The Brief Attachment Scale (BAS-16): Using Item Response Theory to create a clinically useful measure of attachment

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D.Clin.Psy thesis (Volume 1)

2015

University College London

UCL Doctorate in Clinical Psychology

Thesis declaration form

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Overview

This thesis is presented in three parts, and focuses on the measurement of attachment in infants.

Part one is a meta-analysis assessing the validity of the Attachment Q-Sort (AQS), one of the gold-standard measures of attachment. This paper updates a previous meta-analysis (Van IJzendoorn et al., 2004) and contains 97 studies published since 2004. It broadly replicates the results of the 2004 meta-analysis, showing that the observer-rated AQS is a valid measure of attachment. The paper raises concerns about the validity of the self-report measure, in particular its poor discriminant validity.

Part two is a data-analytic study which aims to create a brief, clinically useable version of the AQS. The paper uses data from the National Institute of Child and Human Development Study of Early Child Care and Youth Development. Using Q-factor analysis and Item Response Theory a 16-item version of the AQS was created, named the Brief Attachment Scale (BAS-16). This new measure showed good convergent, predictive and discriminant validity and has potential to be a useful screening tool for insecure attachment.

Part three provides a critical appraisal of the data-analytic study presented in part two. It reflects on the background of the study and practical, conceptual and philosophical issues raised during the work. It also further reflects on the strengths and weaknesses of the study and discusses future directions for research.

Table of contents

Tables

Part 1: Literature Review

Part 2: Empirical Paper

Figures

Part 2: Empirical Paper

Acknowledgments

Many people have supported me throughout the completion of this thesis. Special thanks to my supervisor Pasco for all his guidance and great discussions throughout this project.

I am also hugely grateful to Sophie who supported me throughout this adventure and commented on numerous drafts of papers and case reports.

Thanks also to Jay Belsky for extremely useful feedback on a draft of the empirical paper.

Special thanks to the participants and researchers involved in the NICHD Study of Early Child Care and Youth Development, which provided the data for the present study.

Finally, thanks to my sister Emily for very kindly proof reading the entire thesis.

Part 1: Literature Review

Is the self-report Attachment Q-sort a valid measure of attachment? An updated meta-analysis.

Abstract

Background: A meta-analysis published in 2004 reported good validity for the observer version of the Attachment Q-Sort (AQS), but poor validity for the self-report version. Despite this the self-report AQS has continued to be widely used in attachment research, with a number of researchers arguing that providing additional training to raters can improve its reliability. The aim of the present study was to update the 2004 meta-analysis and examine the validity of the observer and self-report versions of the AQS. Method: 97 studies were included with a combined sample size of 17,277. Separate meta-analyses were conducted to examine convergent, discriminant and predictive validity and stability over time. Results: The observer AQS continued to show good predictive validity in terms of association with sensitivity (r=0.31). It also showed a weaker association with infant temperament (r=0.19) demonstrating discriminant validity. The self-report version also showed a strong association with sensitivity (r=0.30), but a similarly high association with temperament (r=0.30). Moderator analyses provided no evidence that providing additional training improved the validity of the self-report version. Conclusion: This study corroborates the findings of the 2004 meta-analysis that the observer AQS, but not the self-report AQS is a valid measure of infant attachment.

Introduction

Since its introduction in 1985, the Attachment Q-Sort (AQS; Waters & Deane, 1985) has become an established measure of infant attachment alongside the Strange Situation Procedure (SSP; Ainsworth et al., 1978). This has been a positive development for a field which for a long period of time relied on only one established measure. The AQS assesses the interaction between the child and the primary caregiver in a routine situation, normally in the home. Whilst the SSP provides information about the infants' expectation of parental protection in high-stress situations, the AQS examines attachment behaviours in safe, low-stress settings (Cassidy & Shaver, 1999).

The AQS is comprised of 90 cards with statements about infant behaviour, which are sorted into nine piles ranging from 'most descriptive of this child' to 'least descriptive of this child'. The AQS includes items not only describing prototypical secure base behaviour (defined as a balance between exploration and proximity-seeking) but also behaviours such as dependency, affectivity, social interaction, object manipulation and social perceptiveness. An overall security score is calculated by correlating the sort for each child with a criterion sort, created from an expert consensus on the ideal or prototypical behaviours of a securely attached child. In the original version the sort was completed by an observer after a period of observation. However, the AQS has been increasingly been used as a self-report measure with the parent reporting on behaviours of their child.

There has been one previous meta-analytic study assessing the validity of the AQS (Van IJzendoorn et al., 2004). The authors reported good psychometric properties for the observer version, concluding that "this attachment measure belongs to the small set of gold standards in our field, in the same league with the SSP and the Adult Attachment Interview" (Van IJzendoorn et al., 2004, p. 1204). Based on results from 130 studies, they reported moderate correlations with the SSP and measures of maternal sensitivity and child

socioemotional development. These correlations became significantly stronger when the period of observation was greater than three hours. They also reported good discriminant validity indicated by small correlations with infant temperament.

By contrast they reported the relatively poor performance of the self-report version of the AQS, concluding that "the convergent and discriminant validity of the self-reported AQS does not yet warrant its use as a measure of attachment security." (Van IJzendoorn et al., 2004, p.1206). In comparison to the observer version, the self-report AQS showed significantly weaker correlations with SSP classification and sensitivity, and significantly higher associations with infant temperament. The authors hypothesised that mothers of insecurely attached children may lack the observational skills necessary to adequately report on their child's behaviours, and may be more defensive about their child's behaviour (Van IJzendoorn et al., 2004).

There is also evidence that the self-report AQS may be particularly unreliable when other outcome measures are also rated by the parent. Vaughn and colleagues reported that the strongest correlations between the AQS and temperament were in studies where both measures were rated by the same parent (Vaughn et al., 2008). Similarly, in a recent meta-analysis the largest correlations between attachment and social competence were in studies where the parent rated both the AQS and their child's social ability (Groh et al., 2014). This led the authors to conclude that "the mother-reported AQS may artificially inflate associations between attachment and social competence when mothers are also relied upon to report on their child's social competence" (Groh et al., 2014, p.126).

Despite this, the self-report version has continued to be widely used in research studies. This is most likely because it is easier and less costly to use than the observer version, which requires a lengthy period of observation by trained raters. Contrary to the above findings a number of authors have argued that the self-report version *can* be a valid measure

if parents are provided with adequate time to familiarise themselves with the items along with sufficient training and supervision (e.g. Waters et al., 2010). A study by Teti and McGourty is frequently cited in support of this, which reported high inter-rater reliability with observers when such procedures were employed (Teti & McGourty, 1996). However, to date there have been no experimental studies assessing the effect of providing this extra training. One of the primary aims of the current study is to investigate whether the studies published since the previous meta-analysis offer any additional support for the validity of the self-report AQS.

There have also been a number of other developments with the AQS since the 2004 meta-analysis. It has continued to be translated into different languages (De Falco et al., 2014) and used in a wider range of countries (Posada et al., 2013). A number of shortened versions of the AQS have been developed (e.g. De Schipper et al., 2006), most notably the TAS-45 (Kirkland et al., 2004). Shortened versions of the AQS are a promising development which could potentially offer a valid yet resource-efficient alternative to the self-report or full observer versions of the AQS. The previous meta-analysis reported that abbreviated versions of the AQS performed comparably to the full version. Another aim of the current study is to update this finding in the light of a number of subsequent studies using short-form versions.

There were also a number of questions that it was not possible to adequately answer in the 2004 study. First, it wasn't possible to assess the validity of the AQS with fathers or other caregivers as the vast majority of studies were conducted with mothers. This is important to examine as it has been argued that due to different traditional roles for fathers in child-rearing, secure attachment may manifest differently in fathers to mothers and require a different approach to measurement (Grossmann et al., 2008). Second, the 2004 analysis reported a significant moderating effect of country, with studies conducted in North

America reporting significantly smaller correlations with sensitivity and SSP classification than studies conducted in other countries. This difference remained significant even after controlling for other potential moderators (Van IJzendoorn et al., 2004). Given that the majority of studies in attachment are conducted within North America it is important to examine whether this effect has persisted and if so to understand why.

To enable comparison with the previous meta-analysis a broadly similar analytic strategy will be used, with certain caveats. Convergent validity will be assessed by examining the association between the AQS and the SSP, one of the 'gold-standard' measures of attachment. Predictive validity will be primarily assessed by examining correlations between the AQS and parental sensitivity. 'Sensitivity' refers to the ability of the parent to understand their baby's signals and respond appropriately, for example with warmth, comfort and an absence of intrusiveness or hostility (Wolff & IJzendoorn, 1997). Studies have shown a minimal genetic effect on attachment and a strong influence of shared environment, with an abundance of correlational and experimental evidence showing that sensitive parenting is one the key environmental factors in attachment security (Belsky & Fearon, 2008).

Discriminant validity will be assessed by examining correlations between AQS security and infant temperament. 'Temperament' can be defined as 'affective, motivational and cognitive' traits which are grounded in neurophysiology, and include mood, attention and response to change in environment (Vaughn et al., 2008). Infant temperament has a strong heritable component and shows only small associations with attachment (especially when measured with the SSP) and can thus be considered a distinct construct (Belsky & Fearon, 2008; Vaughn et al., 2008).

In the 2004 meta-analysis Van IJzendoorn and colleagues also reported on the ability of the AQS to predict 'socioemotional development', understood as a composite of both externalising behaviours and social competence (Van IJzendoorn et al., 2004). Whilst these

are separate constructs, treating them as a combined outcome may be justified on both empirical and conceptual grounds. First, there is meta-analytic evidence that both are positively correlated with attachment and show a similar strength of association (Fearon et al., 2010; Groh et al., 2014). Second, a plausible mediating pathway between attachment and both of these outcomes is through the development of internal working models (Berlin et al., 2008). This is the hypothesis that infants form internal representations of early interactions with caregivers and use these as templates to predict and navigate future interpersonal relationships (Bowlby, 1982). Securely attached infants are hypothesised to have a representation of others as safe, supportive and reliable, which manifests in stable interpersonal relationships. By contrast, insecurely attached children may have experienced their caregivers as either unavailable or over-intrusive and developed coping strategies to compensate for this (Fearon et al., 2010). These expectations and coping strategies are then carried to future relationships and can manifest as externalising behaviours, over-dependence, or distancing behaviours which may be alienating to peers (Berlin et al., 2008).

However, some caution should be applied in using these outcomes as evidence of the validity of the AQS. In particular, given that the AQS contains a number of items referring to externalising (e.g., defiance) and sociable infant behaviours, it could be argued that associations between these measure reflects in part overlap between the constructs measured, rather than a causal relationship between different constructs. This is partly supported by the finding that the association between attachment and externalising is significantly greater for the AQS than the SSP, though this could be confounded by the older age at which the AQS is normally measured (Fearon et al., 2010). However, to enable comparison with the 2004 analysis the same strategy will be followed with these caveats held in mind. Finally, the stability of the AQS will be assessed by examining the correlation between AQS measurement at different time points.

In summary, the broad aim of this study is to update the results of the previous meta-analysis by exploring the convergent, discriminant and predictive validity of the AQS in studies published since 2004 along with potential moderating factors. In particular we were interested in the validity of the self-report version compared to the observer version and the comparative validity of modified versions of the AQS, in particular shortened versions and versions translated into different languages. An additional aim was to examine the validity of the AQS conducted with fathers and alternative caregivers. A number of hypotheses are made. First, it was hypothesised that the observer AQS will continue to show moderate correlations with SSP classification, sensitivity and socioemotional development, and weak correlations with temperament. Second, it was hypothesised that the self-report AQS will show significantly poorer convergent, predictive and discriminant validity than the observer version. It was predicted that the strongest associations between the self-report AQS and other outcomes will be when both are rated by the parent. However, it was also predicted that the validity of the self-report version will be significantly improved when additional training is provided to raters. Finally, it was hypothesised that there will be no significant moderating effect of AQS version, language or country.

Method

Literature search

We searched the following electronic databases for relevant articles published from 2004 onwards: MEDLINE, Psychinfo, the Science Citation Index Expanded, Social Sciences Citation Index, and Art & Humanities Citation Index. Dissertations indexed in these databases were also included. The search terms used were “attachment q-set”, “attachment q-sort” and “AQS + attachment”. We also searched the ISI database of social science citations for articles referencing any of the validation studies for the AQS or the previous AQS meta-analysis (Van

IJzendoorn et al., 2004; Vaughn & Waters, 1990; Waters, 1987; Waters & Deane, 1985; Waters et al., 1995).

This initial search yielded three partially overlapping sets of studies which when merged contained 431 unique articles. In the first instance the abstracts of the articles were examined to identify studies which included the AQS as a measure. 219 studies were discarded because they were not in English, they didn't contain the AQS or were non-empirical papers (e.g. review articles). Where it was not possible to access identified articles (e.g. unpublished dissertations) authors were contacted by email to request a copy of the study. However there remained 11 identified studies which it was not possible to access.

The remaining 200 articles were reviewed individually using the following inclusion criteria. Articles were included if they reported any of the following information: (i) AQS security score, (ii) correlation between AQS security scores at multiple time points, or (iii) correlations between AQS security score and SSP classification, sensitivity, temperament or social competence. Intervention studies were only included if they presented pre-intervention statistics for either control or intervention group.

To ensure that participants were only included once in each meta-analysis, method and results sections of studies were inspected to identify overlapping samples. Where it was still unclear whether samples overlapped, the corresponding authors of the studies were contacted by email for clarification. When studies contained overlapping samples and reported identical outcomes, the article with the larger sample size was included. Where studies contained overlapping samples and reported on partially overlapping outcomes, each outcome measure was only included once. Where studies included both the observer and self-report AQS with the same parent, the self-report version was included as there were fewer instances of this within the literature. Studies were excluded if they overlapped with samples included in the 2004 meta-analysis and reported identical outcomes. This included

all articles published since 2004 reporting on the NICHD study of Early Child Care and Youth Development. Finally, where studies reported on separate groups within the same paper these were treated as independent samples.

Of the 200 articles reviewed, 54 were excluded because of sample overlap, 46 because they included insufficient details on the AQS and three which were intervention studies and did not present pre-intervention data. This left 97 studies containing a total of 109 independent samples with a combined sample size of 17,277. Thirty-three of these were clinical samples, 72 were non-clinical and four were mixed clinical and non-clinical. Sixty-eight samples included the observer AQS whilst 41 used the self-reported version.

Coding

To enable comparison, a similar coding system was used to the 2004 meta-analysis. Security score means and standard deviations were entered. The association between AQS security and SSP classification (secure vs insecure) was recorded either as a t-statistic or as mean AQS scores for secure and insecure SSP classifications. For the remaining outcomes effect sizes were coded in terms of correlation (r) or regression coefficients (β).

A wide range of measures were identified assessing parenting behaviour. Outcomes were categorised as 'sensitivity' if they assessed the awareness and appropriateness of the caregiver's response to their child's cues (e.g. sensitive, non-hostile, non-intrusive). Measures of sensitivity included the Maternal behaviour Q-Sort; NICHD 'Three bags' task and Emotional Availability caregiver scales (Biringen et al., 2000; NICHD Early Child Care Research Network, 1997; Pederson & Moran, 1995). Measures relating to broader parental behaviours (e.g. verbal validation, goal setting) were also included and categorised as 'Parenting', e.g. as measured by the Parent/Caregiver Involvement Scale (P/CIS; Farran et al., 1986). Indicators of temperament included traits such as mood and activity, for example

as measured by the Infant Characteristics Questionnaire (ICQ; Bates et al., 1979). Outcomes were classified as 'socioemotional development' if they reported on either social competence or externalising behaviours. Social competence was measured by both parent and teacher measures of competence and peer ratings of popularity, whilst externalising behaviours were captured by measures such as the Child Behaviour CheckList (Achenbach & Edelbrock, 1980). Details of the measures included in each study are provided in Table 1. Where studies reported multiple measures of the same construct or reported multiple subscale scores for the same measure an average of these scores was used (Lipsey & Wilson, 2001). Where studies reported on correlations between the AQS and the same outcome at different time-points, the time-point closest to the age at which the AQS was conducted was chosen.

A number of other variables were coded as potential moderators. These included the language of the AQS, whether it was the observer or self-report version and whether it was the 90 item AQS or an abbreviated version. Where the observer version was used the duration of observation period was coded. Where the self-report method was used it was recorded whether the study described using additional procedures (e.g. as described by Teti & McGourty, 1996) to improve validity. The rater for the outcomes was also coded (e.g. observer, parent). Other background variables included the interval of measurement between AQS and outcome in months, age of the child in months, the caregiver being observed, whether the child or mother were from a clinical population, the country in which the study was conducted and the type of publication (e.g. journal vs. dissertation).

Meta-analytic strategy

Six meta-analyses were conducted using Comprehensive Meta Analysis (CMA) to estimate combined effect sizes for: (i) mean security score, (ii) convergent validity (SSP), (iii) predictive

validity (sensitivity), (iv) predictive validity (socioemotional competence), (v) discriminant validity (temperament) and (vi) AQS stability. No effect sizes were identified as outliers. Q statistics indicated that there was significant heterogeneity of effect sizes for all outcomes so random effects models were used throughout. Random effect models are more conservative, and assume that differences in effect sizes are due not only to subject-level sampling error but also other random variability between studies (Lipsey and Wilson, 2001). The influence of potential moderators was tested by calculating Q statistics and p values for differences in combined effect size between subsets of studies. Moderator analyses were only conducted when there was at least four studies in each group. Unfortunately there were insufficient numbers of studies conducted with fathers within each meta-analysis to include this as a moderator in analyses. Effect sizes reported as r were transformed into Fisher's Z statistic for analysis, and transformed back to r for interpretation. This is the recommended procedure for treating the correlation coefficient as it corrects for problems with standard error and the distribution of the statistic at extremes (Lipsey and Wilson, 2001; Van Izendoorn et al., 2004). For ease of comparison to the 2004 meta-analysis the difference in AQS scores between infants classified as secure and insecure on the SSP was also reported as an *r* statistic.

Three of the meta-analyses contained the very large Early Child Longitudinal Study (Rispoli et al., 2013). Given that random effect models were used the influence of this large sample was significantly less than it would have been using fixed-effect models; however to ensure it was not distorting the combined effect size each of these meta-analyses was repeated without this sample for comparison.

The trim and fill method was used to assess for possible publication bias, i.e. the non-publication of non-significant results (Duval & Tweedie, 2000). Traditionally funnel-plots have been used to examine potential publication bias (Lipsey & Wilson, 2001). Funnel-

plots graphically depict the relationship between effect size and sample size for the included studies. They are named 'funnel-plots', because if there is no bias there should be greater variability in effect sizes between small samples compared to large samples, and the scatterplot takes the shape of a funnel. Possible bias is indicated by the absence of studies with small sample sizes (large standard error) to the left of the combined effect size (Lipsey & Wilson, 2001). The trim-and-fill method extends this approach by statistically testing and correcting for asymmetry in funnel-plot. The number of studies in the asymmetric area of the plot are estimated, 'trimmed' (removed) and the remainder are used to calculate an estimate of the true mean. The trimmed studies are then replaced and their 'counterparts' are imputed on the opposite side of the corrected effect size (Duval & Tweedie, 2000). Separate trim-and-fill analyses were conducted for the observer and self-report versions of the AQS.

