although the validity of information obtained from third parties (e.g., teacher- and parent-reports) for measuring constructs such as psychopathology has been shown to decrease from childhood to adolescence, while the reliability of self-report inventories has been found to increase (Frick et al. 2009; Kamphaus and Frick 2002), the impact of pharmacological intervention on self-report is not fully known. The optimal strategy therefore in future studies examining loneliness and ADHD should be to use two or more sources such as parents, educators or clinicians (cf. Antshel et al. 2012).

In summary, the present research has provided important empirical evidence which appears to be the first pertaining to loneliness in children and adolescents with ADHD. Thus, it adds to the very limited knowledge of this issue that is

currently available. That having a few close friendships buffer against feelings of isolation (see Lauren et al. 2007) suggests the need for further research which investigates more closely the dyadic friendships that children and adolescents with ADHD tend to cultivate. This may lead to innovative intervention programs that focus on strategies for establishing and maintaining close friendships and hence improving the lives of children and adolescents with ADHD.

Conflict of Interest There was no conflict of interest and the authors have no relationships with the funding bodies.

Experiment Participants All authors abided by accepted ethical standards. The experimental protocols were approved by the institutional review committee of the University of Western Australia. Informed consent was obtained from all participants.

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