SCHOOL OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY

RESEARCH MANUSCRIPT

Title: The Relationship between Maternal Sensitivity in Infancy, and Actual and Feared Separation in Childhood, on the Development of Adolescent Antisocial Behaviour

Author name and affiliation: Julia Salt

College of Life and Environmental Sciences
Washington Singer Laboratories
Perry Road
Exeter
EX4 4QG

Supervisors: Dr Julian Walker (Avon and Wiltshire Mental Health Partnership NHS Trust, affiliated with Bristol University)
Professor Glyn Lewis (Bristol University)

Target Journal: Journal of Adolescent Psychology and Psychiatry[6][7]

Word Count for Manuscript: 7,982

Word Count for Appendices: 5,000 max

Submission Date: 7th May 2013

Statement of academic probity and professional practice:

"I certify that all material in this assignment which is not my own work has been identified and properly attributed. I have conducted the work in line with the BPS DCP Professional Practice Guidelines."

Submitted in partial fulfilment of requirements for the Doctorate Degree in Clinical Psychology, University of Exeter

[6] See Appendix A for instructions to authors.
[7] The author is aware that the target journal requests 5,000 word limit and 5 or fewer tables and figures, plans for amendments to be made for publication.

Abstract

Background: Research exploring the developmental of adolescent antisocial behaviour suggests that a secure attachment style is a protective factor against problem behaviour (Bowlby, 1969). It is theorised that disruptions in the attachment relationship can increase the likelihood of adjustment difficulties in adolescence, including antisocial behaviour (MacDonald, 1985). Such relationships have been inferred by cross-sectional research studies, but have yet to be tested in a longitudinal sample.

Aims: This research is a secondary data analysis, using data from the Avon Longitudinal Study of Parents and Children cohort study, to explore the relationship between attachment and adolescent antisocial behaviour at age 15.5 years. Attachment was measured using three component measures; maternal sensitivity in infancy (sample 1), separations from main caregiver in early childhood, age 3-5 years (sample 2) and the presence of separation anxiety in middle childhood, age 81 months, 6.75 years (sample 3).

Results: Logistic regression analyses were used to explore the relationships. Using available data, in sample 1 (n=456 complete cases) no evidence was found to support an association between non-positive maternal sensitivity in infancy and an increased incidence of adolescent antisocial behaviour (OR=0.79 [CI=0.42-1.48], p=0.46). In sample two (n=3,961), the number of separations in infancy were not found to significantly increase the risk of adolescent antisocial behaviour (OR=1.26 [CI=0.94-1.71], p=0.17). Separation anxiety in middle childhood was not found to have an effect on adolescent antisocial behaviour (OR=1.01 [CI=0.80-1.26], p=0.96).

Conclusions: The findings suggest that although components of attachment, as measured in this study, were hypothesised to be associated with an increased risk of adolescent antisocial behaviour, this was not statistically supported in this study. In this study effects may be limited due to attrition, leading to the loss of antisocial adolescents from the study, creating a bias in the sample studied.

Keywords: Adolescent antisocial behaviour, Maternal sensitivity; Separation from caregiver; Separation Anxiety; ALSPAC; Longitudinal

Abbreviations

ALSPAC – Avon Longitudinal Study of Parents and Children

ASB – Antisocial Behaviour

CI – Confidence Interval

CLES – Childhood Life Events Scale

CSE – Certificate of Secondary Education

DAWBA – Development and Wellbeing Assessment

DSM-IV – Diagnostic and Statistical Manual 4th Edition

ICD-10 – Identification and Classification of Disorders

OR – Odds Ratio

SDQ – Strength and Difficulties Questionnaire

TIM – Thorpe Interaction Measure

Introduction

Antisocial behaviour has been described as a socially and culturally defined construct (Baker, 2006), which refers to acts that violate societal norms (Gaik, Abdullah, Elias & Uli, 2010), infringe on the rights of others, and cause nuisance and harassment (Frick, 1988). Research has suggested that it marks the start of problematic delinquent behaviours (Moffitt, 1993), which can escalate into adulthood difficulties, affecting employment, interpersonal relationships (Caspi, Elder & Bem, 1987), substance misuse (Farrington, 1991), adulthood criminality (Harrington, Fudge, Rutter, Pickles, & Hill, 1991), and strongly associated with adult mental health problems (Colman, Murray, Abbott, Maughan, Kuh, Croudace, & Jones, 2009).

One argument that has been posited, and popularised, over the years is the importance of a child's early attachment relationships with their primary caregiver, as a protective factor against later antisocial behaviour (Bowlby, 1969; Zeanah, Berlin & Boris, 2011). Attachment theory is derived from the fundamental concept of all human beings having an innate drive to seek relationships with others (Bowlby, 1969), which research has categorised into two attachment styles: a positive secure relationship, or an insecure relationship (divided further into ambivalent, avoidant (Ainsworth, 1989) or disorganised (classified by Main & Solomon, 1986)). A secure attachment relationship between the mother[8], or primary caregiver, and infant has been found to provide a secure and safe base, to facilitate a child's internal learning about their external environment. This learning process in turn informs the development of internal working models, which act as a framework for the infant to interpret and respond to their surroundings (Bowlby, 1969).

Research suggests that a secure infant-mother attachment early in life aids the development of two key mechanisms; empathy, which underlies moral reasoning (Van IJzendoorn, 1997), and self-regulation. Children who are competent and adept at

[8] Mother and caregiver are used interchangeably in the manuscript to refer to the child's primary attachment figure.

empathising with others (LaFreniere & Sroufe, 1985) are more likely to be securely attached to their caregiver (Kobak, Cole, Ferenz-Gillies, Fleming & Gable, 1993). In turn, securely attached children exhibit more prosocial behaviour (Eisenberg, 2000), less antisocial tendencies towards others (Lovett & Sheffield, 2007), and less violent offending in adolescence and adulthood (DeZulueta, 2006). In contrast, insecure and disorganised attachments have been found to impair a child's ability to mentalise, and to use theory of mind, which inadvertently increases the individual's projection of parts of the self into others, increasing externalising behaviours (Fonagy, 2000). This is particularly pertinent in the transition to adolescence; when peers become central attachment figures, thus impaired social and reflective functioning can cause isolation and victimisation, both of which are associated with higher levels of antisocial behaviour (Fonagy, 2000).