Table 1: Sample Characteristics of included studies

Study	Group	N	AQS version	Subject	Rater	Outcome	Measure
(Altenhofen et al., 2013)	Fostered children	104	90	Foster carer	Observer	Sensitivity	Emotional Availability Scale
(Badanes et al., 2012)	Non-clinical	110	90	Mother	Self	Temperament	Teacher-Children's Behaviour Questionnaire
(Balentine, 2007)	Non-clinical	165	90	Mother	Self	Externalising Sensitivity	Behaviour Assessment System for Children Bespoke measure
						Social competence	Preschool Play Behaviour Scale
						Security score	
(Bauminger-Zvieli & Kugelmass, 2013)	ASD	30	90	Mother	Observer	Security score	
(Bauminger-Zvieli & Kugelmass, 2013)	Non-clinical	30	90	Mother	Observer	Security score	
(Bergin & McCollough, 2009)	Non-clinical	41	90	Mother	Observer	Security score	
(Bergin & McCollough, 2009)	Substance exposed	41	90	Mother	Observer	Security score	
(Boldt et al., 2014)	Non-clinical	100	90	Mother	Self	Externalising	Dominic-R
						Social competence	Health Behaviour Questionnaire
						Security score	
(Boldt et al., 2014)	Non-clinical	100	90	Father	Self	Externalising	Dominic-R
						Social competence	Health Behaviour Questionnaire
						Security score	
(Bost et al., 2006)	Non-clinical	90	90	Mother	Observer	Security score	
(Buyse et al., 2011)	Non-clinical	127	90	Mother	Observer	Externalising	Child Behaviour Scale
						Security score	
(Candelaria et al., 2011)	Pre-term birth	124	90	Mother	Observer	Sensitivity	Maternal Behaviour Q-sort
(Cassibba et al., 2004)	Bronchitus	30	90	Mother	Observer	Security score	

(Cassibba et al., 2004)	Non-clinical	30	90	Mother	Observer	Security score	
						Temperament	Toddler Behaviour Assessment Questionnaire
(Chaimongkol & Flick, 2006)	Non-clinical	110	90	Mother	Observer	Sensitivity	Maternal Behaviour Q-sort
						Security score	
(Cohen & Farnia, 2011)	Adopted	70	23	Mother	Self	Externalising	Child Behaviour Check List
						Stability AQS	
(Cohen & Farnia, 2011)	Non-clinical	43	23	Mother	Self	Externalising	Child Behaviour Check List
						Stability AQS	
(Colonnesi et al., 2013)	Adopted	20	90	Mother	Observer	Security score	
(Commodari, 2013)	Non-clinical	279	90	Teacher	Observer	Security score	
(Coppola et al., 2014)	Non-clinical	40	90	Mother	Observer	Security score	
(Costantini et al., 2012)	Non-clinical	20	90	Mother	Observer	Security score	
(Costantini et al., 2012)	Pre-term birth	20	90	Mother	Observer	Security score	
(Coyl et al., 2010)	Non-clinical	235	62	Parent	Self	Parenting	Bespoke measure
(De Falco et al., 2014)	High risk	25	90	Mother	Observer	Sensitivity	Emotional Availability Scale
		40				Security score	
(De Schipper et al., 2006)	Non-clinical	5	37	Parent	Observer	Security score	
(De Schipper et al., 2008)	Non-clinical	48	90	Caregiver	Observer	Sensitivity	Observational Record of Caregiving Environment
						Temperament	Infant Characteristic Questionnaire
						Security score	
(Ding et al., 2014)	Non-clinical	118	90	Mother	Self	SSP	
(Feldstein et al., 2004)	Post-natal depression	38	90	Father	Self	Security score	

(Feldstein et al., 2004)	Post-natal depression	59	90	Mother	Self	Security score	
(Forman et al., 2007)	Post-natal depression	41	90	Mother	Self	Security score	
(Gabler et al., 2014)	Fostered children	48	90	Foster carer	Observer	Sensitivity	NICHD sensitivity measure
						Stability AQS	
						Security score	
(Gartstein & Iverson, 2014)	Non-clinical	47	61	Mother	Self	Sensitivity	Bespoke measure
						Temperament	Infant Behaviour Questionnaire - R
(Goodvin et al., 2008)	Non-clinical	33	90	Mother	Observer	Stability AQS	
						Security score	
(Hall et al., 2014)	Pre-term birth	210	90	Mother	Observer	Sensitivity	NICHD sensitivity measure
(Heikamp et al., 2013)	Non-clinical	82	90	Mother	Self	Security score	
(Houlihan, 2011)	Adopted children	37	90	Parent	Observer	Sensitivity	Maternal Behaviour Rating Scale
						Security score	
(Howard, 2010)	Non-clinical	72	90	Father	Self	Security score	
(Howes & Shivers, 2006)	Non-clinical	160	90	Caregiver	Observer	Externalising	Child Behaviour Check List
						Social competence	Social Skills Rating Scale
						Security score	
(Howes & Guerra, 2009)	Non-clinical	22	90	Caregiver	Observer	Sensitivity	Emotional Availability Scale
						Security score	
(Howes & Guerra, 2009)	Non-clinical	71	90	Mother	Observer	Sensitivity	Emotional Availability Scale
						Security score	
(Howes et al., 2013)	High risk	118	90	Teacher	Observer	Security score	
(Ispa et al., 2007)	High risk	173	90	Mother	Self	Security score	
(Kremmel, 2009)	Non-clinical	91	90	Parent	Self	Social competence	Bespoke measure
(Kreppner et al., 2011)	Adopted children	178	23	Mother	Self	SSP	

(Laible, 2004)	Non-clinical	51	90	Mother	Self	Social competence	Child Behaviour Scale
						Temperament	Child Behaviour Questionnaire
						Security score	
(Laible, 2006)	Non-clinical	51	90	Mother	Self	Externalising	Child Behaviour Scale
						Social competence	Child Behaviour Scale
						Security score	
(Laible et al., 2008)	Non-clinical	64	90	Mother	Self	Stability AQS	
						Temperament	Toddler Behaviour Assessment Questionnaire
						Security score	
(Laible, 2011)	Non-clinical	50	90	Mother	Self	Parenting	Bespoke measure
						Security score	
(LaMont, 2011)	Developmental delay	74	12	Mother	Self	Externalising	Child Behaviour Check List
						Temperament	Dimensions of Temperament Scale - R
(Lavigne et al., 2012)	Non-clinical	796	90	Mother	Observer	Externalising	Child Symptom Inventory
						Sensitivity	Parent Behaviour Inventory
						Temperament	Child Behaviour Questionnaire
(McCabe et al., 2006)	Non-clinical	32	90	Mother	Self	Security score	
(McWey & Mullis, 2004)	Fostered children	123	90	Parent	Observer	Security score	
(Monteiro et al., 2008)	Non-clinical	56	90	Mothers	Observer	Externalising	Social Competence and Behavioural Evaluation Scale
						Social competence	Social Competence and Behavioural Evaluation Scale
						Temperament	Child Characteristics Questionnaire
						Security score	
(Monteiro et al., 2008)	Non-clinical	56	90	Fathers	Observer	Externalising	Social Competence and Behavioural Evaluation Scale

						Social competence	Social Competence and Behavioural Evaluation Scale
						Temperament	Child Characteristics Questionnaire
						Security score	
(Moss et al., 2006)	Non-clinical	152	90	Mother	Self	Externalising	Preschool Socio-affective Profile
						Parenting	Bespoke measure
						SSP	
						Security score	
(Munz, 2011)	Non-clinical	50	90	Parent	Self	Parenting	Bespoke measure
						Security score	
(Murphy & Laible, 2013)	Non-clinical	69	90	Mother	Self	Stability AQS	
						Security score	
(Newcombe & Reese, 2004)	Non-clinical	56	90	Mother	Self	Security score	
Nijmegen University Sample							
(Smeekens et al., 2009)	Non-clinical	111	90	Parent	Observer	Externalising	Child Behaviour Check List
(Van Bakel & Riksen-Walraven, 2004)	Non-clinical	129	90	Parent	Observer	Sensitivity	Erickson scales
						Temperament	Toddler Behaviour Assessment Questionnaire
						SSP	
						Security score	
(Niemann & Weiss, 2011)	Adopted children	22	90	Mother	Observer	Security score	
(Ontai & Thompson, 2008)	Non-clinical	76	90	Mother	Self	Security score	
(Ontai & Virmani, 2010)	Non-clinical	35	90	Mother	Self	Security score	
(Oosterman & Schuengel, 2008)	Fostered children	61	90	Parent	Observer	Externalising	Child Behaviour Check List

						Sensitivity	NICHD sensitivity measure
						Security score	
(Pallini & Laghi, 2012)	Non-clinical	72	90	Parent	Observer	Security score	
(Panfile et al., 2012)	Non-clinical	40	90	Mother	Self	Temperament	Child Behaviour Questionnaire
						Security score	
(Ponciano, 2010)	Fostered children	76	90	Mother	Observer	Sensitivity	Maternal Behaviour Q-sort
(Posada et al., 2004)	Non-clinical	30	90	Mother	Observer	Sensitivity	Maternal Behaviour Q-sort
						Security score	
(Posada, 2006)	Non-clinical	45	90	Mother	Observer	SSP	
						Security score	
(Posada et al., 2007)	Non-clinical	50	90	Mother	Observer	Sensitivity	Maternal Behaviour Pre-school Q-sort
						Security score	
(Posada et al., 2007)	Non-clinical	40	90	Mother	Observer	Sensitivity	Maternal Behaviour Pre-school Q-sort
						Security score	
(Posada et al., 2013)	Canada (Non-clinical)	63	90	Mother	Observer	Security score	
(Posada et al., 2013)	Columbia (Non-clinical)	83	90	Mother	Observer	Security score	
(Posada et al., 2013)	France (High risk)	30	90	Mother	Observer	Security score	
(Posada et al., 2013)	Italy (Non-clinical)	39	90	Mother	Observer	Security score	
(Posada et al., 2013)	Japan (Non-clinical)	45	90	Mother	Observer	Security score	
(Posada et al., 2013)	Peru (Non-clinical)	30	90	Mother	Observer	Security score	
(Posada et al., 2013)	Taiwan (Non-clinical)	68	90	Mother	Observer	Security score	
(Posada et al., 2013)	USA (Non-clinical)	77	90	Mother	Observer	Security score	
(Raikes & Thompson, 2005)	High risk	63	90	Mother	Observer	Sensitivity	NICHD sensitivity measure
						Security score	
(Rispoli et al., 2013)	Non-clinical	6850	TAS-45	Parent	Observer	Sensitivity	NICHD sensitivity measure
						Social competence	Bespoke measure
						Temperament	NICHD sensitivity measure

						Security score	
(Roggman et al., 2009)	High risk	161	90	Mother	Self	Security score	
(Roskam et al., 2011)	Behaviour problems	87	79	Parent	Self	Externalising	Profil Socio-Affectif
		117				Sensitivity	L'Évaluation des Pratiques Éducatives Parentales
(Rutgers et al., 2007)	Mixed (Non-clinical and developmental delay)	89	12	Parent	Observer	Parenting	Child Rearing Practice Report
(Schaaf et al., 2008)	Non-clinical	82	90	Parent	Self	Externalising	Child Behaviour Check List
(Scher & Asher, 2004)	Non-clinical	57	90	Mother	Self	Security score	
(Schofield et al., 2011)	Non-clinical	271	90	Parent	Self	Parenting	Bespoke measure
						Social competence	Bespoke measure
						Security score	
(Seifer et al., 2014)	Non-clinical	136	90	Mother	Observer	Sensitivity	Parent/Caregiver Involvement Scale
						Temperament	Temperament Adjective Triad Assessment
						Security score	
(Spieker et al., 2011)	High risk	55	TAS-45	Mother	Observer	Externalising	Brief Infant Toddler Social Emotional Assessment
						Social competence	Brief Infant Toddler Social Emotional Assessment
						Security score	
		23	90			Stability AQS	
(Spieker et al., 2012)	Fostered children	210	90	Parent	Observer	Externalising	Brief Infant Toddler Social Emotional Assessment
						Sensitivity	Nursing Child Assessment Teaching Scale

						Social competence	Brief Infant Toddler Social Emotional Assessment
						Temperament	Bayley-III Screening Test
						Security score	
(Szewczyk-Sokolowski et al., 2005)	Non-clinical	98	90	Mother	Observer	Social competence	Peer nomination
						Temperament	Infant Characteristic Questionnaire
						Security score	
(Tarabulsy et al., 2005)	Mixed (Non-clinical and high risk)	64	90	Mother	Observer	Stability AQS	
(Tarabulsy et al., 2008)	Mixed (Non-clinical and high risk)	127	90	Mother	Observer	Sensitivity	Maternal Behaviour Q-sort
						Temperament	Infant Characteristic Questionnaire
						Security score	
(Tarabulsy et al., 2008)	Mixed (Non-clinical and high risk)	127	90	Mother	Self	Sensitivity	Maternal Behaviour Q-sort
						Temperament	Infant Characteristic Questionnaire
						Security score	
Texas Tech University Sample							
(Caldera & Hart, 2004)	Non-clinical	60	90	Mother	Self	Temperament	Infant Characteristic Questionnaire
(Caldera & Lindsey, 2006)	Non-clinical	60	90	Mother	Self	Sensitivity	Bespoke measure
						Security score	
(Caldera & Lindsey, 2006)	Non-clinical	60	90	Father	Self	Security score	
(Tornello et al., 2013)	Non-clinical	982	TAS-39	Parent	Self	Externalising	Child Behaviour Check List
University of Montreal Sample							
(Bernier et al., 2012)	Non-clinical	62	90	Parent	Observer	Stability AQS	

(Bernier et al., 2014)	Non-clinical	130	90	Mother	Observer	Sensitivity	Maternal Behaviour Q-sort
(Bouvette-Turcot et al., 2013)	Non-clinical	60	90	Mother	Observer	Temperament	Toddler Behaviour Assessment Questionnaire
University of Texas Sample							
(Caughy et al., 2004)	Non-clinical	161	90	Mother	Self	Security score	
(Caughy et al., 2004)	Non-clinical	217	90	Mother	Self	Security score	
(Caughy et al., 2009)	Non-clinical	318	90	Mother	Self	Externalising	Child Behaviour Check List
		151	90			Stability AQS	
(Huang et al., 2009)	Non-clinical	179	90	Mother	Self	Parenting	Parent/Caregiver Involvement Scale
		70	90			Stability AQS	
(Klein Velderman et al., 2006)	High risk (intevention group)	81	90	Mother	Observer	Externalising	Child Behaviour Check List
(Klein Velderman et al., 2006)	High risk (control group)	26	90	Mother	Observer	Security score	
(Verissimo & Salvaterra, 2006)	Adopted children	106	90	Mother	Observer	Security score	
(Verschueren et al., 2012)	Non-clinical	113	90	Mother	Observer	Social competence	Peer nomination
(Vorria et al., 2006)	Adopted children	61	90	Parent	Observer	SSP	
						Security score	
(Vorria et al., 2006)	Non-clinical	38	90	Parent	Observer	SSP	
						Security score	
(Walker et al., 2014)	Children of wounded veterans	153	10	Parent	Self	Externalising	Social Competence and Behavioral Evaluation scale
						Sensitivity	Maternal Behaviour Pre-school Q-sort
						Social competence	Social Competence and Behavioral Evaluation scale
(Waters et al., 2010)	Non-clinical	73	90	Mother	Self	Parenting	Bespoke measure

						Security score	
(Wong et al., 2011)	USA (Non-clinical)	38	90	Mother	Observer	Security score	
(Wong et al., 2011)	Portugal (Non-clinical)	31	90	Mother	Observer	Security score	
(Wong et al., 2011)	USA (Non-clinical)	52	90	Mother	Observer	Security score	
(Yang & Lamb, 2014)	Non-clinical	67	90	Mother	Observer	Temperament	Child Behaviour Questionnaire

Results

The results section proceeds as follows. First, an estimate of the mean security score is calculated. Separate meta-analyses are then presented for estimates of convergent validity (SSP), predictive validity (sensitivity, socio-emotional development), discriminant validity (temperament) and reliability (AQS stability over time).

Mean security score

Ninety-three samples were included in this analysis with a combined sample size of 13,517. This represents a 400 per cent increase on the sample size used in the 2004 meta-analysis (n=2703). The mean security score was 0.35 (95% C.I. = 0.34-0.37), which is comparable to the mean security score of 0.31 reported in the 2004 analysis. Moderator analysis showed that security scores were significantly higher for non-clinical groups and for older children. Scores were also significantly higher using the self-report and English versions of the AQS, and significantly lower scores for studies conducted in the Middle East or Asia (Table 2). Removal of the very large ECLB study (Rispoli et al., 2013) resulted in a slight increase in the combined observer mean (r=0.35). No studies needed to be trimmed and filled.

Table 2: Mean security scores and moderator analysis

Moderator		*k*	*N*	Security score	Confidence interval 95%		Homogeneity Q	Contrast Q	Contrast P
					Lower	Upper			
Full set		93	13517	0.35	0.34	0.37	5489.96***		
AQS									
Subject								6.02	0.01
	Observer	60	10830	0.34	0.32	0.36	4524.90***		
	Self-report	34	2637	0.38	0.35	0.41	388.94***		
Language								10.98	0.00
	English	74	12265	0.37	0.35	0.38	2146.41***		
	Other	19	1252	0.30	0.27	0.34	1449.84***		
Sample									
Country								12.08	0.02
	Canada	7	345	0.37	0.32	0.43	24.39***		
	Europe	23	1319	0.37	0.34	0.39	336.26***		
	Middle east/Asia	4	280	0.26	0.20	0.32	194.91***		
	South America	5	233	0.38	0.33	0.44	24.19***		
	USA	54	11340	0.36	0.34	0.37	1920.04***		
Age								7.09	0.01
	0-30	52	3030	0.38	0.35	0.40	1014.31***		
	>30	42	10543	0.33	0.30	0.35	4331.38***		
Clinical vs Non-clinical								8.63	0.00
	Clinical	26		0.31	0.28	0.35	685.14***		
	Non-clinical	66		0.37	0.35	0.39	4542.56***		

Significant at ***p<0.001

Convergent validity: SSP

Seven samples were included in this analysis with a combined sample size of 713. Four of these used the observer AQS and three used the self-report version. This represents a 64 per cent smaller sample size than that included in the original meta-analysis (n=1,981). The combined effect size of the association with the SSP was r=0.15 (95% C.I. =-0.12 – 0.41). The effect size for the observer AQS was r=0.02 (k=4, n=257, r=0.02, 95% C.I.=-0.37-0.40) whilst that for the self-report AQS was r=0.31 (k=3, n=456, r=0.31, 95% C.I.=-0.13-0.65). The effect size for the self-report version was strongly influenced by one study reporting a very high correlation (Ding et al., 2014; r=0.77 using a categorical classification on the AQS). These effects were in the expected direction, though appeared markedly different from those reported in the previous meta-analysis (observer: r=0.31; self-report: r=0.14). No moderator analyses were conducted due to the small number of studies in the analysis. No studies needed to be trimmed and filled.