More recently research has focused on a multimodal approach to measuring attachment (Laranjo, Bernier & Meins, 2008), investigating the role of maternal sensitivity, and whether this is a key contributing factor for the development of a secure attachment (Ainsworth, 1987; Lundy, 2003; Meins, Fernyhough, Fradley, & Tuckey, 2001). Elizabeth Meins (1999) looked at maternal sensitivity in mother's, and theorised that for this to be achieved the mother needs to be able to interpret the child's cues, and to treat the child as an "individual with a mind" (Meins et al., 2001; pg. 638); a concept termed mind-mindedness. Mind-mindedness is thought to develop between the mother and infant in the first twelve months of life, and refers to the presence of five key factors; the mother's ability to respond to the infant's gaze direction, responding to object-directed action, imitation, encouraging autonomy in the infant and appropriate verbal responses. Meins hypothesised that the all-encompassing concept of mind-mindedness is a pre-requisite for maternal sensitivity, which in turn predicts attachment security.

In a study with 50 infant-mother pairs Laranjo, Bernier & Meins (2008) measured maternal sensitivity, mind-mindedness (coding free-play interactions), and attachment (using the Attachment Behaviour Q-Sort, Waters & Deane, 1985), at twelve and fifteen months.

The results highlighted that the three variables were all positively interrelated (supported by Lundy 2003; Meins et al., 2001), and that maternal sensitivity partially accounted for the relationship between mind-mindedness and attachment, suggesting that mind-mindedness is the first step to effectively developing maternal sensitivity.

Research by Bigelow, McLean, Proctor, Myatt, Gillis & Power (2010), supports the use of maternal sensitivity as a concept to predict attachment security, and its use as an indicator of attachment. As with attachment, maternal sensitivity has also been found to be a protective factor against children exhibiting externalising behaviours in childhood, and antisocial tendencies in adolescence, with effective maternal sensitivity found to be predictive of better childhood outcomes (Jaffari-Bimmel, Juffer, Van IJzendoorn, Bakermans-Kranenburg, & Mooijaart, 2006). In a longitudinal study by Wang, Christ, Mills-Koonce, Garrett-Peters & Cox (2013), maternal sensitivity was measured through videotape interactions at ages 3, 7, 9 and 11 years. After controlling for maternal education, maternal harshness and maternal depression, positive maternal sensitivity between infant and parent was associated with a decrease in externalising and antisocial behaviours across childhood and into adolescence.

A meta-analysis of over 60 studies (n=4,176) concluded that maternal sensitivity is one of the antecedents to developing a secure attachment (De Wolff & Van IJendoorn, 1997). Securely attached infants are known to be more compliant with their mothers, who in turn tended to use gentler physical prompts, and softer tones of voice (Londerville & Main, 1981). Furthermore, it has been found that parents fostering a warm atmosphere in which to set boundaries, and introduce discipline, are more likely to encourage the development of empathy (Hoffman, 1984), which has been found to be correlated with more prosocial behavioural outcomes.

There have been few longitudinal studies looking at the effect of maternal sensitivity in infancy on adolescent outcomes; but existing longitudinal studies that have explored data

up until pre-adolescence suggest that this would be a plausible extension. Wakschlag & Hans (1999) collected data on maternal responsiveness at 12 months (n= 77) with a follow-up at age ten. They measured antisocial behaviour using the Diagnostic Interview for Children and Adolescents (DICA; Herjanic & Reich, 1982), and found that poor maternal responsiveness was correlated with greater behavioural problems. However, the sample was of African-American children recruited from low-income and high-risk families, with 21 of the children found to no longer be living with their biological mother at follow-up. A longitudinal study, by Trentacosta & Shaw (2008), found similar results, with 231 mother and infant dyads. They used a measure of harsh parenting at 18 months as an indicator of reduced maternal sensitivity. Harsh parenting refers to parental practices that can be perceived as rejecting, hostile, negative or controlling towards the child, which can have a negative impact on the mother-infant attachment. Harsh parenting was found to be correlated with self-reported antisocial behaviour in boys at age 12 years, and in an earlier study with insecure attachment styles in infancy (Shaw, Bell & Gilliom, 2000). Again, the sample incurred biases as it consisted of male children from low-income families, with both these factors known to increase the risk of adolescent antisocial behaviour, and the study failed to capture data from later in adolescence when antisocial behaviour is known to peak.

Thinking about attachment in a more multimodal perspective, separations from the caregiver can also cause disruptions in attachment, which have been found to adversely affect childhood outcomes, and are associated with an increase in adolescent and delinquent behaviours (Bowlby, 1944). Types of separation studied in the literature include parental imprisonment (Murray & Farrington, 2005), brief and prolonged hospital admissions for children (Douglas 1975; Quinton & Rutter, 1976), and divorce or marital separation between parents (Farrington, 1989; Robins & Ratcliffe, 1979). Bowlby (1944) studied 44 male juvenile thieves, and found that childhood separations from the mother were associated with later delinquent behaviours, but the sample was only small and biased in terms of gender. More recent research exploring the relationship between separation and

antisocial behaviour, suggests that at these times, children revert to “adaptive coping styles”, for example, turning their attention away from their caregiver, becoming more introvert, and less expressive of their needs, found in children following a brief hospital admission (Kooman & Hoeksma, 1993).

A longitudinal study, using a sample of adopted children, therefore simulating a disruption in the early attachment relationship, found significantly greater number of externalising behaviours compared to the general population, which persisted throughout childhood and into adolescence (Van der Voort, Linting, Jaffer, Bakermans-Krananberg & Van IJzendoom, 2013). However, the sample looked at adopted children, so again a high risk group, restricting the ability to generalise results to the wider population. For the parent, separations can be stressful due to circumstance (for example a parent getting divorced (Patterson, DeBaryshe & Ramsey, 1990), which may interfere with parenting practices, decreasing the use of psychological and reasoning methods, and increasing the reliance on physical discipline.

If separations during early infancy have an effect on later adolescent antisocial behaviour, it poses the question of whether separation anxiety, which has been found to correlate with attachment security (Easterbrooks & Aebel, 2000) and maternal sensitivity (Dallerie & Weinraub, 2005) in middle childhood, is associated with antisocial behaviour. It is normal for children to experience separation anxiety when growing up (usually between 12-18 months, but can last up to age three, and beyond), with insecure and ambivalently attached children reporting more separation anxiety in middle childhood (Dallerie & Weinraub, 2005). However, it is not known whether children exhibiting separation anxiety are more likely to exhibit antisocial behaviour in adolescence, as there is no empirical evidence testing this. An exploratory analysis will be completed in this study.