Discriminant validity: Temperament

Twenty-one samples were included which reported on aspects of temperament (n=9,524). This represented a 369 per cent increase in the sample included in the 2004 meta-analysis (n=2,032). The combined effect size of r=0.23 (95% C.I. = 0.17-0.29) was in the expected direction (greater temperament reactivity associated with lower AQS scores) and was comparable to that reported in the previous analysis (r=0.29). There was a trend towards a difference between the observer and self-report versions (observer: r=0.19 vs self-report: r=0.30, p=0.10). Moderator analyses showed that studies conducted in countries outside of USA had significantly smaller associations with temperament (Table 3); no other moderators were significant. There were insufficient numbers in each group to test the moderating influence of AQS language, self-report training, duration of observation, interval between

measurement, clinical vs non-clinical sample and the rater of the temperament measure. Removal of the large ECLB study (Rispoli et al., 2013) did not alter the combined effect size. Trim-and-fill analyses suggested the removal of one study for the self-report version, yielding a corrected effect size of r=0.28.

Table 3: Correlation between AQS and infant temperament

Moderator		***k***	***N***	***r***	**Confidence interval 95%** Lower	Upper	**Homogeneity Q**	**Contrast Q**	**Contrast P**
Full set		21	9524	0.23	0.17	0.29	68.22***		
AQS									
Subject								2.78	0.10
	Observer	12	8633	0.19	0.12	0.26	37.08***		
	Self-report	9	891	0.30	0.20	0.40	18.87*		
Length								0.61	0.43
	Full	17	2343	0.21	0.14	0.28	35.84**		
	Shortened	4	7181	0.30	0.08	0.49	31.81***		
Sample									
Country								12.84	0.00
	USA	16	9156	0.28	0.21	0.34	55.93***		
	Other	5	368	0.05	-0.05	0.16	2.53		
Age								2.34	0.12
	0-30	12	8202	0.22	0.20	0.24	56.36***		
	>30	9	1322	0.20	0.14	0.25	11.29		

Significant at *p<0.05 **p<0.001 ***p<0.001

Predictive validity

Sensitivity. Thirty-seven samples included measures of sensitivity or parenting with combined sample size of 11,265. This represents a 307 per cent increase on the sample size used in the 2004 meta-analysis (n=2,768). Analysis showed that there was no significant difference in the association between the AQS and outcomes classified as 'sensitivity' or

'parenting' (p=0.58), therefore the outcomes were combined for the remainder of the analysis. This yielded a combined effect size in the expected direction of 0.30 (95% C.I. = 0.26-0.35; Table 4). This is very similar to the effect size of r= 0.31 reported in the 2004 analysis. There were no significant differences in the magnitude of effect for the observer and self-report or full versus shortened versions of the AQS. This stands in contrast to the 2004 analysis which reported a significantly greater magnitude of effect for the observer version (0.39) compared to the self-report version (0.23). We also tested whether studies using the self-report AQS which described providing extra training to raters showed a greater effect size than those that did not, however there was no significant difference. We tested a range of other potential moderators but none showed a significant effect. Removal of the large ECLB study (Rispoli et al., 2013) did not alter the combined effect size. No studies needed to be trimmed and filled.

Table 4: Correlation between AQS and parental sensitivity

Moderator		*k*	*N*	*r*	Confidence interval 95% Lower	Upper	Homogeneity Q	Contrast Q	Contrast P
Full set		37	11265	0.31	0.26	0.35	152.10***	0.31	0.58
	Sensitivity	29	10166	0.31	0.26	0.37	132.83***		
	Parenting	8	1099	0.28	0.17	0.38	5.32		
Sensitivity + Parenting									
AQS									
Subject								0.10	0.76
	Observer	24	9586	0.31	0.25	0.37	115.59***		
	Self-report	13	1679	0.30	0.22	0.37	9.39		
Self-report training								1.88	0.17
	Yes	9	1011	0.27	0.22	0.33	6.08		
	No	4	668	0.34	0.27	0.40	1.43		
Length								0.77	0.38
	Full	29	3454	0.32	0.26	0.37	54.50**		
	Shortened	8	7811	0.27	0.18	0.36	41.12***		
Language								0.86	0.35
	English	32	10836	0.30	0.24	0.35	126.22***		
	Other	5	429	0.36	0.23	0.49	9.38		
Duration (Observer)								1.63	0.20
	0-120	12	8703	0.28	0.20	0.36	70.52***		
	120+	10	625	0.37	0.26	0.46	8.42		
Interval between measurement								0.10	0.75
	<1 month	24	2484	0.30	0.23	0.35	27.06		
	1 month +	8	7646	0.31	0.22	0.40	55.44***		
Sample									
Clinical vs Non-clinical								0.14	0.71
	Clinical	13	1111	0.33	0.24	0.41	23.52*		
	Non-clinical	20	9601	0.31	0.24	0.37	92.40***		
Country								0.00	1.00
	USA	24	10074	0.31	0.25	0.36	112.51***		
	Other	13	1191	0.31	0.22	0.39	23.47*		
Age								1.10	0.30

	0-30	22	9258	0.33	0.26	0.39	130.36***		
	>30	15	2007	0.27	0.18	0.35	15.92		
Publication year								0.62	0.43
Observer									
	2004-2008	10	747	0.34	0.24	0.44	11.51		
	2009-2014	14	8839	0.29	0.21	0.37	73.48***		
Self-report								0.16	0.69
	2004-2008	4	504	0.29	0.20	0.37	0.29		
	2009-2014	9	1175	0.31	0.25	0.36	8.94		

Significant at *p<0.05 **p<0.001 ***p<0.001

Socioemotional development. Twenty-nine samples (n=11,397) reported correlations between AQS scores and measures of socioemotional development. This represents a 460 per cent increase on the sample size used in the original meta-analysis (2,035). The combined effect size was r=0.24 (95% C.I. = 0.19-0.29) in the expected direction, and was comparable with that previously reported (r=0.22). There were no significant differences in effect size between the self-report and observer versions of the AQS or between full and shortened versions (Table 5). However, we found significantly higher effect sizes when the AQS and outcome measure were both rated by the parent. Additional moderator analysis showed that studies with a shorter interval of measurement between AQS and outcome showed a significantly larger effect size, as did those including clinical samples. There were insufficient numbers in each group to test the potential moderating effect of language and duration of observation. Removal of the large ECLB study (Rispoli et al., 2013) slightly increased the combined effect size (r=0.25). Trim-and-fill analysis suggested the removal of one study for the self-report version also resulting in a slight increase to the estimated effect size (r=0.25).

We also repeated the above analysis treating social competence and externalising as separate outcomes. Given that the two meta-analyses partially overlapped and thus were not independent it was not possible to directly compare effect sizes. However, non-overlapping 85% confidence intervals can be taken to indicate significantly different effect sizes (Bakermans-Kranenburg et al., 2003). In this instance the confidence intervals between

the two outcomes overlapped, indicating that the combined effect sizes were not significantly different (Social competence: k=17, n=8691, r=0.21, 85% CI=0.17-0.26; Externalising: k=23, n=3923, r=0.26, 85% CI=0.25-0.30).

Table 5: Correlation between AQS and socioemotional development

Moderator		*k*	*N*	*r*	Confidence interval 95% Lower	Upper	Homogeneity Q	Contrast Q	Contrast P
Full set		29	11397	0.24	0.19	0.29	109.19***		
AQS									
Subject								0.47	0.49
	Observer	13	8774	0.22	0.16	0.29	49.67***		
	Self-report	16	2623	0.26	0.19	0.32	24.9		
Self-report training								0.19	0.66
	Yes	5	570	0.24	0.13	0.34	3.39		
	No	11	2053	0.26	0.20	0.33	20.47*		
Length								2.93	0.09
	Full	20	2873	0.21	0.15	0.28	18.88		
	Shortened	9	8524	0.31	0.22	0.39	81.01***		
Interval between measurement								7.86	0.01
	<1 month	22	3077	0.27	0.22	0.32	37.26*		
	1 month +	5	7413	0.14	0.06	0.22	3.83		
Sample									
Clinical vs Non-clinical								4.61	0.03
	Clinical	8	791	0.33	0.24	0.42	15.76*		
	Non-clinical	20	10455	0.21	0.16	0.27	71.45***		
Country								1.32	0.25
	USA	21	10680	0.26	0.20	0.32	106.59***		
	Other	8	717	0.19	0.08	0.29	2.17		
Age								0.01	0.90
	0-30	13	8313	0.25	0.18	0.31	50.75***		
	>30	16	3084	0.24	0.18	0.30	21.86		
Same rater for outcome variable?								11.12	<0.01
	Yes	8	1575	0.31	0.26	0.35	0.79		
	No	4	679	0.20	0.13	0.27	7.69		

Significant at *p<0.05 ***p<0.001

Reliability: Stability

Eleven samples (n= 697) reported correlations between AQS scores at different time points. This represents a 330 per cent increase on the sample size used in the 2004 analysis (n=162). The combined effect size was 0.56 (95% C.I. = 0.49-0.62) in the expected direction. This appeared notably larger than that reported in the previous meta-analysis (r=0.28). The self-report AQS showed significantly greater stability than the observer version (Self: k=6, n=467, r=0.63 vs. Observer: k=5, n=230, r=0.43, Q-contrast=7.61, $p<0.01$). No other moderators were tested due to insufficient number of studies. Trim-and-fill analyses suggested the removal of one study for the self-report AQS and two for the observer version, resulting in corrected effect sizes of r=0.60 and r=0.39 respectively.

Discussion

In the eleven years since the publication of the first meta-analysis of the AQS by Van IJzendoorn and colleagues over 200 new studies including the AQS have been published. This provides an opportunity to update the previous analysis and address a number of outstanding issues. In particular we were interested in the validity of the self-report measure, which despite the cautionary findings from the previous study has continued to be widely used within attachment research. We also wanted to examine the validity of modified versions of the AQS and address anomalies arising from the 2004 analysis.

Our results for the observer AQS broadly replicate the previous findings. The measure showed moderate correlations with sensitivity (r=0.31) which suggests good predictive validity. This compares fairly closely with the findings of the previous analysis which reported an effect size of r=0.39. It also compares well to the estimated association between the SSP and sensitivity (r=0.24; De Wolff & IJzendoorn, 1997). The observer AQS continued to show reasonable discriminant validity in terms of modest correlations with

temperament (r=0.19; compared to r=0.15 in the previous meta-analysis). We also found improved stability over time.

Similarly, we found moderate correlations between the observer AQS and socioemotional development (r=0.22), although it should be noted that this correlation was only slightly higher than that found with temperament. In line with previous findings, this effect size appears higher than that reported in studies using the SSP. Recent meta-analyses have estimated associations between attachment and social competence and externalising of d=0.27 (r=0.13) and d=0.18 (r=0.09) when measured by the SSP (Fearon et al., 2010; Groh et al., 2014). This may show that the strength of this association is over-estimated by the AQS, possibly because of the inclusion of questions describing a broad range of child behaviours. These include items describing both social behaviours (e.g. “When given a choice, child would rather play with toys than with adults”) and behaviours which may be related to externalising behaviours (e.g. “Child easily becomes angry with toys”). Alternatively, the higher association may also reflect the fact that the sample of behaviour captured by the AQS is greater (i.e., longer) than the SSP, or that the later age of assessment tends to produce stronger predictive associations. However, it was notable that within the albeit smaller age-range included in the AQS studies, age was not a significant moderator of attachment-outcome associations.

In contrast to these generally positive findings we found very poor convergent validity between the observer AQS and the SSP (r=0.02, compared to r=0.31 in the previous meta-analysis). However, it is unlikely that our figure is reliable as it is based on findings from only four identified samples (n=257). In addition, one of these studies contained an interval of approximately three years between the SSP and AQS and would therefore be expected to show a smaller magnitude of correlation (Vorria et al., 2006). Consequently the 95% confidence intervals were very wide (r=-0.37 to 0.40) and encompassed the figure from the

2004 analysis. What this finding does reflect is how few studies have been published since 2004 including both AQS and SSP (compared to the 32 published prior to 2004), and may represent a shift towards including only one measure of attachment in research.

In terms of the self-report AQS, our results showed a higher degree of predictive validity compared to the 2004 analysis. We found no significant differences between the self-report and observer versions for the associations with sensitivity or socioemotional development. This stands in contrast to the previous meta-analysis which reported significantly lower correlations with sensitivity for the self-report version (r=0.23). We found no evidence that this apparent improvement was due to publication bias. We also found significantly higher stability across time for the self-report version (r=0.63) compared to the observer version (r=0.44). Whilst we found moderate convergent validity with the SSP, this finding is again unlikely to be reliable and should be interpreted with extreme caution. It was based on only three samples, one of which reported a very high correlation between the AQS and SSP. Consequently the 95% confidence intervals were extremely wide (-0.13 to 0.65).

However, in findings similar to the 2004 analysis, the discriminant validity of the self-report version was poor. The effect size of 0.30 for the association with temperament was similar to that reported in the 2004 analysis (r=0.35), and the difference between the self-report and observer versions approached significance. In keeping with the findings for predictive validity, this appears to show that the self-report AQS correlates at least as highly with a construct to which it should be mostly unrelated (temperament) as it does with one to which it should relate (sensitivity). These findings are consistent with studies including both self-report and observer AQS within the same design, which have reported significantly higher correlations with temperament for the self-report version. (Tarabulsy et al., 1997; Tarabulsy et al., 2008).

We also found no evidence to support the claims of a number of authors that providing extra support and training for the raters improves the validity of the self-report AQS (for example using the measures described in Teti & McGourty, 1996). There were no significant differences in predictive validity between studies which reported providing extra training to those that did not. There was an insufficient numbers of studies to test this moderating effect for temperament; however on a surface inspection, studies reporting having provided extra training showed slightly higher rather than lower correlations with temperament (extra training: k=3, r=0.32 vs no extra training: k=6, r= 0.27). A limitation is that these moderator analyses were based only on qualitative descriptions provided in the method: it is of course possible that some studies supplied extra training to raters but did not state this. To fully determine whether differences in administration improve the self-report version this would need to be tested experimentally.

How do we explain the poor discriminant validity of the self-report version? It has previously been suggested that this might be due to a lack of insight or defensiveness on the part of the informant (Van IJzendoorn et al., 2004). However, another hypothesis is that it is due in part to common method variance (CMV), i.e. shared variance which is attributable to measurement method rather than actual covariation between constructs (Podsakoff et al., 2003). There is considerable evidence that when multiple constructs are measured by the same rater this can inflate any shared variance (Podsakoff et al., 2003). Possible explanations for this effect include the desire for consistency on the part of the rater or the common influence of transitory mood states (Podsakoff et al., 2003; Podsakoff & Organ, 1986). It was notable in this analysis that in all but one studies where temperament was measured together with the self-report AQS, the parent also reported on their child's temperament. Whilst we were therefore unable to test the CMV hypothesis with temperament, we did find that the correlation between self-report AQS and socioemotional development was significantly higher when the parent rated both measures (r=0.31) compared to when they

only rated their child's attachment (r=0.20). This fits with the meta-analytic findings of Groh et al. (2014) who reported that correlations between AQS and social competence was highest when the parent rated both outcomes. Vaughn et al. (2008) also reported similar findings for the association between self-report AQS and temperament. Taken together these findings raise concern about the ongoing use of the self-report AQS in conjuncture with self-report measures for other outcomes. This highlights the need for further investigations in which temperament is measured directly using observational methods.

Another aim of the present study was to explore the performance of modified versions of the AQS, e.g. shortened versions or versions translated into different languages. We found that studies using versions of the AQS with fewer than 90 items showed comparable associations with sensitivity and socioemotional development to those including the full version. However, we also found a comparatively large correlation with temperament for the shortened versions, suggesting poor discriminant validity. There are a number of limitations in this analysis however. First, there were insufficient studies to explore the validity of shortened versions of the self-report and observer AQS separately. Second, all studies with less than 90 items were grouped together, ranging from ultra-short 12 item measures (e.g. Rutgers et al., 2007) to versions including 62 items (Coyl et al., 2010). Different versions may have differed markedly in the items they included. More development and evaluation of specific shortened measures (such as the TAS-45) is required before firm conclusions can be drawn about their validity. In terms of the performance of translated versions of the AQS, there were only sufficient numbers of studies to conduct moderator analyses with the overall security scores and sensitivity. However, we found no significant differences compared to the English version.

We also sought to address some anomalous findings from the previous meta-analysis. Van Izjendoorn and colleagues reported significantly higher associations with SSP

and sensitivity when the study was conducted outside of the USA. We were unable to test this moderating effect for the association with the SSP; however we found no significant effect of country on the relationship with sensitivity. It is not clear why this effect no longer emerged; however given the significantly larger sample size in the present study when addressing that association it could suggest that the 2004 finding was influenced by idiosyncratic results from a small number of samples.

Disappointingly, we were unable to assess the performance of the AQS for fathers and alternative caregivers. As with the previous meta-analysis there were insufficient studies reporting results for fathers to conduct moderator analyses. Whilst a number of studies included both fathers and mothers, in most cases these were only reported as a combined sample. Future research could address this through mega-analysis, i.e. pooling of individual datasets containing AQS data on both mothers and fathers.

In summary, our results provide further evidence for the validity of the observer version of the AQS. The measure showed good predictive validity (especially in terms of the association with sensitivity), good discriminant validity, and improved stability over time compared to the previous analysis. Whilst we found poor convergent validity, our finding was based on only three studies (including one study with a long interval between measurement) and is insufficient to undermine the findings of the previous meta-analysis. We also found mixed results for the self-report AQS. Whilst the measure showed good predictive validity it continued to show poor discriminant validity. We also found evidence that associations between the self-report AQS and other infant behaviour (e.g. socioemotional development) may be artificially inflated when the parent rates both outcomes. In the previous meta-analysis Van Izjendoorn and colleagues concluded that because of its relatively poor predictive, convergent and discriminant validity, it was not clear exactly what the self-report AQS measured and thus it was not warranted as a measure

of infant attachment (Van IJzendoorn et al., 2004, p.1206). Whilst we found improved predictive validity, the continued findings of poor discriminant validity caution against the use of the self-report AQS as a valid measure of attachment.