Although there is evidence to support a causal relationship between early attachment indicators, including maternal sensitivity and separations, on later behavioural problems,

much of the evidence is taken from small homeogeneous samples representing high-risk groups. The research focuses on male samples, therefore questioning whether research findings can be reliably generalised to the wider population (Marcus, 1999). A large proportion of the research relies on cross-sectional and correlation designs, utilising retrospective attachment measures (Bor, McGee & Fegan, 2004; Liaible, 2007; Laible, Carlo & Roesch, 2004; Nelis & Rae, 2009), hence it is not possible to infer causality, and biases in data collection more common.

This study aims to overcome some of the limitations in previous research, exploring the development of antisocial behaviour, and to explore the relationship between attachment in early infancy and childhood on the outcome of adolescent antisocial behaviour. Firstly, it will explore the relationship between maternal sensitivity, between the infant and caregiver in infancy, on adolescent antisocial behaviour. Second, it aims to determine the effect of early separations or disruptions in the mother and infant relationship, looking specifically at events that suggest a prolonged period of separation between the child and attachment figure, and their effect on adolescent antisocial behaviour. Lastly the study investigates the effect of feared separation (displayed as separation anxiety symptoms) in middle childhood, on the outcome variable of adolescent antisocial behaviour. In light of the research aims, this research will investigate the following hypothesis, using three different samples taken from the target population identified for this study.

It is hypothesised that an insecure attachment in infancy and childhood will increase the likelihood of adolescent antisocial behaviour. This will be tested using three indicators of attachment security from different time points in the child's development.

1. Infants observed with their caregiver to engage in negative/neutral maternal sensitivity in infancy, will be associated with an increased risk of antisocial behaviours in adolescence, compared to children categorised in the positive maternal sensitivity category. (Sample 1).

2. The number of separations of the infant from the caregiver in early childhood will be associated with an increased risk of antisocial behaviour in adolescence. (Sample 2)
3. There will be an increased risk of adolescent antisocial behaviour in the group of children exhibiting separation anxiety at age 81 months, compared to those who do not show signs of separation anxiety. (Sample 3).

Method

Sample

ALSPAC. Cohort data were used from the Avon Longitudinal Study of Parents and Children (ALSPAC), an on-going population-based study convened in the South West of England. The study targeted mothers residing in the south-west of England, who were expecting to give birth between 1st April 1991 and the 31st December 1992, with the initial sample consisting of 14,541 births, of which 13,971 were alive at 12 months and enrolled in the study. In comparison to the wider population in the South West, the ALSPAC cohort has been found to compare favourably with National Census data collected from mothers in the South West; those in ALSPAC had a slightly higher rate of mothers married or cohabiting, slightly higher incidence of residing in property owned as opposed to rented, and higher incidence of car ownership (Golding, 2004). Further details regarding the sample can be retrieved from the ALSPAC website: www.bristol.ac.uk/alspac.

Sample 1. This was a sub-sample of the ALSPAC dataset, collected from the Child in Focus Clinic, targeted at infants of 12 months of age. Those who attended the clinic were randomly selected from participants within the core ASLPAC sample, born between June 6th and December 11th 1992; 1,432 parents and children were invited to attend. Clinics were held in the city centre, at a Children's Centre, accessible by public and private transport, and travel expenses were reimbursed. Exclusion criteria included those lost to follow-up, babies that had not survived, and premature babies already in the Avon Premature Infant Project

(<33 weeks). All twins in the study were invited due to an interest in habituation tests (Northstone, Carmichael, Sadler & Golding, 2010). Of the 1,388 mothers and children who attended the Child in Focus Clinic, 1,144 completed the Thorpe Interaction Measure of maternal sensitivity, and 683 of these participants were followed up at the age of 15 at the Teen in Focus Clinic (held between the 10th October 2006 and the 9th May 2008). Of the 683 infants, there were 456 complete cases once adjusting for confounding variables (see Figure 1).

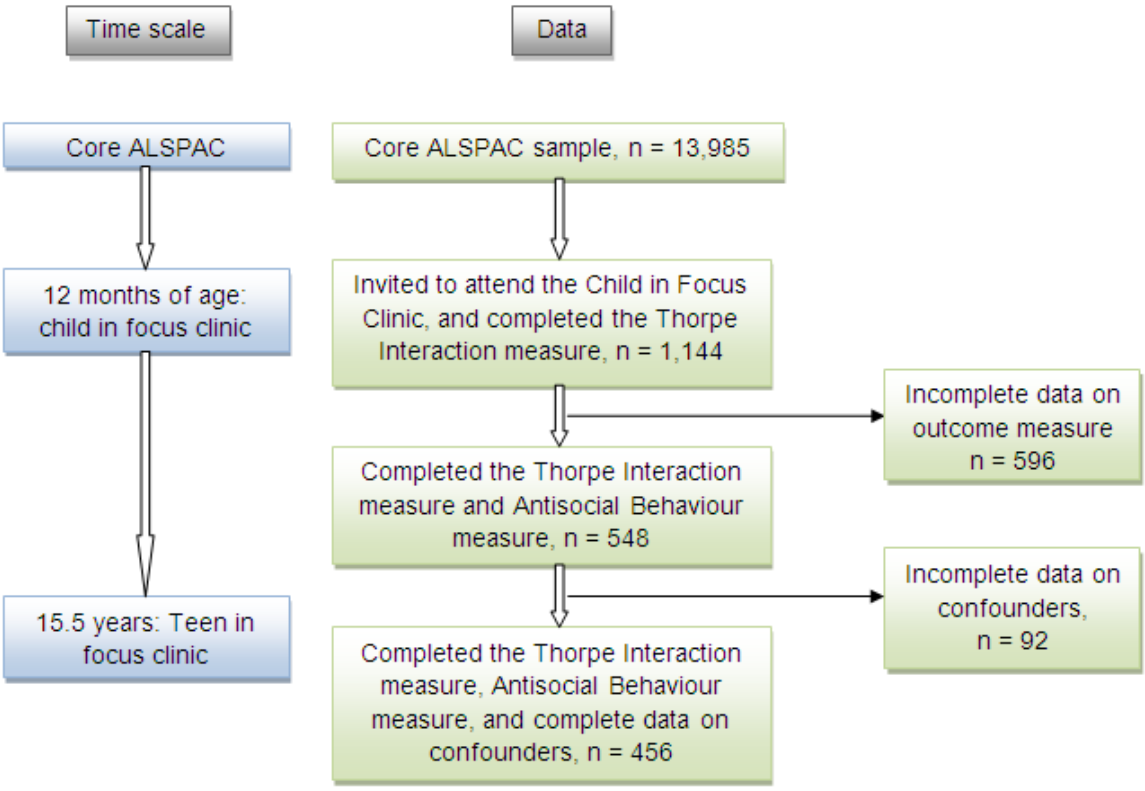


Figure 1. Data collection for sample 1

Sample 2 and 3. Samples 2 and 3 were taken from the core ALSPAC population (n=13,971), and looks at two subsamples (see Figure 2). The first sample included children with data completed on early separations, between the ages of 3-5 years, and completed the antisocial behaviour measures at age 15.5 years. This gave a sample of 3,961 complete cases. The second sample were participants with data on separation anxiety at age 7 years

and 7 months, and completed antisocial data in adolescence; a sample of 3,360 complete cases.

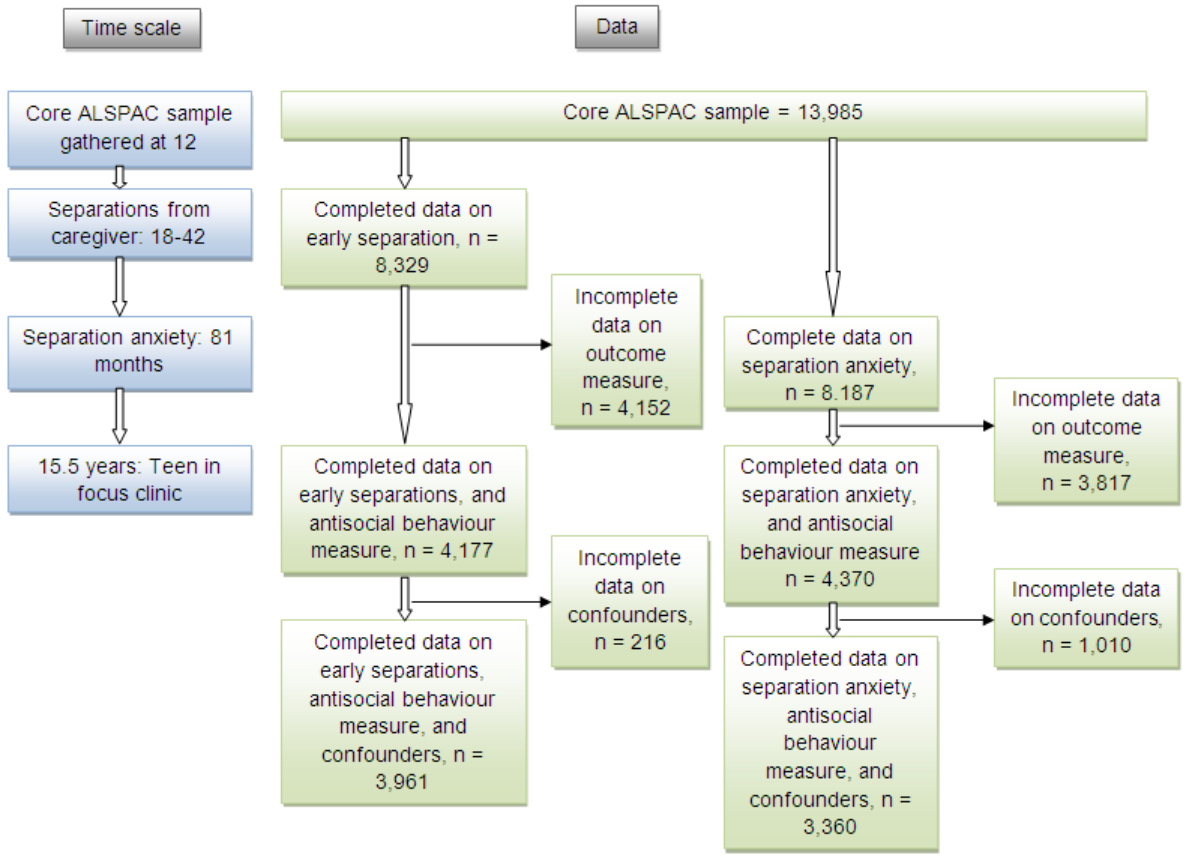


Figure 2. Data collection for sample 2 and sample 3

Power Calculations

Sample 1, using the Thorpe Interaction Measure was anticipated to have the smallest sample, and has been used in previous research using the ALSPAC data. Pearson, Lightman & Evans, (2012) found, that in a sample of 437 mother and infant dyads, 437 showed a positive response style, 295 neutral and 12 negative response styles. Based on these findings, the results show a 60/40 ratio; therefore for 80% power, an effect size of 0.4, significance level of 0.05, and a type two (alpha) error rate of 0.2, power calculations conclude that a total of 205 participants are needed, with 123 required in the positive group

and 82 in the neutral response group. All analyses carried out in both studies were considered to be sufficiently powered.

Ethical Considerations

Ethical approval for this study was sought from the University of Exeter ethics committee, and the ALSPAC study committee convened at Bristol University (see Appendix B1 and B2). Informed consent was given by all parents participating in the ALSPAC study, with parental consent given for data on the identified infants to be gathered and retained, for research purposes. All data used in this study was anonymous, and stored on a secure network, with no direct contact with participants sought at any time.

Measures

Antisocial behaviour (outcome). Questionnaire data on antisocial behaviour were completed by 5,515 teenagers, who attended the Teen in Focus Clinic, an express/outreach clinic targeted at participants of approximately 15.5 years of age. The measure comprised of a self-report computer based questionnaire, completed by the adolescents, who were asked to rate 22 items to reflect the frequency of acts of antisocial behaviour they had been involved in over the past 12 months, using a 4 point likert scale (0 = not at all, 1 = just once, 2 = 2-5 times, 3 = 6+). These questions were administered as part of a questionnaire battery entitled “Boys/Girls Experiences, Thoughts and Behaviour Pack”, with the antisocial behaviour questions taken from the Edinburgh Study of Young People Questionnaire (Smith & McEvie, 2003). See Appendix C for measure and list of items.