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Part 2: Empirical Paper

The Brief Attachment Scale (BAS-16): Using Item Response Theory to create a clinically useful measure of attachment

Abstract

Background: Insecure attachment in infancy is associated with a range of socioemotional problems later in life. It is important therefore to identify at-risk children so that appropriate support can be provided. However, the two most well-established measures of attachment, the Attachment Q-sort (AQS) and Strange Situation Procedure (SSP), are both time-consuming and costly to administer. The aim of this study is to create a valid, short version of the AQS using modern psychometric techniques. Method: Data was used from the NICHD Study of Child Care and Youth Development (NICHD SECCYD) (n=1,364). First, the factor structure of the AQS was explored using Q-factor analysis. Item response theory (IRT) was then used to create shortened scales containing the subset of items which provided the most information. The validity of the shortened scales was then examined. Results: Q-factor analysis indicated two clear factors relating to harmonious interaction with the caregiver and proximity-seeking behaviours. Two scales of eight items each were created based on these factors. The shortened measure showed comparable convergent, discriminant and predictive validity to the full AQS. Conclusion. This brief version of the AQS shows good potential as a screening measure for insecure attachment in infancy.

Introduction

Attachment theory describes the early bond between the child and caregiver in which the child seeks out the caregiver for safety and comfort in times of stress. Infants who display secure attachment show distress upon separation from the caregiver, approach the caregiver for contact upon reunion, and quickly return to play and exploring. By contrast, two patterns of insecure attachment have been identified (M. Ainsworth et al., 1978). Avoidant children show little distress on separation and actively avoid the caregiver on reunion, whilst resistant children show extreme distress on separation, but resist contact on reunion. A fourth category of attachment, disorganised, is evident when the infant displays incoherent attachment behaviour, such as approaching the caregiver whilst turning away (Mainz et al., 1990).

A growing body of research has highlighted the negative long-term correlates of insecure and disorganised attachment in childhood. These include later childhood externalising problems (Fearon et al., 2010), anxiety and depression (Groh et al., 2012), peer relationships (Groh et al., 2014) and adolescent self-harm behaviour (Wright et al., 2005). These studies reported minimal differences in effect size between the insecure categories, with the exception of externalising which showed a significantly greater association with disorganisation than with avoidant and resistant attachment.

The magnitude of these cross-time links should not be exaggerated, however, being small to moderate in magnitude rather than large. In any event, there is evidence that parenting interventions in childhood can improve the attachment relationship. Indeed, an early meta-analysis indicates that interventions focusing on improving parental sensitivity - the ability to be attuned to the baby's signals and respond appropriately - are effective at fostering security, especially in high-risk populations (Bakermans-Kranenburg et al., 2005). Subsequent research studies have has continued to document the efficacy of sensitivity-

based interventions, especially when combined with video-feedback to parents (Moss et al., 2011). Accordingly, it is important to be able to identify infants at risk of insecure attachment at an early age so that interventions can be offered on a targeted rather than universal basis (Allen, 2011).

At present there are two 'gold-standard' measures of attachment for infants and young children– the Strange Situation Procedure (SSP; M. Ainsworth et al., 1978; Main & Solomon, 1990) and the Attachment Q-Sort (AQS; Van IJzendoorn et al., 2004; Waters & Deane, 1985). The SSP is a laboratory procedure involving two brief periods of separations and reunion between the infant and their attachment figure. The purpose of these separations is to create a mildly stressful situation for the infant which activates the attachment system. On the basis of time-consuming, video coding of their behaviour in these periods the infant is classified as either Secure, Avoidant, Resistant or Disorganised.

By contrast, the AQS is a naturalistic observation of the interaction between the child and the primary caregiver in a routine situation, normally in the home. The AQS uses Q-sort methodology, originally developed in order to "systematically measure subjectivity" (Stephenson, 1953). Following observation of parent-child interaction, raters sort 90 cards describing child behaviour (e.g. "Child enjoys relaxing in mother's lap"; "Child keeps track of mother's location when he plays around the house) into nine piles ranging from 'most descriptive of this child' to 'least descriptive of this child'. Cards are sorted in a fixed normal distribution, with set numbers of cards allowed in each pile. A security score is then calculated by correlating the individual sort with a criterion sort created from an expert consensus on the behaviours of the prototypically securely attached child. Waters and Deane (1985, p. 52) contend that the items in the AQS cover "a broad range of secure base and exploratory behaviour [and] can be construed as an overview of the entire domain of attachment relevant behaviour" (Waters & Deane, 1985, p.52). Support for the utility of

the AQS has been provided by two meta-analyses which reveal good convergent, predictive and discriminant validity for the observer version of the measure (Cadman, *forthcoming;* Van IJzendoorn et al., 2004).

Despite the strengths of the SSP and AQS, in their current form neither are suitable for use in routine clinical settings, as both require considerable time and resources to administer. The SSP requires a laboratory setting, whilst in its present form the AQS requires a long observation period (i.e., a minimum of two hours), followed by a lengthy period of sorting items. A shorter measure, the Toddler Attachment Sort – 45 (TAS-45), was therefore developed from the original AQS using a novel analytic approach (Andreassen., 2007; Kirkland et al., 2004). First, a large number of individuals were asked to sort the original AQS items into groups based on their semantic similarity. Next, multidimensional scaling was used to model the relationship between the items based on these sorts. Eight clusters were identified (analogous to factors) which provided the best model of the latent structure of the data. The 39 items having the strongest association with these clusters were selected to form the TAS-45, along with six new items to assess disorganised attachment. Finally, the sorting procedure was changed, with the number of piles reduced from nine to five. Two studies provide initial support for the validity of the TAS-45 (Roisman & Fraley, 2008; Spieker et al., 2011).

Whilst the TAS-45 shows considerable promise, there are still outstanding issues to be addressed. First, it is unknown whether it shows convergent validity with the SSP, considered the "gold standard" when it comes to attachment assessment in the opening years of life. Second, despite some strengths, there are limitations with the methodology used to develop the measure. As described above, clusters of AQS items were identified based on their *perceived* semantic similarity. However, it is not known whether items which *appear* to be similar actually describe behaviours which statistically covary in infants. Indeed,

studies which have used empirical approaches to examine the factor structure of the AQS have reported between three and five dimensions, in contrast to the eight included in the TAS-45 (Bailey et al., 2007; Bailey et al., 1999; Howes & Smith, 1995; Pederson & Moran, 1995; Posado et al., 1995).

Perhaps the most promising alternative analytic approach to creating an abbreviated measurement tool was that employed by Bailey and colleagues who used q-factor analysis to explore the latent structure of the AQS. Because the q-sort procedure requires cards to be sorted in a forced normal distribution, conventional principal component analysis cannot be used because of violations of the assumption of independence of measurement. Q-factor overcomes this limitation. This method can be understood as 'inverted' traditional factor analysis with variables entered as subjects and subjects as variables (Brown, 1980; Kline, 2014). This allows the identification of clusters of subjects with similar response patterns - conceptually similar to a cluster or latent-class analysis. Crucially, because the q-sorts for each subject are independent from one another, q-factor analysis does not violate the assumption of independence. When applied to the AQS, Bailey et al. (1999) identified four factors: (i) 'Interacts Harmoniously with Mother', (ii) 'Prefers Visitors', (iii) 'Socially Withdrawn', and (iv) 'Demanding with Mother'. Importantly, the first three of these factors were successfully replicated in a subsequent study (Bailey et al., 2007).

The research presented herein builds on the work of Bailey and colleagues to develop a shortened version of the AQS with robust psychometric properties, and examine how it corresponds to the SSP – the putative gold standard measure of attachment. Predictive and discriminant validity will also be assessed, and the validity of the new measure will be compared to both the TAS-45 and the full AQS. The first task is to bring together and replicate previous psychometric work with the AQS to reliably identify its latent structure.

The second task concerns how to move from this identified structure to create a shortened measure. Using classical test theory, a standard approach would be to choose items with the highest loadings on the identified factors to form a new measure. However, classical test theory has a number of limitations; for example, it assumes that all questions on a test measure the underlying construct with equal precision across the trait range, an assumption which may not be born out (Fraley et al., 2000).

Increasingly, Item Response Theory (IRT) is being used in the behavioural sciences , including in the development of attachment measures (Fraley et al., 2000), to circumvent this problem. IRT is a statistical approach for modelling the relationship between a latent trait (designated by the Greek letter theta, θ) and responses on test or survey items (Reise & Waller, 2009). The principles of IRT are most clearly illustrated by considering dichotomous response items, before polytomous ones. The underlying principle of IRT is that the probability of a person answering correctly on a test item will be influenced both by characteristics of the person and characteristics of the item (Furr & Bacharach, 2013). Different IRT models specify different item and person parameters.

The widely used two parameter logistic model (2PLM; Birnbaum, 1968) specifies the probability of an individual correctly endorsing an item as a function of one person parameter (trait level, (θ)) and two item parameters (item difficulty (β), and item discrimination (α)) in the following equation:

$$P_j\theta_i = \frac{1}{1 + \exp\left(\alpha_j\left(\theta_i - \beta_j\right)\right)}$$

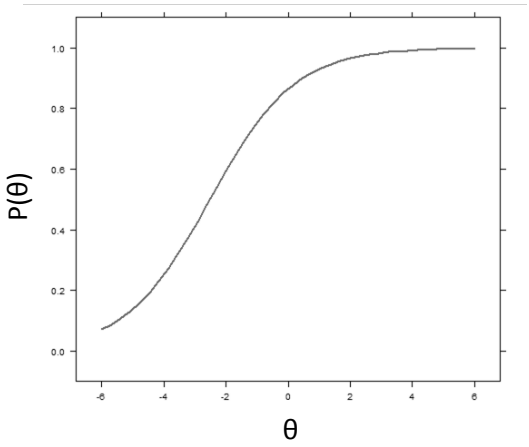
Item difficulty (β) refers to the level of the latent trait required to have a 50 per cent chance of getting the question correct. To illustrate this concept consider a maths exam. Some questions will have very low difficulty (e.g. “4+12”) and would require only a low-level of the underlying trait (e.g., intelligence) to have at least a 50 per cent probability of a correct

answer. By contrast, items with a much higher difficulty (e.g. 13 x 23) would require higher levels of intelligence for an examinee to have the same probability of a correct answer. The term 'difficulty' is used because IRT was primarily developed for educational measurement. However, the concept still applies to psychological constructs. To take the example of depression, a person would only need a low level of the trait (depression) to endorse the question "do you ever feel a bit low", whilst they would need a much higher level to endorse the question "Have you ever made plans to end your life?".

Item discrimination (α) refers to how well items discriminate between individuals with similar trait levels and is related to the factor loading of the item in classical test theory (Reise et al., 2005). Importantly, item discrimination and difficulty are related: items will discriminate most effectively between individuals with similar trait levels at the region of θ corresponding to the item's difficulty (Fraley et al., 2000). For example, a very difficult item will only discriminate effectively between individuals with a high-level of the trait as all individuals at the lower end will very likely get it wrong; for example, a question on calculus would be useless in testing the maths skills of six-year-olds. Item discrimination typically ranges from 0-2 (Hambleton, 1991).

The relationship between the underlying trait, item difficulty and discrimination and the probability of a correct answer is displayed using an *item characteristic curve* (*ICC)* (Hambleton, 1991). Figure 1 shows a hypothetical ICC for a test item. This illustrates that the probability of a correct response on the item increases as the level of the underlying trait increases. Item difficulty is represented by the point of inflection of the ICC. Easy items are represented by curves to the left (lower) end of the trait range whilst more difficult items are represented by curves to the right. Discrimination is represented by the slope of ICC at the point of β. Items with steeper slopes are more effective at discriminating between individuals whilst those with shallower slopes are less effective (Fraley et al., 2000).

Figure 1: Item Characteristic Curve



IRT allows one to estimate the difficulty and discrimination values of each item in a test, and from this the measurement precision of the whole test. This offers a key advantage over classical test theory in the development of psychometric measures, as it allows one to customise measures for different intended functions (Fraley et al., 2000; Hambleton, 1991). For example, if one were developing a broad-range ability test one would select questions which discriminate equally well across the trait range. By contrast, if the aim is to develop a measure to identify people below a certain trait cut-off, items can be selected which discriminate most effectively at the required trait level. For example, if one is developing a depression screening questionnaire questions can be selected which provide a high precision in separating very depressed people from moderately depressed people; the measure need not contain any questions which are effective at discriminating between individuals who are not very depressed or not at all depressed. For the purposes of this project whose goal is to distinguish insecure from secure infants, IRT therefore presents an opportunity to construct a brief measure of attachment which will maximise measurement precision at the lower end of the trait.

To summarise, the present study has three main aims. First, Q-factor analysis will be used to identify the factor structure of the AQS, and this will be compared to previous findings. Second, IRT will be used to create a shortened version of the AQS based on the

identified factor structure. Finally, the validity of this shortened measure will be compared to both the full version of the AQS and the TAS-45. Convergent validity will be assessed by exploring the association with the Strange Situation Procedure. Predictive validity will be assessed by examining the associations with maternal sensitivity and socio-emotional development (measures of peer competence and behavioural problems) both of which are conceptually and empirically related to attachment (Belsky & Fearon, 2008; Fearon et al., 2010; Schneider et al., 2001; Wolff & Ijzendoorn, 1997). Discriminant validity will be assessed by examining associations with infant temperament, which should only be weakly related to attachment (Vaughn et al., 2008).[1]

Method

Sample

The National Institute of Child Health and Development Study of Early Child Care and Youth Development (NICHD SECCYD) recruited 1,364 families shortly after the birth of a child at 10 university-based locations in the US (for a detailed description of the study methodology see NICHD Early Child Care Research Network, 1997). Initially 8,986 women giving birth were screened for eligibility; of these 1,364 completed a home interview when the child was one month old and became study participants. Analysis was based on the 1,197 participants for whom there was complete AQS data at age 24 months. In terms of demographic characteristics, 26 per cent of the mothers had no more than high school education at enrolment and 22 per cent were from ethnic minority backgrounds.

Measures

[1] Further justification of the use of these constructs in assessing the validity of the AQS is provided in the meta-analysis which forms part of this thesis.

Attachment Q-Set (AQS). The AQS was completed by trained raters at 24 months. The AQS consists of 90 cards with statements about child behaviour (e.g. "Child enjoys relaxing in mother's lap"). Raters observed the child interacting with their mother in the home for a period of two hours during activities such as bathing, changing and feeding. Immediately after this observation period raters sorted the cards into nine piles, ranging from 'most describes this child' to 'least describes this child'. The cards are sorted in a forced normal distribution, with the following amount of cards required in each pile: 4, 6, 10, 15, 20, 15, 10, 6, 4. An overall security score, ranging from -1 to 1 is calculated by correlating the individual sort with an expert criterion sort (Waters, 1987). Inter-rater reliability was on average 0.73 across all sites.

Previous studies have derived subscales from the full AQS either by identifying items which appear conceptually similar (Howes & Ritchie, 1999; Pederson & Moran, 1995) or by using dimension reduction techniques (Posado et al., 1995; Appendix B). Scores for these subscales are calculated by summing the scores for individual items (i.e. the number of the pile in which the item is placed), reverse-scoring where necessary.

Strange Situation Procedure (SSP). The Strange Situation Procedure (M. Ainsworth et al., 1978) was completed at 15 and 36 months. The SSP is a laboratory procedure consisting of two episodes of separation and reunion between the infant and the primary caregiver. At the start of the procedure the infant and mother are together in a room. They are then joined by a stranger who converses with the mother. For the first period of separation, the mother leaves the room whilst the stranger remains with the infant. The mother then returns and spends time alone with their infant, before leaving again. After a short period the stranger returns and spends time with the infant. Finally, the mother returns and the stranger leaves. At 36 months the procedure was slightly modified: the role of the stranger was eliminated and the second separation was increased from three to five

minutes (Cassidy et al., 1992). Infants' behaviour during the reunion episodes are rated on four scales: (i) proximity and contact seeking, (ii) contact maintenance, (iii) resistance, and (iv) avoidance. On the basis of their behaviours in the procedure children are classified into one of four categories: *Secure (B), Avoidant (A), Resistant, (C) or Disorganised (D).* (M. Ainsworth et al.; Main & Solomon, 1990) Children who could not be categorised into any of these categories were placed in a fifth category, *Unclassifiable (U).* Videotapes of the SSP were coded by independently by two trained raters and Inter-rater reliability was 83% (k=0.67) (NICHD Early Child Care Research Network, 1997). The following analysis excluded infants who were unclassifiable.

Maternal Sensitivity. Maternal behaviours was assessed at 24 months using videotaped mother-child interactions during the completion of interactive tasks. Tasks included working together to draw a picture of a house and a tree using an Etch-A-Sketch (with each person controlling one knob), a patterned-block activity using coloured blocks to fill in geometric frames, and a card game. All videotapes were coded at a location separate from that used to code the SSP tapes. The tapes were coded by teams of trained coders who were blind to information on the family. Information on the training and coding procedures can be found at http://secc.rti.org/.

Maternal behaviour was coded on four-point Likert scales measuring Supportive Presence, Respect for Autonomy and Hostility (reverse-scored). A composite maternal sensitivity score was calculated by summing the three scales, with a possible range of 0-12. Inter-coder reliability (calculated as the intra-class correlation coefficient) was 0.85, whilst Chronbach's alpha was 0.74.

Child Externalising Behaviour. The externalising subscale of the Child Behaviour Checklist (CBCL) was completed by parents at 24 months. The CBCL a 100 item questionnaire measuring a variety of child behaviours (Achenbach, 1991). Parents rate on a three-point

Likert scale (ranging from 0=”not true” to 2=”very true”) the extent to which descriptions of behaviour describe their child. The measure generates two subscales: Internalising Problems (e.g., ‘too fearful and anxious’) and Externalising Problems (e.g., ‘hits others’, ‘disobedient at school’, ‘argues a lot’). Achenbach reports test–retest reliability of .89 and inter-parent agreement of .70.

Social competence. Social competence was rated by teachers at 54 months using the Social Skills Rating System (SSRS; (Gresham & Elliott, 1990). The SSRS contains 30 questions rated on a three-point Likert scale (ranging from 0 “Not true to 2 “Often true”). The SSRS contains three subscales: Cooperation, Assertion and Self-control. A standardised score is calculated using included age and gender norms.

Temperament. The Early Infant Temperament questionnaire (EIT) was completed by mothers at six months (Medoff-Cooper et al., 1993). The EIT is a 76 item measure assessing child behaviours on a six-point Likert scale (ranging from “almost never” to “almost always”). It assesses temperament on 11 dimensions: activity, rhythmicity, approach/withdrawal, adaptability, intensity, mood, persistence, distractibility and threshold. A total score of temperamental difficulty is calculated by summing the scores on the individual questions.