An exploratory factor analysis was carried out, by the researcher, for the purpose of this study. Using all of the available data collected for the 22 item scale, the factor analysis confirmed that 81% of the variance was accounted for by one factor (Eigen value = 5.83, n=5,333), with 21 items loading above 0.3 on the identified factor. Therefore a one factor model was assumed for this study, which could be represented by a sum of all the

behaviours with a range of 0-63. A mean 6.82 and standard deviation 7.14 was found using all available data; the variable distribution is illustrated below (see Figure 3).

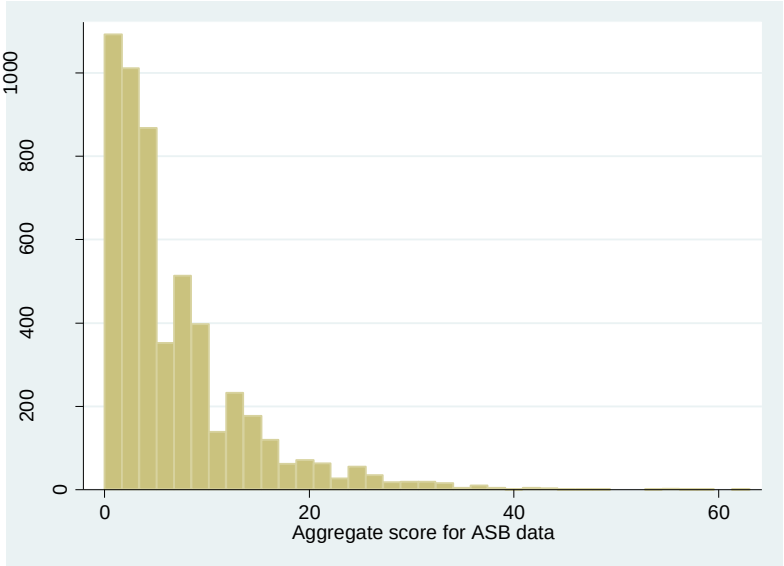


Figure 3. Histogram of "aggregate antisocial behaviour" variable

The antisocial behaviour variable was recoded into a binary variable to account for the non-normal distribution observed. Participants scoring in the top 15% on the antisocial behaviour variable (14+ incidents of antisocial behaviour recorded) were placed in an antisocial category, with those reporting <14 incidents of antisocial behaviour (in the lower 85%) forming a non-antisocial category.

Maternal sensitivity. Data on maternal sensitivity were collected at the Child in Focus Clinic, attended by 1,388 children and mothers at age 12 months. The Thorpe Interaction Measure (Thorpe, Rutter & Greenwood, 2003) was used: a video observation lasting approximately five minutes, where the mother was instructed to read a picture book to their infant in the same way that they would if they were reading it together at home. This measure of maternal sensitivity focuses on non-verbal communication between the mother and child, and promotes responsiveness, regulation of positive affect, acceptance and cooperation within the caregiver relationship (Lyons-Ruth, 1996). This measure reflects more innate and unconscious communications, that occur naturally between the infant and child, decreasing social desirability biases that inevitably occur in a clinic setting.

The interactions were video recorded and non-verbal interaction rated by experienced coders using three categories; positive, negative and neutral (see Table 1 below). The measure had previously been developed with an established inter-rater reliability of kappa = 0.6 (Pearson, Lightman & Evans, 2012; Pearson, Heron, Melotti, Joinson, Stein, Ramchandani, & Evans, 2011). For this analysis we combined the scores into two categories; positive and negative/neutral, due to the small number of observations found in the negative category (n=7 for crude analysis).

Table 1

Thorpe Interaction Measure Coding

Code	***Description***	***N***
Positive	Good eye-contact, stroking, caressing and smiling	317
Neutral	Neither negative nor positive interaction is observed	224
Negative	the mother was observed to be unresponsive to their infant initiating positive interaction, gaze aversion, obvious distraction	7

Separation data. Separations of the child from the mother in early infancy were measured using the Childhood Life Events Scale (CLES; Coddington, 1972, see Appendix D). This measure has been used in research prior to being used in the ALSPAC study, and found to have strong psychometric properties; the questionnaire was normed on a large sample (n=3,617 children), found to have good test-retest reliability, inter-rater reliability, content validity and concurrent validity (Coddington, 1972). The CLES was administered and completed by the parent when the child was 18, 30 and 47 months of age. The questionnaire was part of a larger questionnaire ("My Son's/Daughter's Health and Behaviour"), with the section on "Upsetting Events" consisting of 15 items rated using a likert scale of 1-5 (1=yes, child very upset; 2=yes, child upset; 3=yes, child bit upset; 4=yes, child not upset; 5=no, didn't happen). All three measures were completed by a total of 8,329

mothers, resulting in 3,961 complete cases, when taking into account data for the exposure outcome (adolescent antisocial behaviour), and confounding variables.

For the purpose of this research, we were interested in questions that signified a period of extended separation between the child and caregiver, and distilled three primary variables to focus on across the three questionnaires: 1) Child separated from mother 2) Child separated from father 3) Child admitted to hospital. An aggregate score of separations was calculated for each child across the three questionnaires, between 0 and 9, to create a separate variable "aggregate number of separations", the distribution of this variable is illustrated in Figure 4 below. This variable was then re-categorised into three categories (0=0 separations, 1=1-2 separations, 3=3-8 separations), with 4,332 (52.01%) reporting 0 separations, 3,113 (37.38%) 1-3 separations and 884 (10.61%) 3 or more separations.

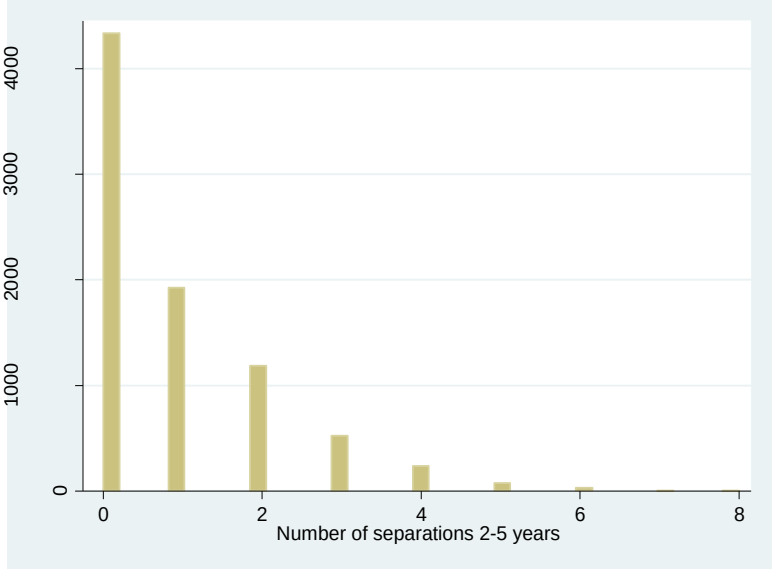


Figure 4. Distribution of number of separations

Separation anxiety data. Separation anxiety was measured at age 91 months, using the Developmental and Wellbeing Assessment (DAWBA) developed for the British Child Mental Health Surveys (Meltzer, Gatward, Goodman & Ford, 2000), designed to generate diagnoses of mental health problems based on diagnostic criteria (Diagnostic and Statistical Manual, 4th Edition (DSM-IV), American Psychiatric Association, 1994) for 5-17

year olds. The DAWBA has been extensively researched (Goodman R, Ford T, Richards H, et al., 2000; Maughan B, Rowe R, Messer J, et al., 2004), and found to be a well-validated measure, with excellent discriminatory validity between community and clinical samples (Goodman et al., 2000), and fair agreement in detecting emotional (kappa = 0.26), hyperactive (kappa = 0.29) and disruptive disorders with clinical diagnosis (Kappa = 0.31), (Kuhn, Winkler Metzke, Aebi & Steinhausen, 2010).

A shortened version of the DAWBA was administered to the child's mother, as a postal questionnaire, with a total of 8,329 questionnaires returned, giving a complete case sample of 3,360. The shortened version of the DAWBA included nine of the fourteen sections, with the questions within the included sections remaining the same as in the full DAWBA[9]. Hence, this was not thought to affect the psychometric properties of the data, with previous studies using individual sections of the DAWBA effectively (Moya, Fleitlich-Bilyk & Goodman et al., 2005), and in research using the ALSPAC data (Marwick, Doolin & Allely, 2012). Questionnaires returned with more than 5 items unanswered were omitted from the analysis. Parents were asked to complete seven items to assess for separation anxiety (see Appendix E), and a score generated using a predefined computer algorithm, based on criteria from the DSM-IV and the International Classification of Disease 10 (ICD-10); see www.dawba.com for information on the scoring process. From the data, two categories were generated: severe separation anxiety, and the presence of separation anxiety symptoms. This research focused on the latter category.

Confounding Variables

[9] Sections included in the shortened version of the DAWBA were: separation anxiety, specific fears or phobias, fear of social situations, post traumatic stress, compulsions and obsessions, generalised anxiety, depression, attention and activity, and awkward and troublesome behaviour.

Variables that had previously been associated with adolescent antisocial behaviour were controlled for during the analysis process, and grouped into two categories: child and parental.[10]

Child variables. Child variables included gender (1=male, 2=female), which has been found to be associated with antisocial behaviour (Fontaine et al., 2009) and maternal sensitivity (Biringen, Robinson & Emde, 1994), and the child's ethnic group (0=white, 1=non-white), also found to be associated with maternal sensitivity (Ispa et al., 2004).

Child variables used in sample 2 and smaple 3 analyses included the following additional variables; incidences of conduct disorder, with a higher incidence of externalising behaviours in early childhood predictive of later behavioural problems (Moffitt, 1993), and incidences of hyperactivity and inattentiveness prior to age 81 months (measured using the Strength and Difficulties Questionnaire (SDQ); Goodman et al., 1997), again associated with later delinquency (Barker, Oliver & Maughan, 2010). These were measured using the SDQ completed by parents and designed to give a score to indicate a child's level of functioning in the following areas; conduct problems, hyperactivity and inattentiveness, emotional disorders, peer problems and pro-social score. A score of 4 or more (out of 10) for conduct problems indicates a higher need in this area (http://www.sdqinfo.com/py/sdqinfo/c0.py). In the ALSPAC sample, 10% of children were found to have a score of 4 or more for conduct disorder using the SDQ, and were classified into a conduct disorder group with those scoring less than 4 (90%) identified as a non-conduct disorder group (variable "conduct disorder at 81 months Y/N"; 1=yes, 0=no). Scores for hyperactivity at 81 months were derived from the SDQ, with the top 10% of participants found to score above 7 out of 10 on the subscale indicating higher needs in this area (Murray et al., 2010). The variable "hyperactivity at 81 months Y/N" was recoded into a dichotomous variable (1=yes, 2=no).

[10] Only confounding variables in the manuscript are commented on in this section, confounder model can be found in Appendix F.

Parental variables. Parental variables explored both maternal and paternal factors that may affect the association between the predictor variables and the outcome variable. These included: mother's age at the birth of the identified child, which has been found to affect parenting styles and child outcomes (Trentacosta & Shaw, 2007). This was coded as follows: 1= 14-15 years, 2=16-20 years, 3=21-25 years, 4=26-30 years, 5=31-35 years, 6=36-40 years, 7=41-45 years, 8=46+ years. The effect of parity (0=primiparous, 1=multiparous) was also explored again as it has been found to influence parenting behaviours, particularly in regard to rules and discipline (Wagner, Schubert & Schubert, 1983), as well as mothers and partner's highest qualification 1=CSE, 2=vocational, 3=O-Level, 4=A-Level, 5=Degree (Tamis-LeMonda, Briggs, McClowry & Snow, 20009), mother's and father's ethnic group (Ispa et al., 2004) (1=white, 2=non-white), and mother and father's social class (Farrington, 2005), scored as 1=professional, 2=skilled, non-manual, 3=skilled, manual, 4=partly skilled, 5=unskilled, 6=armed forces. Maternal and paternal social class were combined into one variable to account for highest parental social class. A history of maternal criminality was also adjusted for: "mother in trouble with the police prior to age 17 years" which, has been found to increase the risk for the child exhibiting antisocial behaviour (Murray & Farrington, 2005).

Attrition and missing data

Missing data was identified within all the variables needed for the analyses, and recoded to exclude any missing values (all missing data was coded with ".").