Data Analysis

Q-factor analysis. Q-factor analysis was used to identify the latent structure of the AQS. As described above Q-factor analysis identifies latent variables based on the correlations between subjects, rather than between variables. Q-factor analysis was conducted using principle component analysis (PCA) with varimax rotation. The number of factors was chosen based on scree plot analysis.

Following factor extraction, the next stage of analysis was to identify items on the AQS which are most and least descriptive of individuals who load strongly on each factor. This enables one to identify the conceptual theme described by each factor (Bailey et al., 1999). To do this, a weighted aggregate sort for each factor is calculated using the sorts of participants loading highly on each factor. First, participants with a factor loading >0.4 or <-0.4 are identified to represent each factor. Next, for these selected participants (which will differ for each factor) a *factor weight* is calculated using the following equation, where *f* is the participant's factor loading (Brown, 1980):

$$w = \frac{f}{1 - f^2}$$

This function serves to assign a proportionally higher weight to participants loading more highly on a factor (Schmolck, 2014). Next, for representatives of each factor the position of each of the 90 items in the sort is multiplied by their factor weight. The score for each item is then averaged across all participants representing that factor, yielding for each factor the average position of each item weighted in proportion to how strongly each participant loads on the factor. The items are then ranked, and the 10 items with the highest and lowest scores are selected to illustrate the behaviours most and least typical of infants representative of each factor.

In contrast to traditional ('R') factor analysis, it is not advantageous to use a large number of participants for q-factor analysis. An important principle behind R-factor analysis is that the standard error of factor loadings decreases in proportion to sample size, meaning that larger samples yield more stable solutions (MacCallum et al., 1999). However, as q-factor analysis inverts variables and participants, analysis conducted with a much greater number of subjects than variables would theoretically yield unstable solutions. With large datasets of q-sorts this problem can be overcome by deriving the factor structure from a subset of participants (Schmolck, personal communication). However, there is little

consensus on the ideal sample size to use for q-factor analysis (Kampen & Tamás, 2013). Whilst authors have suggested that samples of 40 are sufficient (Brown, 1980; Watts & Stenner, 2005), this has not been supported by empirical analysis. In the present study, preliminary Monte Carlo simulations showed that using a sample size of 40 did not produce reliable factor solutions (Appendix A). In the absence of empirical research to inform this decision, a sample size of 200 was chosen to balance concerns about high standard error of factor loadings with the preliminary analysis showing poor replicability of results at low sample sizes.

Reliability of factor structure. The next stage of analysis was to assess the reliability of the derived factor structure by comparing it to that reported in previous studies. First, the items most and least descriptive of the identified factors were compared qualitatively to those identified by Bailey and colleagues (Bailey et al., 2007; Bailey et al., 1999). In addition, correlations were calculated between participants' factor loadings and the 14 previously identified subscales (Howes & Ritchie, 1999; Pederson & Moran, 1995; Posado et al., 1995; Appendix B) .

Item response theory. For the remainder of the analysis the entire dataset was randomly split in two, with the first half (n=597) used for the IRT analysis and the second half (n=599) used to assess the validity of the new measure.

Initial pools of items from the full AQS were identified on the basis of the identified factor structure. To maximise reliability, items from subscales identified by other researchers were also included in the relevant pools if they correlated highly with participants' factor scores ($r \geq \pm 0.5$). Item parameters were estimated using Samajima's Graded Response Model (GRM; Samejima, 1969), an extension of the 2PML model to items with more than two response categories. It allows one to estimate the probability of

endorsing a particular response option *or higher* (Hambleton, 1991). The probability of a participant *P* with a trait level θ endorsing category *x* or higher on item *I* is given by the equation:

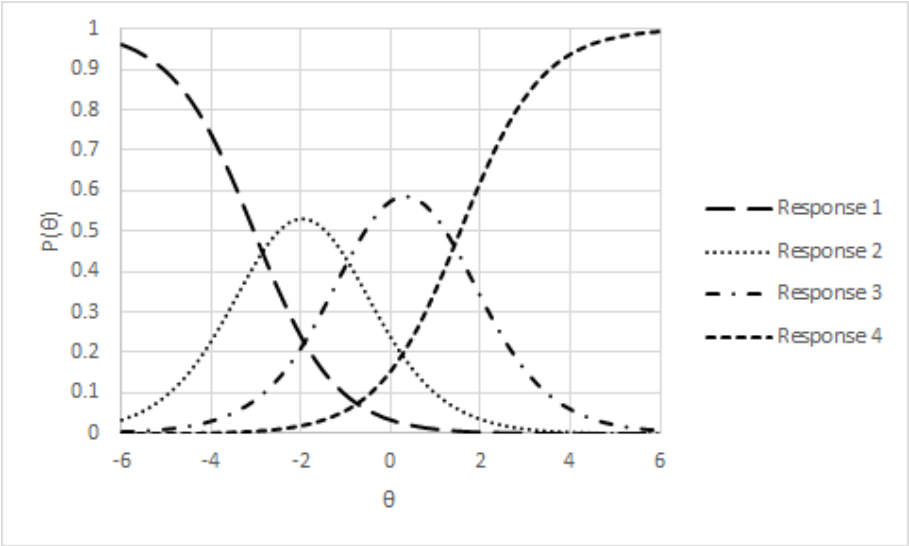
$$P_{ix}(\theta) = \frac{\exp\big(DA_i(\theta - b_{ix})\big)}{1 + \exp(DA_i(\theta - b_{ik}))}$$

Where *b* refers to the difficulty level of each response category. For a measure with *m* response options, each item is conceptualised as a series of *m*-1 response dichotomies (Fraley et al., 2000). For example, the nine-item AQS would be conceptualised as eight dichotomous response options (response 1 vs 2-9, responses 1 & 2 vs 3-9 etc). Thus whilst for the 2PLM model one ICC is calculated per item, for the AQS eight ICCs would be calculated for each item. These in turn can be used to compute *Category response curves* (Fraley et al., 2000) which represent the probability of endorsing an exact response option using the following equation:

$$P_{xi}(\theta) = P_{xi}(\theta) - P_{xi+1}\theta$$

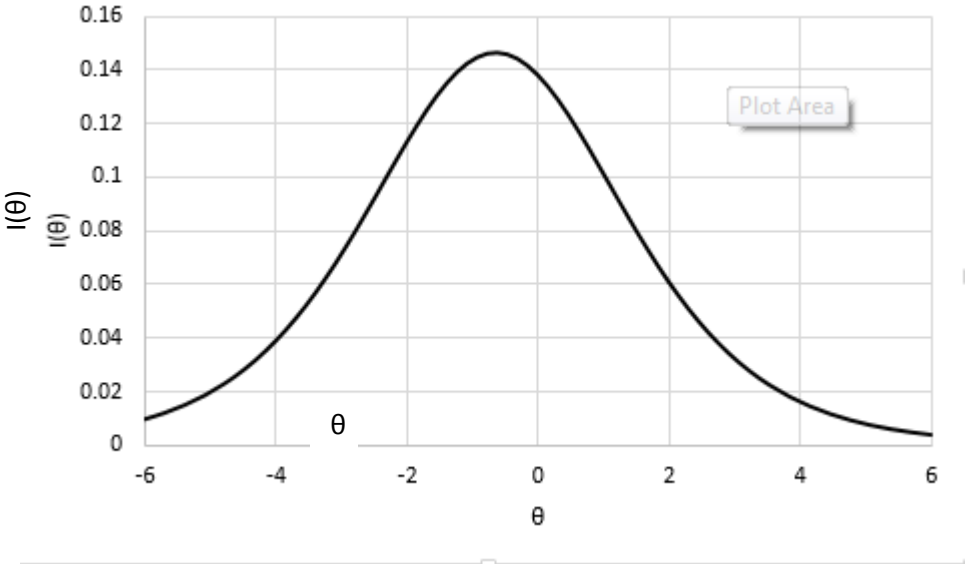
Figure 2 shows hypothetical category response curves for an item with four response options. It shows that the probability of endorsing the first response option decreases to almost zero as the level of the underlying trait increases. The probability of choosing responses two and three peak at trait levels of approximately -2 and 0. The probability of endorsing the final response option, four, is almost zero at low levels of the trait but increases to almost 1 at high levels.

Figure 2: Hypothetical Category Response Curves



Item Characteristic Curves can be transformed into *Item Information Curves* (IIC, Figure 3) and *test information curves* (TIC) which depict the measurement precision of the individual items and test across the trait range (Hambleton, 1991). Items for the shortened measure were selected on the basis of their discrimination and difficulty, with preference given to items which discriminate most effectively at the low end of the trait range.

Figure 3: Item Information Curve



Validity of shortened measure. The second half of the dataset (n=599) was then used to explore the validity of the shortened scale in comparison to the full AQS and the TAS-45. Whilst the TAS-45 was designed as a separate measure, its subscales can be

approximated by summing the AQS items from which each domain was derived. Unfortunately it was not possible to include all items as some were derived from the original 100-item version of the AQS. One way ANOVAs were calculated for the SSP at 15 and 36 months and bivariate correlations with measures of sensitivity, externalising behaviours, social competence and temperament.

Q-factor analysis was conducted using PQMethod 2.35 (Schmolck, 2014), IRT was conducted using R-Studio 3.03 (R Studio, 2015) and all other analyses were conducted using SPSS version 22 (IBM Corp, 2013). Missing data was handled using pairwise deletion.

Results

Latent structure of AQS

Q-Factor analysis of the AQS revealed four factors, explaining in total 45% of the variance. There was a large correlation between factors 1 and 3 (r=0.66), a moderate correlation between factors 1 and 2 (r=0.45), and small correlations between all other factors (r=0.22-0.39; all p-values <0.001).

Factor 1, labelled 'Harmonious Interaction', accounted for 19% of the variance with 95 subjects (48%) loading on this factor, including one who loaded negatively. Items most descriptive of children loading on this factor indicate that the child is generally happy and obedient, whilst items least descriptive of children loading on this factor describe children who are often angry and upset (Table 1). This factor shows considerable similarity to the first factor described by Bailey et al. (1999), labelled "interacts harmoniously with mother" The weighted average sort derived from this factor correlated highly with the AQS security criterion sort (r=0.68).

Table 1: items most and least descriptive of Factor 1 ('Harmonious Interaction')

Most descriptive

9. Child is light-hearted and playful most of the time.

48. Child readily lets new adults hold or share things he has, if they ask to.

18. Child follows mother's suggestions readily, even when they are clearly suggestions rather than orders.

77. When mother asks child to do something, he readily understands what she wants (May or may not obey).

1. Child readily shares with mother or lets her hold things if she asks to.

15. Child is willing to talk to new people, show them toys, or show them what he can do, if mother asks him to.

89. Child's facial expressions are strong and clear when he is playing with something.

62. When child is in a happy mood, he is likely to stay that way all day.

41. When mother says to follow her, child does so.

5. Child is more interested in people than in things.

Least descriptive

75. At home, child gets upset or cries when mother walks out of the room (May or may not follow her).

79. Child easily becomes angry at mother.

54. Child acts like he expects mother to interfere with his activities when Morn is simply trying to help him with something.

58. Child largely ignores adults who visit the home Finds his own activities more interesting.

65. Child is easily upset when mother makes him change from one activity to another (even if the new activity is something child often enjoys).

30. Child easily becomes angry with toys.

38. Child is demanding and impatient with mother. Fusses and persists unless Mom does what he wants right away.

63. Even before trying things himself, child tries to get someone to help him.

6. When child is near mother and sees something he wants to play with, he fusses or tries to drag mother over to it

31. Child wants to be the center of mother's attention. If mom is busy or talking to someone, he interrupts.

Factor 2, labelled "Proximity-seeking", accounted for 10% of the variance with 42 subjects (21%) loading on this factor, including three who loaded negatively. Items most descriptive of children loading on this factor indicate children who maintain close proximity to their caregiver, enjoy physical contact with them and prefer them to strangers. Items least descriptive indicate children who are independent, like exploring, but who also can become upset easily (Table 2). This factor also showed considerable similarity to the second factor reported by Bailey et al. (1999), labelled "prefers visitors". There was a large correlation

between the weighted aggregate sort for this factor and the AQS security criterion sort (r= 0.60).

Table 2: items most and least descriptive of Factor 2 ('Proximity-seeking')

Most descriptive
11. Child often hugs or cuddles against mother, without being asked or invited to do so.
44. Child asks for and enjoys having mother hold, hug and cuddle him.
28. Child enjoys relaxing in mother's lap.
43. Child stays closer to mother or returns to her more often than the simple task of keeping track of her requires.
1. Child readily shares with mother or lets her hold things if she asks to.
18. Child follows mother's suggestions readily, even when they are clearly suggestions rather than orders.
21. Child keeps track of mother's location when he plays around the house.
50. Child's initial reaction when people visit the home is to ignore or avoid them, even if he eventually warms up to them.
64. Child enjoys climbing all over mother when they play.
53. Child puts his arms around mother or puts his hand on her shoulder when she picks him up.
Least descriptive
35. Child is independent with mother. Prefers to play on his own; leaves mother easily when he wants to play.
54. Child acts like he expects mother to interfere with his activities when she is simply trying to help him with something.
67. When the family has visitors, child wants them to pay a lot of attention to him.
30. Child becomes easily angry with toys
7. Child laughs and smiles easily with a lot of different people.
65. Child is easily upset when mother makes him change from one activity to another.
66. Child easily grows fond of adults who visit his home and are friendly to him
52. Child has trouble handling small objects or putting small things together.
79. Child easily becomes angry at mother.
12. Child quickly gets used to people or things that initially made him shy or frightened him.

Factor 3, labelled "Sociable", accounted for 10 percent of the variance, with 39 subjects (20%) loading on this factor. No subjects had a negative loading. The most descriptive items described children who were even tempered and sociable, whilst the least descriptive items described children who were more social withdrawn (Table 3). This showed considerable

similarity to the third factor described by Bailey et al. (1999) labelled “Socially Withdrawn”, though appeared inverted in our analysis. The weighted aggregate sort derived from this factor also had a medium correlation with the AQS security criterion sort (r=0.40).

Table 3: items most and least descriptive of Factor 3 (‘Sociable’)

Most Descriptive
37. Child is very active. Always moving around. Prefers active games to quiet ones.
5. Child is more interested in people than in things.
67. When the family has visitors, child wants them to pay a lot of attention to him
44. Child asks for and enjoys having mother hold, hug, and cuddle him.
48. Child readily lets new adults hold or share things he has, if they ask to.
11. Child often hugs or cuddles against mother, without her asking or inviting him to do so.
28. Child enjoys relaxing in mother’s lap.
77. When mother asks child to do something, he readily understands what she wants (May or may not obey.)
85. Child is strongly attracted to new activities and new toys.
15. Child is willing to talk to new people, show them toys,
Least Descriptive
58. Child largely ignores adults who visit the home. Finds his own activities more interesting.
50. Child's initial reaction when people visit the home is to ignore or avoid them even if he eventually warms up to them.
76. When given a choice, child would rather play with toys than with adults.
75. At home, child gets upset or cries when mother walks out of the room. (May or may not follow her.)
63. Even before trying things himself, child tries to get someone to help him.
82. Child spends most of his play time with just a few favorite toys or activities.
04. Child is careful and gentle with toys and pets.
39. Child is often serious and businesslike when playing away from mother or alone with his toys.
32. When mother says "No" or punishes him, child stops misbehaving (at least at that time). Doesn’t have to be told twice.
65. Child is easily upset when mother makes him change from one activity to another

The final factor accounted for 6 percent of the variance, with 27 subjects (14%) loading on this factor. No subjects had a negative loading. However, the items most and least descriptive of children loading on this factor failed to display any particular coherence, so no label was given to it (Table 4).

Table 4: items most and least descriptive of Factor 4

Most descriptive
81. Child cries as a way of getting mother to do what he wants.
68. On the average, child is a more active type person than mother.
77. When mother asks child to do something, he readily understands what she wants (May or may not obey)
38. Child is demanding and impatient with mother. Fusses and persists unless Morn does what he wants right away-.
74. When mother doesn't do what child wants right away, child behaves as if Mom were not going to do it at all.
85. Child is strongly attracted to new activities and new toys.
50. Child's initial reaction when people visit the home is to ignore or avoid them, even if he eventually warms up to them.
37. Child is very active. Always moving around. Prefers active games to quiet ones.
89. Child's facial expressions are strong and clear when he is playing with something.
27. Child laughs when mother teases him
Least descriptive
75. At home, child gets upset or cries when mother walks out of the room. (May or may not follow her.)
66. Child easily grows fond of adults who visit his home and are friendly to him.
11. Child often hugs or cuddles against mother, without her asking or inviting him to do so.
67. When the family has visitors, child wants them to pay a lot of attention to him.
63. Even before trying things himself, child tries to get someone to help him.
16. Child prefers toys that are modeled after living things (e.g., dolls, stuffed animals).
32. When mother says "No" or punishes him, child stops misbehaving (at least at that time). Doesn't have to be told twice.
52. Child has trouble handling small objects or putting small things together
56. Child becomes shy or loses interest when an activity looks like it might be difficult.
24. When mother speaks firmly or raises her voice at him, child becomes upset, sorry, or ashamed about displeasing her.

To further assess the reliability of these factors, correlations were calculated between participants' factor scores and their scores on subscales previously defined by other investigators (Table 5). Participant loadings on the Harmonious Interaction factor correlated highly with subscales related to cooperation and difficult interactions, whilst loadings on the Proximity-Seeking factor correlated highly with subscales describing a preference for proximity to and physical contact with their mother. The convergence of factor scores for

these conceptually related subscales adds further support to the reliability of these two factors. However, loadings on both the third and fourth factors showed moderate correlations with a number of different subscales suggesting they may capture a less distinct group of child behaviours.