Analysis Method

Logistic regression models were used to explore the data; these have been found to be an effective method in epidemiological studies to examine the prevalence and effect of dichotomous variables (Dominguez-Almendros, Benitez-Parejo & Gonzalez-Ramirez, 2011). Analyses were first completed for all available data, before confounders were added to the model, and the analysis repeated on complete case data, to allow for comparison between

the crude and adjusted models, and following data attrition. All analyses were completed using Stata/MP12.1 (www.stata.com), and results presented using odds ratios (OR) and 95% confidence intervals (95% CI).

Results

Sample 1

Sample 1 demographics. To test for bias in the sample, a complete cases variable was generated to include all mother and infant pairs in the study, who had complete data for maternal sensitivity and adolescent antisocial behaviour. The complete cases (n=456) were compared to mothers who attended the 12 month clinic, but had incomplete data at follow-up in the Teen in Focus clinic (n=688). Sociodemographics for the two samples were compared, looking at variables including maternal age when giving birth, maternal and paternal education, ethnicity and social class. The juxtaposition of the two samples (see Table 2) revealed that participants in the complete case samples were more likely to be primiparous mothers (52.63% compared to 40.76%), with a higher level of maternal educational attainment, and more likely to be of white ethnic group[11].

Table 2

Means and proportionate of sociodemographics for sample 1

Sociodemographic Variables	Mothers who attended the clinic but had incomplete data (n=688)	Complete cases (n=456	Maternal Sensitivity: Positive (n=264)	Maternal Sensitivity: Negative or neutral (n=192)
Maternal age at delivery, mean (s.d), yrs	26.87 (6.08)	27.62 (5.59)	27.28(5.83)	26.89 (5.91)
Maternal gestation at delivery, mean (s.d). weeks	8.01 (.35)	8.05 (0.33)	8.06(0.36)	8.04 (0.29)

[11] Statistical analyses comparing the complete case sample with the wider ASLPAC sample showed significant differences in parity, $t(1201)=-3.75$, $p<0.00$, level of maternal education $t(1150)=4.40$, $p<0.00$, and ethnicity $\chi^2=9.93$, $p=0.002$.

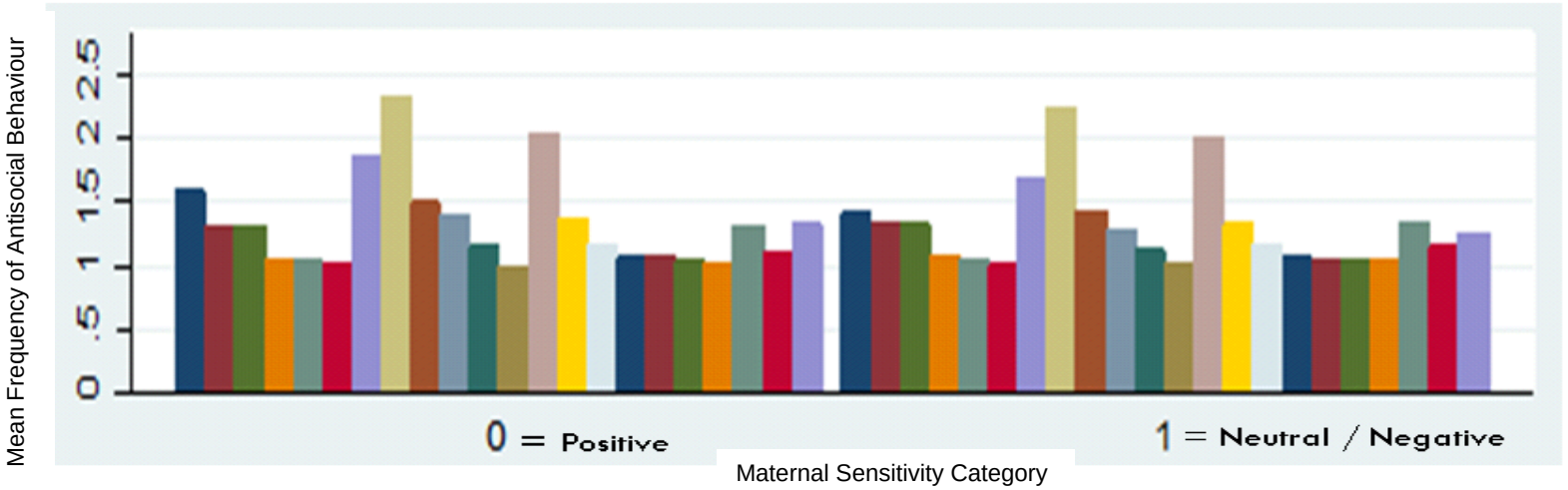
Sociodemographic Variables	Mothers who attended the clinic but had incomplete data (n=688)	Complete cases (n=456	Maternal Sensitivity: Positive (n=264)	Maternal Sensitivity: Negative or neutral (n=192)
Parity, %				
Primiparous	40.76	52.63	57.95	45.31
Multiparous	59.24	47.37	42.05	54.69
Maternal Education, %				
CSE	12.36	5.70	3.41	8.85
Vocational	11.93	8.33	6.82	10.42
O-Level	35.78	40.13	39.77	40.63
A-Level	27.59	26.32	30.30	20.83
Degree	12.36	19.52	19.70	19.27
Paternal Education, %[12]				
CSE	15.55	7.66	8.17	6.95
Vocational	8.71	8.33	6.23	11.23
O-Level	28.46	22.30	23.74	20.32
A-Level	27.37	34.23	32.68	36.36
Degree	19.91	27.48	29.18	25.13
Gender, %				
Male	57.58	48.03	48.86	46.88
Female	42.42	51.97	51.14	53.13
Ethnic Group, %				
Maternal				
White	97.07	99.34	100.00	98.44
Non-white	2.93	0.66	0.00	1.56
Paternal				
White	97.41	99.34	99.62	98.96
Non-white	2.59	0.66	0.38	1.04
Child's				
White (1)	95.63	98.90	99.62	97.92
Non-white (2)	4.37	1.10	0.38	2.08
Social Class %				
Maternal				
I (1)	4.09	7.68	7.20	8.33
II (2)	30.20	36.62	41.67	29.69
III non-manual (3)	44.23	43.20	39.77	47.92
III manual (4)	9.24	5.48	4.55	6.77
IV (5)	9.41	6.36	6.82	5.73
V (6)	2.84	0.66	0.00	1.56
Armed Forces (7)	0.00	0.00	-	-

[12] Missing data for this variable: core sample n=9,635; missing data n=643, complete cases n = 444