Table 5: Correlations between factor loadings and previously defined subscales (n=200)

Subscale	Harmonious Interaction	Proximity seeking	Sociable	Factor 4
Howes and Smith (1995)				
Secure base	.10	.36**	-.10	-.13
Avoid	.01	**-.50****	-.37**	.47**
Seek comfort	-.10	**.66****	.24**	**-.50****
Positive negotiate	**.56****	.24**	-.32**	-.28**
Difficult negotiate	**-.71****	-.28**	.30**	**.56****
Pederson and Moran (1995)				
Secure base	.41**	.17*	.08	-.25**
Affective sharing	.00	.17*	.03	-.03
Enjoyment of physical contact	-.14	**.66****	.27**	-.49**
Compliance	**.60****	.28**	-.33**	-.27**
Fussy/Difficult	**-.84****	-.13	.22**	**.51****
Posado et al. (1995)				
Smooth interactions with mother	**.82****	.25**	-.32**	**-.49****
Proximity to mother	-.15*	**.73****	.16*	-.37**
Physical contact with mother	-.05	**.64****	.18**	-.47**
Interactions with other adults	**.61****	**-.56****	**.60****	**-.57****

Significant at *p<0.05, **p<0.01, ***p<0.001

Correlations >0.5 marked in bold

Item response analysis

Item pool. Out of the four identified factors, the first two showed clear conceptual coherence and convergence with previous psychometric work on the AQS. Whilst results also indicated a third factor, this contained significant overlap with the first factor both in terms of correlation between factor scores and the items most and least descriptive of individuals loading highly on that factor. Therefore and in order to produce a shortened measure with distinct subscales, it was decided to conduct IRT on pools of items relating to

the first two factors only. The first pool consisted of the ten items most and least descriptive of the Harmonious Interaction factor identified in the above analysis and in the two studies by Bailey and colleagues (Bailey et al., 2007; Bailey et al., 1999), and the items from the Smooth Interaction, Compliant and Fussy/difficult (reverse scored) subscales. The second pool consisted of the ten items most and least descriptive of the Proximity-seeking factor identified above and in the Bailey studies, and the items from the Enjoys Physical Contact, Proximity to Mother and Physical Contact with Mother subscales (Pederson & Moran, 1995; Posado et al., 1995). Four items were removed from the first pool and three from the second because they contained unused response categories. Items duplicated between scales were also removed, leaving pools of 37 and 40 items respectively.

Model assumptions. The key assumption underlying IRT is unidimensionality (i.e., that there is one dominant factor measured by the test items). The conventional way to test this is to conduct a principle component analysis (PCA) and examine the scree-plot for evidence of a dominant first factor (Hambleton, 1991). Separate PCAs were therefore performed on the two pools of items. Whilst analysis of the scree plot for the first pool showed a relatively clear first factor (Eigenvalues for factors 1 and 2 = 6.4 and 3.0, respectively), examination of the factor map appeared to show a distinct second factor. Five items with a loading of >0.4 on the second factor and three with a loading <0.1 on the first factor were therefore removed, leaving 29 items in the first pool. The PCA was repeated resulting in Eigenvalues of 6.3 and 2.0 for the first two factors (Figure 4).

Initial results for the second pool of items showed a less dominant first factor (Eigenvalues for factors 1 and 2 = 5.2 and 3.2, respectively). Ten items were removed which loaded >0.4 on the first factor and three which loaded <0.1 on the second factor, leaving a pool of 27 items. The PCA was redone resulting in Eigenvalues of 5.1 and 2.0 for the first two

factors. Analysis of scree plot suggested a more dominant first factor (Figure 5). Whilst there was still evidence of a small second factor, there is reason to believe that IRT models may be robust to small violations of unidimensionality, especially with sufficient test length (>20) and sample size (>250) (De Ayala, 2009; Kirisci et al., 2001). As these conditions were met in the present study, it was decided to continue the analysis including the second pool of items.

Figure 4: Scree plot for first pool of items

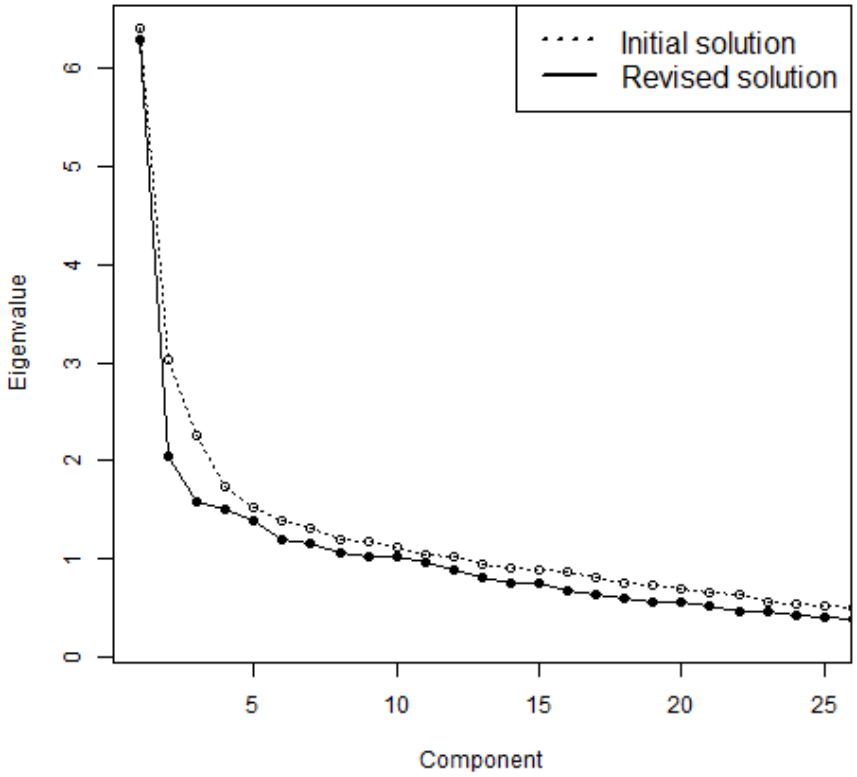
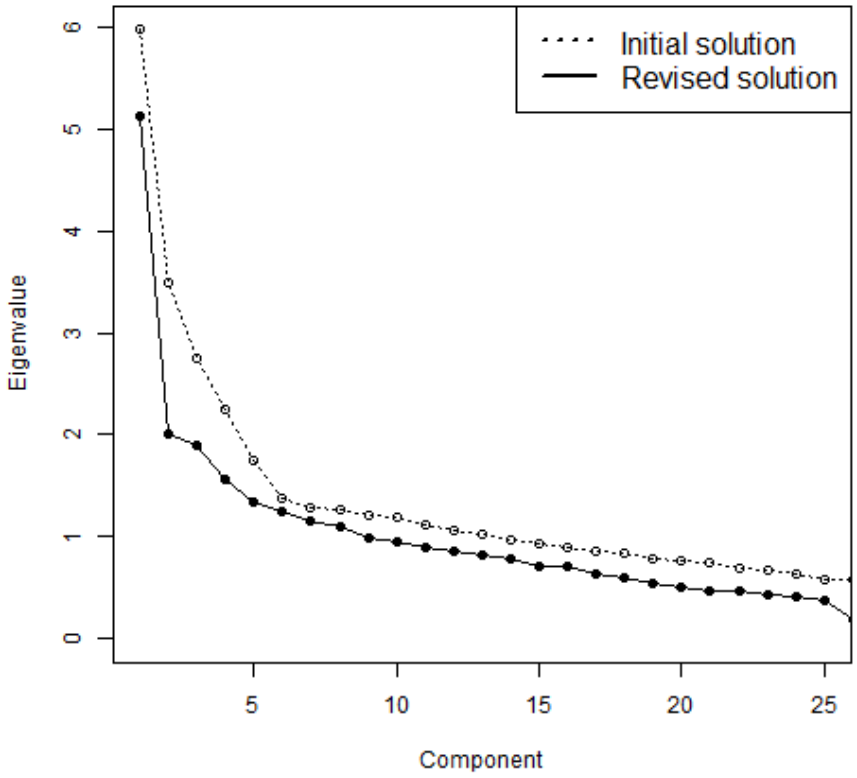


Figure 5: Scree plot for second pool of items



Model fit. Model fit was assessed both statistically and through examination of item residual plots (Hambleton & Swaminathan, 1985). Residual plots graphically predict discrepancies between observed responses and those predicted by the model. They were constructed using the method outlined in Hambleton (1991) and DeMars (2010). First, participants were placed into rank order based on their estimated θ value and split into 10 equal groups. For each item the mean response category for each θ group was then plotted against the predicted mean values (i.e., the item response function). Item misfit is indicated by deviations between the observed and expected values. Item fit was also assessed using the S-X^2 statistic, which has shown promising performance with polytomous IRT models (Kang & Chen, 2011; Orlando & Thissen, 2000). However, like most goodness of fit statistics it is susceptible to sample size and was therefore only interpreted in conjunction with graphical depictions of item fit (Hambleton & Swaminathan, 1985). Residual plots and S-X^2

statistics were inspected for each item in both pools; no items from either pool showed signs of significant misfit.

Construction of the Brief Attachment Scale. To create the shortened measure (named the "Brief Attachment Scale") category response curves and item information curves were examined in conjuncture with the difficulty and discrimination values for each item. Analysis of both pools showed that items differed markedly in terms of their discrimination, with α values varying from 0.04 to 2.64. However there were minimal differences in item difficulty with items discriminating evenly across the trait range. Items were therefore selected on the basis of discrimination values alone. To help determine how many items to include, items were first ranked by their discrimination values and a cumulative total was calculated. This was then plotted to graphically depict the relative increase in information as more items are included (Figure 6). As such plotting showed no clear points of inflection it was decided (albeit arbitrarily) to construct a 16 item measure containing two eight-item scales (BAS-16; Table 6). Analysis of the BAS-16 showed that whilst the Proximity-seeking scale contained slightly more information towards the middle of the trait range, the Harmonious Information scale discriminated more effectively over a wider trait range (Figure 7).

Figure 6: Cumulative discrimination values for each factor

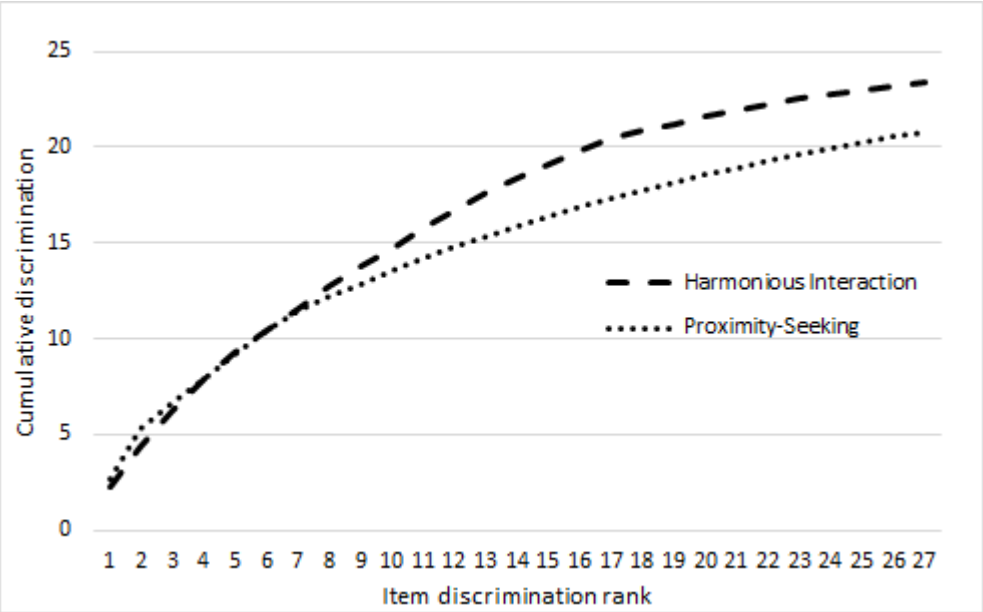
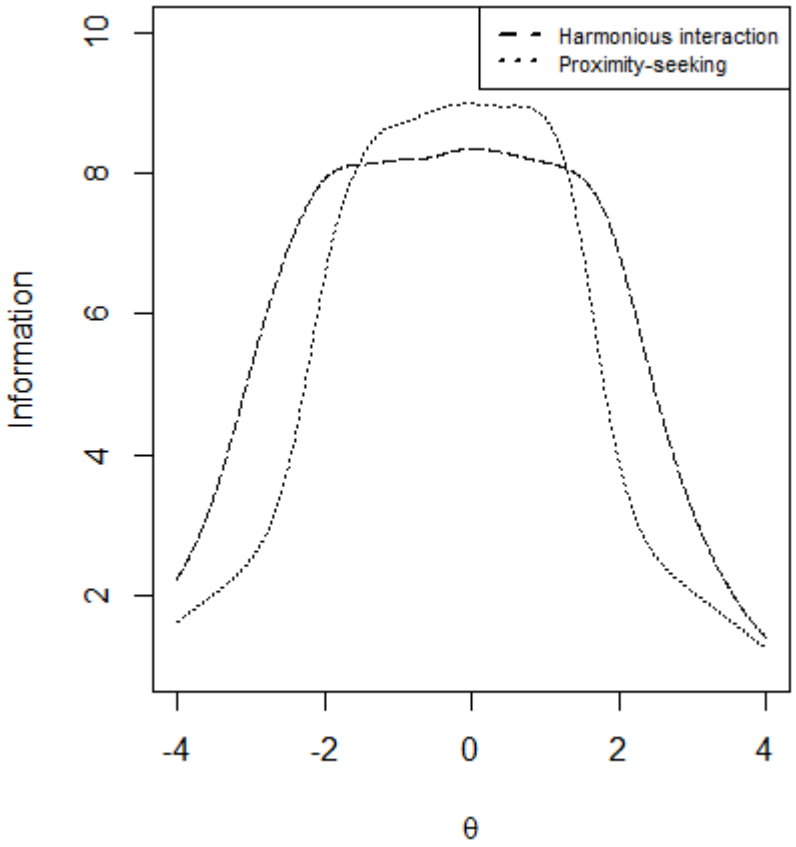


Table 6: Items comprising the BAS-16

AQS item	**α**
Harmonious Interaction	
*74. When mother doesn't do what child wants right away, child behaves as if mom were not going to do it at all.	2.26
*38. Child is demanding and impatient with mother. Fusses and persists unless she does what he wants right away.	2.05
*79. Child easily becomes angry at mother.	1.92
*81. Child cries as a way of getting mother to do what he wants.	1.64
62. When child is in a happy mood, he is likely to stay that way all day.	1.36
18. Child follows mother's suggestions readily, even when they are clearly suggestions rather than orders.	1.22
32. When mother says "No" or punishes him, child stops misbehaving (at least at that time). Doesn't have to be told twice.	1.13
19. When mother tells child to bring or give her something, he obeys.	1.11
Proximity-seeking	
*35. Child is independent with mother. Prefers to play on his own; leaves mother easily when he wants to play.	2.68
43. Child stays closer to mother or returns to her more often than the simple task of keeping track of her requires.	2.64
*59. When child finishes with an activity or toy, he generally finds something else to do without returning to mother between activities.	1.33
11. Child often hugs or cuddles against mother, without her asking or inviting him to do so.	1.27
90. If mother moves very far, child follows along and continues his play in the area she has moved to.	1.25
44. Child asks for and enjoys having mother hold, hug, and cuddle him.	1.21
21. Child keeps track of mother's location when he plays around the house.	1.04
*57. Child is fearless.	0.74

***Reverse scored**

Figure 7: Test information function for BAS-16



Validity of Brief Attachment Scale

Correlations with full AQS and TAS-45. The next stage of analysis was to evaluate the validity of the new scales in the second half of the dataset not used for conducting the psychometric analyses just detailed (n=599). Scores for the Harmonious Interaction and Proximity-seeking scales were calculated by summing scores on the individual items, reverse scoring where necessary. Total scores for the BAS-16 were calculated by summing the two subscale scores.

First, we examined how the new scales related to the full AQS by regressing the 90-item security score on the shortened scales. As expected, the BAS-16 correlated significantly, substantially and positively with the overall security score. The two scales of the BAS-16 collectively accounted for 67% of the variance in the overall security score (Table 7). We also

examined how the items comprising the new scales were placed in the original criterion sort, and found that five of the items from the Harmonious Interaction scale and two from the Proximity-seeking scale were placed in either the top or bottom two piles in the criterion sort.

Table 7: Relationship between subscales and overall security score

Independent variable	Beta	R^2
BAS-16		
Harmonious interaction	0.72***	0.67
Proximity seeking	0.36***	

Significant at ***p<0.001

We also examined the relationship between the new measures and scales derived from the TAS-45 items. Bivariate correlations showed that Harmonious Interaction scale correlated highly and in the anticipated direction with the Cooperative and Demanding/Angry scales from the TAS-45, whilst the Proximity scale correlated highly and positively with the Warm, Cuddly and Independent subscales (Table 8).

Table 8: Correlations between Harmonious interaction, Proximity-seeking and TAS-45

	BAS-16	
	Harmonious Interaction	Proximity - Seeking
TAS-45		
S: Warm, cuddly	0.11	**0.68**
T: Cooperative	**0.65**	-0.00
U: Enjoys company	0.08	-0.36
V: Independent	0.06	**-0.61**
W: Attention seeker	-0.40	0.47
X: Upset by separation	-0.12	-0.02
Y: Avoids others, does not socialise	-0.02	0.14
Z: Demanding/angry	**-0.73**	0.01

Correlations >0.5 marked in bold

Convergent validity. Next we examined how the BAS-16 related to SSP classification at 15 and 36-months-old in comparison to both the full AQS and the TAS-45. A series of one-

way ANOVAs were conducted using SSP classification as the independent variable; notably, there were no significant main effects for any of the scales at 15 months (Table 9). To investigate whether the BAS-16 distinguished between security and insecurity in general, we created a binary variable (secure vs all insecure on 15-month SSP) and compared BAS-16 scores between the two groups (Table 10), however again there were no significant differences.

Table 9: One-way ANOVAs with Strange Situation Classification at 15 months (n=552)

	Mean (SD) SS (15 months)				**F**	**Effect size (η_p^2)**
	A (N=75)	B (N=340)	C (N=50)	D (n=87)		
Security score	0.32 (0.19)	0.30 (0.20)	0.27 (0.19)	0.31 (0.17)	0.80	0.004
BAS-16 Total	86.80 (16.43)	86.69 (15.30)	87.32 (12.19)	86.87 (14.78)	0.03	0.000
Harmonious interaction	44.73 (10.41)	42.66 (10.70)	42.42 (10.27)	42.99 (9.69)	0.85	0.004
Proximity seeking	42.07 (11.77)	44.03 (10.06)	44.90 (8.02)	43.89 (10.02)	0.98	0.005
TAS-45						
S: Warm, cuddly	22.19 (7.06)	23.53 (6.49)	23.64 (5.53)	23.47 (6.63)	0.91	0.005
T: Cooperative	32.32 (5.03)	31.34 (5.60)	31.14 (5.62)	31.76 (5.46)	0.79	0.004
U: Enjoys company	29.48 (5.31)	28.27 (5.49)	27.04 (6.04)	29.09 (6.12)	2.38	0.012
V: Independent	19.46 (5.97)	18.87 (4.73)	17.76 (4.33)	18.41 (4.66)	1.41	0.008
W: Attention seeker	14.87 (2.42)	14.96 (2.68)	15.04 (2.60)	14.67 (2.64)	0.33	0.002
X: Upset by separation	15.92 (3.18)	16.57 (3.74)	17.14 (4.21)	15.87 (3.36)	1.96	0.011
Y: Avoids others, does not socialise	20.33 (5.86)	20.78 (5.99)	21.56 (6.72)	19.42 (6.06)	1.66	0.009
Z: Demanding/angry	22.33 (4.50)	22.51 (4.54)	23.56 (4.74)	22.18 (4.09	1.10	0.006

Table 10: Differences in BAS-16 scores between insecure and secure infants at 15 months

	Mean (SD) Secure vs Insecure SS 15 months			
	Secure (n=340)	Insecure (n=234)	T	P
BAS-16 Total	86.69 (15.30)	86.50 (14.64)	-0.15	0.57
Harmonious interaction	42.66 (10.70)	43.18 (10.48)	0.57	0.42
Proximity seeking	44.03 (10.06)	43.32 (10.50)	-0.81	0.88

By contrast, there was a significant main effect for SSP classification at 36-months-old on the overall security score and the Harmonious Interaction scale, with the disorganised group showing significantly lower scores than the secure group. The total BAS-16 score was also significant; however it showed a smaller effect size than the Harmonious Interaction scale alone. There was also a significant main effect on two TAS-45 subscales: Cooperative and Demanding/Angry (Table 11). The largest effect sizes were shown by the Harmonious Interaction scale. We also compared BAS-16 scores between infants categorised as secure and insecure at 36 months, and again found significant differences on the BAS-16 total scale and the Harmonious interaction scale (Table 12).

Finally, to explore whether the Harmonious Interaction, Cooperative and Demanding/Angry scales were independently related to SSP classification at 36-months-old we regressed the binary variable indicating security vs insecurity of attachment on these scales, however, none independently predicted attachment security.

Table 11: One-way ANOVAs with Strange Situation Classification at 36 months (n=563)

	Mean (SD) SS (36 months)				**F**	**Effect size (η_p^2)**
	A (N=29)	B (N=342)	C (N=87)	D (n=105)		
Security score	0.31 (0.20)	0.31 (0.19)[a]	0.27 (0.22)	0.24 (0.18)[b]	3.82 *	0.020
BAS-16 Total	86.83 (15.79)	87.92 (14.73)	85.10 (16.23)	83.16 (14.83)	2.99	0.016
Harmonious interaction	46.10 (11.30)	43.65 (10.45)[a]	41.20 (10.92)	40.45 (10.19)[b]	4.11 **	0.022
Proximity seeking	40.72 (9.79)	44.27 (10.17)	43.90 (9.79)	42.70 (11.06)	1.50	0.008
TAS-45						
S: Warm, cuddly	22.41 (7.17)	23.45 (6.41)	23.39 (6.51)	22.44 (6.84)	0.80	0.004
T: Cooperative	33.14 (5.11)	31.73 (5.62)	30.47 (5.26)	30.74 (5.53)	2.68 *	0.014
U: Enjoys company	27.93 (6.31)	28.30 (5.50)	28.30 (5.40)	28.84 (6.18)	0.32	0.002
V: Independent	20.03 (5.17)	18.39 (4.91)	19.28 (4.97)	19.38 (5.21)	2.10	0.011
W: Attention seeker	14.28 (2.28)	14.92 (2.59)	14.78 (2.74)	15.21 (2.86)	0.36	0.006
X: Upset by separation	15.58 (3.19)	16.63 (3.84)	16.70 (3.75)	16.39 (3.34)	0.82	0.004
Y: Avoids others, does not socialise	20.97 (6.25)	20.92 (6.00)	20.24 (6.44)	20.30 (6.09)	0.48	0.003
Z: Demanding/angry	21.90 (4.68)	22.22 (4.47)[a]	23.18 (4.76)	23.61 (4.37)[b]	3.27 *	0.017

Significant at *p<0.05 **p<0.01

Table 12: Differences in BAS-16 scores between insecure and secure infants at 36 months

	Mean (SD) Secure vs Insecure SS 36 months			
	Secure (n=342)	Insecure (n=221)	T	P
BAS-16 Total	87.92 (14.73)	84.40 (15.50)	-2.70	0.02
Harmonious interaction	43.65 (10.45)	41.49 (10.45)	-2.37	0.013
Proximity seeking	44.27 (10.17)	42.92 (10.42)	-1.52	0.007

Predictive and discriminant validity. Next we compared the predictive validity of the BAS-16 with the full AQS and TAS-45 by calculating correlations with sensitivity, externalising and social competence (Table 13). The BAS-16 Harmonious Interaction scale and the Cooperative scale from the TAS-45 showed a comparable magnitude of correlation with sensitivity, externalising (24 months) and social competence (54 months) as the full security score. Interestingly, externalising at grade 6 was not significantly correlated with the Harmonious Interaction scales, but was negatively correlated with the Proximity-Seeking scale. The BAS-16 total score was also significantly related to these outcomes, however again it showed a slightly smaller association than the Harmonious Interaction scale alone.

Table 13: Correlations with sensitivity, externalising and social competence

	Sensitivity (24 months)	**Externalising (24 months)**	**Externalising (Grade 6)**	**Social competence (54 months)**
Security score	0.23***	-0.25***	-0.08	0.12**
BAS-16	0.15**	-0.23***	-0.12**	0.10*
Harmonious interaction	0.18***	-0.24***	-0.07	0.13**
Proximity seeking	0.05	-0.10*	-0.11*	0.01
TAS-45				
S: Warm, Cuddly	0.05	-0.11**	-0.11	-0.01
T: Cooperative	0.21***	-0.20***	-0.03	0.16***
U: Enjoys Company	-0.04	0.03	0.15**	0.03
V: Independent	-0.07	0.09*	0.09	-0.07
W: Attention Seeker	-0.07	0.10*	-0.01	-0.02
X: Upset by Separation	-0.06	0.00	-0.06	-0.04
Y: Avoids Others	0.02	-0.05	-0.11*	-0.01
Z: Demanding/Angry	-0.12**	0.20***	0.07	-0.07

*p<0.05 **p<0.01 ***p<0.001

Again, to explore the independent contribution of the various subscales a series of regression analyses were conducted including the scales which showed significant bivariate associations; however none of the scales showed independent predictive power.

Finally, we compared the discriminant validity of the new measures to the overall security score and TAS-45. There were no significant correlations with temperament for either of the two shortened measures or the full AQS security score (Table 14).

Table 14: Correlations with infant temperament

	Temperament (6 months)
Security score	0.06
BAS-16	0.03
Harmonious interaction	0.05
Proximity seeking	-0.01
TAS-45	
S: Warm, Cuddly	0.04
T: Cooperative	0.03
U: Enjoys Company	-0.05
V: Independent	0.03
W: Attention Seeker	-0.03
X: Upset by Separation	0.02
Y: Avoids Others	-0.01
Z: Demanding/Angry	-0.07

*p<0.05

Discussion

The overall aim of this study was to develop a short form of the AQS - a widely used measure of infant and toddler attachment - without sacrificing validity. Toward that end, the factor structure of the AQS was examined. Item response theory was then used to create a shortened measure (the Brief Attachment Scale) based on this identified structure. Finally, the performance of this shortened measure was compared to both the 90-item AQS and the TAS-45 by examining convergent, predictive and discriminant validity.

In terms of the first aim we identified two clear factors within the AQS. Individuals loading highly on the first factor were characterised by being happy and harmonious in their interactions with their mother, whilst those loading highly on the second factor were characterised by proximity and physical-contact seeking behaviours. These factors showed only modest correlations with each other (suggesting they measure distinct aspects of child behaviour) and showed good convergent and discriminant validity with other previously defined AQS subscales (Howes & Smith, 1995; Pederson & Moran, 1995; Posado et al., 1995). We found evidence of a third factor relating to sociable behaviour; however this correlated highly with the first factor suggesting a significant overlap between the two constructs. These findings closely replicate the work of Bailey and colleagues who identified three factors with very similar conceptual themes (Bailey et al., 2007; Bailey et al., 1999). Together this provides strong evidence for the existence of at least two conceptually distinct factors within the AQS.

IRT was then used to create a shortened measure (the BAS-16) which contained two scales ("Harmonious Interaction" and "Proximity-seeking") based on the identified factor structure. Items were selected on the basis of discrimination values alone as items did not differ notably in their difficulty. Whilst items differed markedly in terms of their discrimination, the final scales showed good information across a wide range of the underlying trait.

We then explored how the BAS-16 related to the full AQS. Impressively, although it only contained 18% of the original items the BAS-16 accounted for 67% of the variance in the security score. This suggests that removing a large proportion of the items results in only a small loss of information. However, some proportion of this correlation may be attributable in part to shared systematic error, as the shortened version was not administrated independently from the full version (Peters et al., 2012). An examination of

the security criterion sort showed that five items from the Harmonious Interaction scale and two from the Proximity-seeking scale were placed in either the top or bottom two piles. This helps explain the robustness of the AQS to a removal of a large number of items: whilst the full AQS measures a wide range of child behaviours, behaviours related to harmonious interaction are already given strong weighting in calculating the security score.

Next we examined the convergent, predictive and discriminant validity of the shortened scales. Overall the results were encouraging, showing that the new scales demonstrated at least the same (if not greater) validity associations as the full AQS. In terms of convergent validity, the Harmonious Interactions scale from the BAS-16 significantly related to SSP classification at 36-months-old. Infants categorised as insecure showed significantly lower scores on the BAS-16 total scale and on the Harmonious Interaction scale. Analysis of the different categories of insecurity showed that infants classified as resistant or disorganised showed significantly less harmonious interaction compared to those classified as secure. Impressively, the magnitude of these effects was slightly larger for the shortened scales than the full security score

Interestingly, we failed to find any significant relationships between scales describing more conceptually proto-typical secure base behaviour (e.g. the Proximity-seeking scale or the Upset by Separation scale on the TAS-45) and SSP classification at 15 or 36-months-old. This suggests that in the home, secure attachment primarily manifests in harmonious parent-child interaction rather than safety-seeking/exploration behaviours. This fits with the findings of Van Bakel and colleagues who reported that questions on the AQS related to non-compliance and fussiness were most strongly associated with disorganised attachment at 15 months (Van Bakel & Riksen-Walraven, 2004). How do we explain this finding? An answer may lie in the fact that typical secure base behaviours are most prominently displayed when the attachment system is activated - in stressful situations

(Cassidy & Shaver, 1999). In non-stressful, familiar situations, these behaviours may not be observed and related AQS items will be placed towards the middle of a sort (indicating that they neither describe nor fail to describe the child) and will thus fail to differentiate securely and insecurely attached children. Indeed, in the present study we found that a number of items describing responses to separation (e.g. items 10, 13, 26, 33, 34, 89) had few to no responses in the highest or lowest piles, suggesting the events had not occurred. Some authors have tried to elicit such behaviours by introducing brief, structured periods of separation within the observation to activate the attachment system (e.g. Van Bakel & Riksen-Walraven, 2004). It is possible that if used in such a structured interaction items relating to separation may be helpful in identifying insecurely attached children; however this was not possible to test with the current sample.

It was also surprising that in contrast to the findings at 36-months-old, neither the overall security score nor the BAS-16 scales significantly related to SSP classification at 15-months-old. This stands in contrast to the findings of Bailey and colleagues (2007) who reported that infants classified as disorganised at 12-months-old showed less harmonious relationships with their mother and a greater preference for visitors. One possible reason we did not find a significant association was the 11 month interval of measurement between the AQS and SSP at a time of rapid infant development. However, this pattern of results does fit with other findings that the association between difficult behaviours and attachment increases with age, perhaps as problematic two-way interactions with the caregiver become more deeply embedded (Fearon et al., 2010). It is important to keep in mind that this association was also weak for the standard criterion security sort of the AQS in this study, despite the relatively robust associations discerned in meta-analytic review (Van Ijzendoorn et al., 2004). Thus it may be that this lack of association reflects the particular methodology or population included in this study and suggests that further assessment of the validity of

the BAS-16 against infancy SSP classifications would be warranted using different study samples.

In terms of predictive and discriminant validity, we again found that both the BAS-16 performed as well or better than the full AQS. The Harmonious Interaction scale showed comparable effect sizes to the overall security score in relation to sensitivity, social competence and externalising at 24-months-old. The proximity-seeking scale showed smaller associations with sensitivity and externalising at 24-months-old, but interestingly (and unlike the overall security score) significantly predicted externalising behaviour at grade 6. In addition, the BAS-16 was not significantly associated with infant temperament, suggesting that shortening the measure and focusing on these specific domains does not create correlations with temperament that were not there in the original set. However, given the previously reported associations between the AQS and infant temperament (Van IJzendoorn et al., 2004) this finding may reflect the large interval between measurement rather than the discriminant validity of the AQS.

We also tentatively compared the validity of the BAS-16 to another promising shortened version of the AQS, the TAS-45. There was substantial overlap in the questions comprising the BAS-16 and those from related scales in the TAS-45. We found comparable validity between the BAS-16 Harmonious Interaction scale and the Cooperative and Demanding/angry scales from the TAS-45, and between the Proximity-seeking scale and the TAS-45 Warm, cuddly scale. An important caveat of these comparisons is that our measure was not tested against the actual TAS-45 but a reconstruction based on the AQS items from which the TAS-45 was derived. The actual TAS-45 is scored using a different system and "is not a reduced or adjusted version of the AQS" (Spieker et al., 2011, p.82). Furthermore, as some of the TAS-45 items derived from the 100-item version of the AQS it was not possible

to include them in the reconstruction. For a full comparison future studies would need to compare the two measures side by side.

However, taken together our findings show that considerably fewer than eight scales are required for a short-from version of the AQS. Indeed, our results suggest that the Harmonious Interaction scale alone could be a valid measure of attachment within the home. Whilst the total scores from the BAS-16 showed convergent and predictive validity, this effect were smaller than those found just for the Harmonious Interaction scale. The one potential advantage of including the Proximity-seeking scale is the association shown with externalising at 6 years. However, were this scale to be included it would be more informative to interpret the scales separately rather than combining in a total score as they appear to have different correlates.

These findings have important clinical implications. They suggest that an ultra-short measure comprising the eight-item Harmonious Interaction scale could be an effective screening tool to identify insecure attachment in the home. Whilst this scale does not cover the same range of behaviours as the full AQS, it appears to capture the important manifestations of insecure attachment within a non-stressful setting. Given its brevity, the scale could plausibly be used by healthcare professionals – such as health visitors or social workers - who have routine contact with at-risk families. This measure could be an important tool in the early identification of insecure attachment and enable support to be provided to improve long-term outcomes. In addition, the BAS-16 could be used in longitudinal studies where brevity is paramount given the large batteries of measures involved.

This study had a number of strengths. It is the first study to use IRT to reduce the number of items in the AQS based on an empirically determined factor structure, and was conducted on a large sample. However the study also had limitations. First, despite the forced distribution of the sorting process it was assumed that AQS items were independent,

i.e. that scores on one item were not affected by scores on other items. The justification for treating them as independent is the vast number of possible ordered combinations of AQS items (90!= 1.49 E+145). However, it is unknown how similar or different the pattern of responses would have been if rated on separate Likert scales. Second, the AQS was completed at 24-months-old and thus not contemporaneously with either SSP measure. However, if anything this would have reduced the strength of observed associations between the two measures. Conversely, the large interval between the measurement of temperament and the AQS likely resulted in an over-estimation of discriminant validity.

Future studies are needed to assess the validity of these new scales in different samples. They should also explore whether introducing a structured period of separation and reunion could help elicit additional attachment behaviours. Ainsworth argued that this can provide a 'short-cut' over longer periods of observation and may therefore improve the clinical utility of the measure (Ainsworth et al., 1978). It should also be investigated whether these scales could function better as Likert-style observation schedules rather than as a q-sort. There is emerging evidence that the requirement to sort cards according to a forced distribution leads to order effects with later items being more likely to be placed in the middle of a sort (Serfass & Sherman, 2013). In addition, introducing a simpler scoring procedure may reduce time-consuming decisions about card placement and make the measure easier for healthcare professionals to use or for researchers conducting large-scale field studies. A final area for future investigation is whether the measure could be improved by including items to specifically measure disorganised attachment (e.g. as included in the TAS-45). Studies have shown particularly negative outcomes for disorganised attachment, even compared to other insecure attachment categories (e.g. Fearon & Belsky, 2011). Whilst the Harmonious Interaction scale did significantly relate to disorganised attachment as classified by the SSP, there may also be other manifestations of disorganisation with the home that it is important to capture.

In summary, we have developed a shortened measure of attachment based on the AQS – the BAS-16. This new measures shows good psychometric properties and represents a brief, yet valid alternative to much longer existing measures of attachment.

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Part 3: Critical Appraisal

Introduction

This paper presents an opportunity to reflect on conceptual, practical and philosophical issues which arose through undertaking this project. First I will discuss the theoretical background to this work. I will then reflect on the strengths of the research and how it helped me develop personally and professionally. I will also reflect on practical, conceptual and ethical challenges encountered throughout. Finally I will discuss future directions for research.

Interests/principles underlying this project

I was drawn to this project because of my interest in developmental psychopathology and a belief in the importance of early intervention. Developmental psychopathology is an integrative, life-span approach to understanding mental health problems (Cicchetti & Rogosch, 2002). The development of problems is understood probabilistically in terms of interacting risk and protective factors across multiple domains (e.g. environmental, biological, genetic, psychological). The concept of *developmental trajectories* is key: multiple risk factors throughout life accumulate to increase the probability of experiencing mental and physical health problems, whilst long-term recovery becomes increasingly more difficult (Felitti et al., 1998).

Whilst numerous risk and protective factors have been implicated, perhaps the most striking findings have been on the damaging impact of adverse experiences in early childhood. For example, the presence of four or more adverse childhood experiences (e.g. abuse, neglect, parental domestic violence) is associated a raft of negative outcomes, including a seven-fold increase in risk of dangerous alcohol use and 12 times increase in the risk of attempting suicide (Felitti et al., 1998). Similarly, studies have reported that a large

majority of individuals with a diagnosis of 'borderline personality disorder' or 'psychosis' suffered childhood trauma or abuse (Read et al., 2005; Zanarini et al., 2003).

The findings from developmental psychopathology have a number of important implications for clinical psychologists. First, they clearly illustrate that 'problems' are not located within the person: problems arise out of the interaction of multiple factors across multiple levels. Diagnoses such as 'borderline personality disorder' risk obscuring this fact and invalidating the significant adverse experiences of those who eventually attract such a diagnosis.

These findings also illustrate the central importance of prevention and early intervention. This has also been very apparent through my clinical experience across the three years. In particular I have been struck how so many of the clients in secondary mental health and addiction services have survived hugely difficult childhood experiences of poverty, neglect and abuse. In my child placements I have also worked with families at earlier points on perhaps similar trajectories. For me one of the huge rewards of working with young people is the hope of helping them onto a more positive path.

The necessity of early intervention is also recognised at a political level. A number of policy documents have highlighted the current overwhelming bias towards late intervention, despite the fact by this stage problems are often highly entrenched and interventions of limited success (Allen, 2011; Department of Health, 2010). Allen argues that by contrast, a program of early intervention provides an opportunity to "[M]ake lasting improvements in the lives of our children, to forestall many persistent social problems and end their transmission from one generation to the next, and to make long-term savings in public spending" (Allen, 2011; p.vii).

As discussed in the empirical paper, there is a large body of evidence showing both the long-term negative effects of insecure (especially disorganised) attachment, and the

effectiveness of parenting interventions. Increasingly, there is also the political will to invest in programs to support young families. However, what became increasingly apparent in the initial reading for this project was the absence of useable clinical tools to identify infants with attachment difficulties. This was surprising given the huge interest and volume of research in the field of attachment. Whilst admittedly not the most glamorous of theses, given this pressing need, my interest in the field and my background in research and statistics it seemed the ideal project to take on.

Strengths of the project and personal benefits

Using the large NICHD ECCRN dataset provided an opportunity which simply would not have been available had I collected the data myself. Whilst doctoral theses involving data-collection offer advantages (e.g. in the skills learned and the investigation of novel research questions) they also carry limitations. In particular, they are often only cross-sectional and run the risk of adding to the existing body of underpowered psychological research (Marszalek et al., 2011).

The NICHD dataset used in this project contained a large sample collected by hundreds of researchers across different sites, including both Strange Situation and socioemotional outcome data at multiple time-points. The sample size provided the power to conduct Item Response Theory analyses, and the also the opportunity to split the dataset and validate the BAS-16 against key outcomes on a separate subset of participants, increasing the robustness of the findings.

On a personal level, I feel I have gained many useful skills from this project. I have increased my knowledge and confidence in a data-analysis and learned how to use R-Studio, which is a powerful statistical package. I have also learned how to conduct meta-analyses, which can provide clinically useful syntheses of study findings. Given the unprecedented

level of data now being collected within NHS services (e.g. IAPT), being skilled in data-analysis provides the opportunity to be involved large-scale clinical research projects. It has also increased my confidence in being able to appraise and interpret complicated research studies.

Challenges and advice to future researchers

I encountered three main areas of challenge throughout this project: (i) practical/personal, (ii) conceptual, and (iii) philosophical. I will discuss them in turn.

Practical and personal challenges

One of the main challenges I faced with this project was learning both the theory behind new statistical techniques and how to implement them (Q-factor analysis, Item Response Theory, Monte Carlo simulation, meta-analysis). In theory this process of learning involved four separate stages: (i) deciding on an analytic approach based on a review of previous literature, (ii) learning the principles behind the chosen approach, (iii) learning how to use the software required for the analysis (e.g. R-studio, Comprehensive Meta-Analysis), and (iv) writing the code to run the analysis. However, in practice stages (ii)-(iv) often happened together: I would be both understanding and trying to implement at a strategy at the same time. Whilst this was motivated by a desire for speed, in hindsight it was inefficient as it resulted in many problems within the code which could take lengthy periods to resolve. It may have been more helpful to try to approach the task in the steps described above. In particular, it would have been much more efficient to have set aside time early in the project to attended training courses on software such as R-studio to thoroughly understanding the environment and the coding principles, rather than learning as I went along.

I was also struck by how many 'hidden hours' this project involved. Often tasks which on the surface appeared straightforward could end up taking considerable time. For example, one of the steps of IRT was to assess the fit of the model. The solution I settled on was to produce residual plots for each item; however within R-studio there were no existing packages to do this. Consequently I had to write the code from scratch based on the principles outlined in Hambleton and Swaminathan (1985), a process which in all took approximately 10-15 days, but resulted in only a paragraph in the final write-up. Similarly, a search of the literature showed that there were no empirical studies setting out guidelines for the sample size for q-factor analysis. The solution – to correspond with the author of PQMethod and to write a Monte Carlo simulation – again took many days of work.

A limitation I encountered using already-collected data was that the NICHD study was not designed specifically for the purposes of the present project. As the original aim was not to validate the AQS (or derived versions), neither the Strange Situation or measurements of temperament were collected at the same time that the AQS was administered. This limited the strength of the conclusions that we could draw from the research. In addition, had the project been designed for this specific purpose the AQS could have been administered both as a Likert-scale observation schedule and a q-sort which would have overcome potential problems of a lack of independence described in the limitations of the empirical paper.

Conducting a data-analytic project also brought personal challenges. It meant that I was on a very different trajectory than others in my cohort, which to some degree reduced the peer support available to me. It also meant long periods of lone working, less social contact, and episodes of conceptual and theoretical grappling which could be mentally exhausting. However, overall I thoroughly enjoyed the work, and these challenges were

more than offset by the intellectual satisfaction and the much reduced stress and uncertainty as a result of not having to struggle with ethics and the recruitment process.

Conceptual challenges

A recurring issue throughout this research is ambiguity over the range of behaviours which constitute 'attachment'. A narrow definition might understand attachment behaviours as behaviours which promote proximity or contact with a selective caregiver in times of danger, stress or novelty. Securely attached infants are those who will engage in these behaviour when stressed, but once comforted or reassured will quickly return to playing and exploring the room. These are the types of behaviour measured specifically by the Strange Situation Procedure, and there is good evidence that they are displayed by infants across a wide range of different cultures (Posada et al., 2013).

However, the construct measured by the AQS is clearly broader than this. It includes not just proximity-seeking behaviours, but behaviours relating to a wide range of infant behaviours. Furthermore, whilst the 2004 meta-analysis on the validity of the AQS found that it significantly correlated with the SSP, it still showed that only approximately 10 per cent of the variance in AQS scores can be explained by the SSP. This suggests that despite both the SSP and AQS being described as 'gold-standard measures of attachment' (Van IJzendoorn et al., 2004), they are actually measuring separate, partially-overlapping constructs.

One of the strengths of this project is that it has helped to bring to greater clarity to the domains the AQS is measuring. In combination with the research by Bailey and colleagues (Bailey et al., 2007; Bailey et al., 1999), we can be increasingly confident that the AQS is primarily measuring harmony of interaction with the caregiver and proximity-seeking behaviours. Whilst this is a promising step forward, future work should continue to try to

close the gap between the AQS and SSP. In particular, introducing a structure period of separation into the AQS procedure could more effectively activate the attachment system within the home. As well as potentially improving the sensitivity of the BAS-16, it could also help bring about greater convergence with the SSP.

Philosophical and ethical challenges

Perhaps the biggest challenge of this project was to reconcile some of the implicit epistemological assumptions of this type of research with my developing philosophical and ethical beliefs. Over the course of the thesis I've become increasingly influenced by ideas from social constructionism and critical psychology. This has led me to question some of the assumptions of nomothetic research and fostered an increased interest in idiographic, qualitative approaches.

I also felt a tension throughout this project with how this type of research fits with my broader ethical beliefs. In particular, I have felt concerned about the risk that attachment research could be co-opted into the social discourse that 'bad parenting' - especially by parents from poorer backgrounds – is to 'blame' for their child's problems (Jones, 2012). Whilst identifying insecure attachment and supporting parents is undoubtedly important, it also has the danger of obscuring some of the wider political and social factors. A recent meta-analysis reported that the prevalence of insecure and disorganised attachment is significantly greater in high-risk families, especially those exposed to multiple socioeconomic risk factors (Cyr et al., 2010). So whilst we know that sensitive parenting is a predictor of security of attachment (Belsky & Fearon, 2008), to focus on parenting alone has the danger of disregarding the context in which insensitive parenting can occur.

There are a number of possible reasons why children from higher-risk socioeconomic groups are more likely to develop insecure or disorganised attachment (Cyr

et al., 2010). Parents in these environments are likely to experience much greater stressors than those from more privileged environments and have much less time and resources to engage with their children. Such parents are also much more likely to experience mental health problems themselves, which when interacting with environmental stressors could further reduce their capacity to meet the needs of their children. These theoretical findings have been very apparent in my clinical work with teenagers from deprived backgrounds, where young parents face a host of material and emotional challenges not faced by the more affluent.

For me, the upshot of this is that whilst interventions to support parents and improve the attachment relationship are certainly important, these should be employed alongside a recognition of the social context in which insecure attachment manifests. The reduction of poverty and economic inequality, the provision of education, the reduction of crime and the empowerment of communities are goals which I believe should be equally as pressing for clinical psychologists.

However, it's important to recognise that none of these goals are at odds with the tenets of developmental psychopathology. The theoretical framework recognises that whilst insecure attachment is associated with a range of poor outcomes, this is just one risk factor intricately related with myriad other factors across different levels of description. The challenge for politicians and the media is to accept the vast complexity in the development of mental health problems. The human mind is drawn to simple explanations and simple solutions – explanations which say if we could just tackle *this* then we would solve these problems. However, what this research – and developmental psychopathology in general – shows us that problems are multi-factorial and multi-levelled. There is no one solution or one intervention to the problem of psychological distress. What is needed is a range of

solutions and early intervention, one of which is to identify and support at risk families with the attachment relationship.

Future directions

The next steps for this project are to further evaluate the validity of the BAS-16 in separate samples and continue to develop the measure. We have already started this work and the initial results appear very promising. In addition to the findings from the empirical paper we have found that the measure also performs well in a separate dataset including the AQS and a range of socioemotional outcomes. We are currently exploring the possibility of conducting observational research with infants with disorganised attachment styles to identify additional items to measure disorganisation within the home. The next step will be to trial the BAS-16 in a new sample, potentially with additional items to measure disorganisation in order to establish the measure as viable measure of infant attachment within clinical settings.

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Appendix A: Monte Carlo simulation to determine sample size for Q-factor analysis

To explore the stability of factor solutions at different sample sizes a series of Monte Carlo simulations were carried out using the following procedure. First, a specified number of cases were randomly sampled from the overall dataset (ranging from 50-1000 in increments of 50). For each iteration, a weighted aggregate sort was calculated for the first 4 factors using the procedure described in the methods section. This process was repeated for 1000 iterations for each sample size. For each factor, the average correlation between these 1000 weighted aggregate sorts was calculated. The resulting correlation coefficients represent how reliable the solution is for each factor at differing sample sizes (Figure 1).

Figure 1: Average correlation between weighted aggregate sorts for the first four factors at various sample sizes. Number of iterations = 100.

Analysis showed that the correlation between sorts increased as sample size increased. This is to be expected given that as sample size increases so does the likelihood that the same cases will be sampled. However, what was unexpected was the very low correlations between solutions at small sample sizes (e.g. 50), suggesting that these do not produce stable solutions (especially for the second factor onwards). The sample size of 200 was

chosen as this provides correlations of approximately 0.5 or greater for all estimates (correlations coefficients for the factor = 0.91, 0.53, 0.50, 0.49)

Appendix B: AQS questions comprising previous subscales

Note italicised questions are reverse-scored

Howes and Ritchie (1999)

Secure Base

14. When child finds something new to play with, he carries it to mother or shows it to her from across the room.

21. Child keeps track of mother's location when he plays around the house.

36. Child clearly shows a pattern of using mother as a base from which to explore.

80. Child uses mother's facial expressions as good source of information when something looks risky or threatening.

90. If mother moves very far, child follows along and continues his play in the area she has moved to. (Doesn't have to be called or carried along; doesn't stop play or get upset).

Avoid

05. Child is more interested in people than in things.

25. Child is easy for mother to lose track of when he is playing out of her sight.

29. At times, child attends so deeply to something that he doesn't seem to hear when people speak to him.

36. Child clearly shows a pattern of using mother as a base from which to explore.

43. Child stays closer to mother or returns to her more often than the simple task of keeping track of her requires.

59. When child finishes with an activity or toy, he generally finds something else to do without returning to mother between activities.

76. When given a choice, child would rather play with toys than with adults.

88. When something upsets the child, he stays where he is and cries.

Seeks Comfort

11. Child often hugs or cuddles against mother, without her asking or inviting him to do so.

28. Child enjoys relaxing in mother's lap.

44. Child asks for and enjoys having mother hold, hug, and cuddle him.

53. Child puts his arms around mother or puts his hand on her shoulder when she picks him up.

64. Child enjoys climbing all over mother when they play.

71. If held in mother's arms, child stops crying and quickly recovers after being frightened or upset.

Positive Negotiate

18. Child follows mother's suggestions readily, even when they are clearly suggestions rather than orders.

19. When mother tells child to bring or give her something, he obeys.

32. When mother says "No" or punishes him, child stops misbehaving (at least at that time). Doesn't have to be told twice.

41. When mother says to follow her, child does so.

Difficult Negotiate

38. Child is demanding and impatient with mother. Fusses and persists unless she does what he wants right away.

54. Child acts like he expects mother to interfere with his activities when she is simply trying to help him with something.

74. When mother doesn't do what child wants right away, child behaves as if mom were not going to do it at all.

Pederson and Moran (1995)

Secure base

03. When he is upset or injured, child will accept comforting from adults other than mother.

15. Child is willing to talk to new people, show them toys, or show them what he can do, if mother asks him to.

21. Child keeps track of mother's location when he plays around the house.

25. Child is easy for mother to lose track of when he is playing out of her sight.

33. Child sometimes signals mother (or gives the impression) that he wants to be put down, and then fusses or wants to be picked right back up.

34. When child is upset about mother leaving him, he sits right where he is and cries. Doesn't go after her.

36. Child clearly shows a pattern of using mother as a base from which to explore.

47. Child will accept and enjoy loud sounds or being bounced around in play, if mother smiles and shows that it is supposed to be fun.

60. If mother reassures him by saying "It's OK' or "It won't hurt you", child will approach or play with things that initially made him cautious or afraid.

71. If held in mother's arms, child stops crying and quickly recovers after being frightened or upset.

75. At home, child gets upset or cries when mother walks out of the room (May or may not follow her).

80. Child uses mother's facial expressions as good source of information when something looks risky or threatening.

88. When something upsets the child, he stays where he is and cries.

90. If mother moves very far, child follows along and continues his play in the area she has moved to. (Doesn't have to be called or carried along; doesn't stop play or get upset).

Fussy/difficult

02. When child returns to mother after playing, he is sometimes fussy for no clear reason.

08. When child cries, he cries hard.

09. Child is lighthearted and playful most of the time.

10. Child often cries or resists when mother takes him to bed for naps or at night

13. When the child is upset by mother's leaving, he continues to cry or even gets angry after she is gone.

20. Child ignores most bumps, falls, or startles.

26. Child cries when mother leaves him at home with babysitter, father, or grandparent.

30. Child easily becomes angry with toys.

38. Child is demanding and impatient with mother. Fusses and persists unless she does what he wants right away.

61. Plays roughly with mother. Bumps, scratches, or bites during active play. (Does not necessarily mean to hurt mom)

62. When child is in a happy mood, he is likely to stay that way all day.

74. When mother doesn't do what child wants right away, child behaves as if mom were not going to do it at all.

79. Child easily becomes angry at mother.

81. Child cries as a way of getting mother to what he wants.

Affective Sharing

14. When child finds something new to play with, he carries it to mother or shows it to her from across the room.

70. Child quickly greets his mother with a big smile when she enters the room. (Shows her a toy, gestures, or says "Hi, Mommy").

86. Child tries to get mother to imitate him, or quickly notices and enjoys it when mom imitates him on her own.

Compliant with Mother

01. Child readily shares with mother or lets her hold things if she asks to.

18. Child follows mother's suggestions readily, even when they are clearly suggestions rather than orders.

19. When mother tells child to bring or give her something, he obeys.

32. When mother says "No" or punishes him, child stops misbehaving (at least at that time). Doesn't have to be told twice.

41. When mother says to follow her, child does so.

65. Child is easily upset when mother makes him change from one activity to another.

Enjoys Physical Contact

11. Child often hugs or cuddles against mother, without her asking or inviting him to do so.

28. Child enjoys relaxing in mother's lap.

44. Child asks for and enjoys having mother hold, hug, and cuddle him.

53. Child puts his arms around mother or puts his hand on her shoulder when she picks him up.

64. Child enjoys climbing all over mother when they play.

Posado et al. (1995)

Smooth interactions with mother

01. Child readily shares with mother or lets her hold things if she asks to.

02. When child returns to mother after playing, he is sometimes fussy for no clear reason.

06. When child is near mother and sees something he wants to play with, he fusses or tries to drag mother over to it.

18. Child follows mother's suggestions readily, even when they are clearly suggestions rather than orders.

19. When mother tells child to bring or give her something, he obeys.

24. When mother speaks firmly or raises her voice at him, child becomes upset, sorry, or ashamed about displeasing her.

32. When mother says "No" or punishes him, child stops misbehaving (at least at that time). Doesn't have to be told twice.

38. Child is demanding and impatient with mother. Fusses and persists unless she does what he wants right away.

41. When mother says to follow her, child does so.

Proximity to mother

11. Child often hugs or cuddles against mother, without her asking or inviting him to do so.

14. When child finds something new to play with, he carries it to mother or shows it to her from across the room.

21. Child keeps track of mother's location when he plays around the house.

25. Child is easy for mother to lose track of when he is playing out of her sight.

34. When child is upset about mother leaving him, he sits right where he is and cries. Doesn't go after her.

35. Child is independent with mother. Prefers to play on his own; leaves mother easily when he wants to play.

36. Child clearly shows a pattern of using mother as a base from which to explore.

43. Child stays closer to mother or returns to her more often than the simple task of keeping track of her requires.

59. When child finishes with an activity or toy,he generally finds something else to do without returning to mother between activities.

69. Rarely asks mother for help. Middle if child is too young to ask.

83. When child is bored, he goes tomother looking for something to do.

88. When something upsets the child,he stays where he is and cries.

90. If mother moves very far, child follows along and continues his play in the area she has moved to. (Doesn't have to be called or carried along; doesn't stop play or get upset.)

Physical contact with mother

03. When he is upset or injured, child will accept comforting from adults other than mother.

28. Child enjoys relaxing in mother's lap.

33. Child sometimes signals mother (or gives the impression) that he wants to be put down, and then fusses or wants to be picked right back up.

44. Child asks for and enjoys having mother hold, hug, and cuddle him.

53. Child puts his arms around mother or puts his hand on her shoulder when she picks him up.

64. Child enjoys climbing all over mother when they play.

71. If held in mother's arms, child stops crying and quickly recovers after being frightened or upset.

Interactions with other adults

07. Child laughs and smiles easily with a lot of different people.

12. Child quickly gets used to people or things that initially made him shy or frightened him.

15. Child is willing to talk to new people, show them toys, or show them what he can do, if mother asks him to.

17. Child quickly loses interest in new adults if they do anything that annoys him.

48. Child readily lets new adults hold or share things he has, if they ask to.

50. Child's initial reaction when people visit the home is to ignore or avoid them, even if he eventually warms up to them.

51. Child enjoys climbing all over visitors when he plays with them.

58. Child largely ignores adults who visit the home Finds his own activities more interesting.

60. If mother reassures him by saying "It's OK' or "It won't hurt you", child will approach or play with things that initially made him cautious or afraid.

66. Child easily grows fond of adults who visit his home and are friendly to him.

67. When the family has visitors, child wants them to pay a lot of attention to him.