Sociodemographic Variables	Mothers who attended the clinic but had incomplete data (n=688)	Complete cases (n=456	Maternal Sensitivity: Positive (n=264)	Maternal Sensitivity: Negative or neutral (n=192)
Paternal				
I (1)	11.08	14.04	16.29	10.94
II (2)	35.96	37.50	36.74	38.54
III non-manual (3)	12.20	10.96	13.64	7.29
III manual (4)	27.93	27.85	24.24	32.81
IV (5)	9.31	8.55	7.95	9.38
V (6)	3.53	1.10	1.14	1.04
Armed Forces (7)	0.00	0.00	-	-
Parental				
I (1)	2.12	3.29	2.65	4.17
II (2)	23.89	28.29	31.82	23.44
III non-manual (3)	38.34	38.82	39.39	38.02
III manual (4)	24.47	23.03	20.45	26.56
IV (5)	9.06	6.14	5.30	7.29
V (6)	2.12	0.44	0.38	0.52
Armed Forces (7)	0.00	0.00	-	-
Neutral or negative maternal response, %	47.82%	42.11%	n/a	n/a

Descriptive statistics. Descriptive statistics for sample 1, show that for the unadjusted sample (n=548) with data on the maternal sensitivity (12 months), and antisocial behaviour at age 15.5 years 42.15% were observed to have negative or neutral maternal sensitivity. In the complete case sample (n=456, see Table 2), the distribution of maternal sensitivity remained similar with 42.11% observed as negative/neutral.

Comparisons looking at the types of antisocial behaviours engaged in across the two groups of maternal sensitivity, identified similar patterns (see Figure 5), with the most common antisocial acts recorded as “said nasty things someone they know or slagged them off”, “kicked or punched a brother or sister on purpose” and “ignored someone they know on purpose”. Antisocial acts that were less common, were more severe law defying incidents, for example; “broke into a car or van to try and steal something out”, “broken into a house or building to try and steal something out” and “stolen something from a shop or store in the last year”.



Key	Variable	Key	Variable
	YP has travelled on a bus/train without paying		YP has broken into a house or building to try and steal someth
	YP has written things or sprayed paint on property that did no		YP has hit/kicked/punched a brother or sister on purpose, in t
	YP has stolen something from a shop or store, in the last year		YP has hit/kicked/punched someone else on purpose with the int
	YP has sold an illegal drug to someone, in the last year		YP has deliberately damaged or destroyed property that did not
	YP has ridden in a stolen car/van/motorbike, in the last year		YP has sold something that didn't belong to them or that they
	YP has broken into a car/van to try and steal something out of		YP has stolen money or property that someone was holding/carry
	YP has ignored someone they know on purpose or left them out		YP has hit or picked on someone because of their race or skin
	YP has said nasty things to someone they know, or slagged them		YP has hurt or injured animals or birds on purpose, in the las
	YP has threatened to hurt someone they know, in the last year		YP has set fire or tried to set fire to something on purpose,
	YP has hit, spat or thrown stones at someone they know, in the		YP has carried a knife or other weapon with them for protectio
	YP has got other people to do these things to someone they kno		YP has been rowdy or rude in a public place such that people c

Figure 5. Bar graph of antisocial behaviours across maternal sensitivity categories.

Antisocial behaviour by maternal sensitivity. Initial logistic regression analyses were carried out to explore the relationship between maternal sensitivity and adolescent antisocial behaviour, on the sample of 548. The analysis gave an OR=1.12 [CI=0.67-1.89], p=0.67, indicating that maternal sensitivity had little effect (non-significant) on the risk of adolescent antisocial behaviour.

The analysis was repeated adjusting for confounders derived from the literature that have been evidenced to be correlated with an increased prevalence of adolescent antisocial behaviour, including gender (Fontaine, Carbonneau, Vitaro, Barker & Tremblay, 2009), social class (Farrington, 2001), maternal education (Barker & Maughan, 2009), and the early parental criminality (for example, mother being in trouble with the police prior to the age of 17 years (Farrington, 1989)). Confounders were initially entered into the analysis singly, to look at individual effects (see table 3, and Appendix F), with maternal trouble with police prior to age 17 found to have the largest effect (OR=1.18 [CI=0.69-2.01], P=0.54), but yet not substantially different to the crude analysis. Further analyses, including all identified confounders, using a complete case sample (n=456), found an OR=0.72 [CI=0.37-1.39], p=0.33). These results show that the points estimate was in the direction of a slight protective effect of negative/neutral maternal sensitivity, but there was no statistical evidence to support a difference.

Looking at the relationship between maternal sensitivity and adolescent antisocial behaviour, on the complete case sample, found an unadjusted OR=0.79 [CI=0.42-1.48], p=0.46; see Table 3). A discrepancy between the crude analysis on all data compared with the complete case sample is evident, with a shift away from the direction hypothesised. Results are shown in the table below (see Appendix F for extended results, as only results directly relevant to the hypotheses are covered in the manuscript).

Table 3

Odds ratios for antisocial behaviour by maternal sensitivity, with and without adjustments, in sample with all available data and complete cases.

Analysis	**Unadjusted**					**Adjusted for Gender**			**Adjusted for Maternal trouble with police < 17 yrs**		
	N	**% ASB**	**OR**	**CI**	**P**	**OR**	**CI**	**P**	**OR**	**CI**	**P**
Maternal Sensitivity											
Positive	317	11.36	1.00*			1.00*			1.00*		
Neutral / negative	231	12.55	1.12	0.67-1.69	0.67	1.10	0.65-1.86	0.72	1.18	0.69-2.01	0.54
Maternal Sensitivity											
Positive	264	10.98	1.00*			1.00*			1.00*		
Neutral/ negative	192	8.85	0.79	0.42-1.48	0.46	0.79	0.42-1.51	0.49	0.74	0.39-1.41	0.36
(complete case sample, n=456)											

**Reference category*

Sample 2 and 3

Demographics for Samples 2 and 3

Sample 2 and 3 were both taken from the available ALSPAC population; the sociodemographics of both samples, when compared with the larger ALSPAC sample, displayed in Table 4. Differences between the samples were noted in the following variables; higher level of educational attainment for parents in the complete samples when compared to the ALSPAC population, and a higher number of primiparous mothers (49.22% compared to the wider ALSPAC sample (44.75%)[14].

Table 4

Means and proportions of sociodemographics data for sample 2 and 3

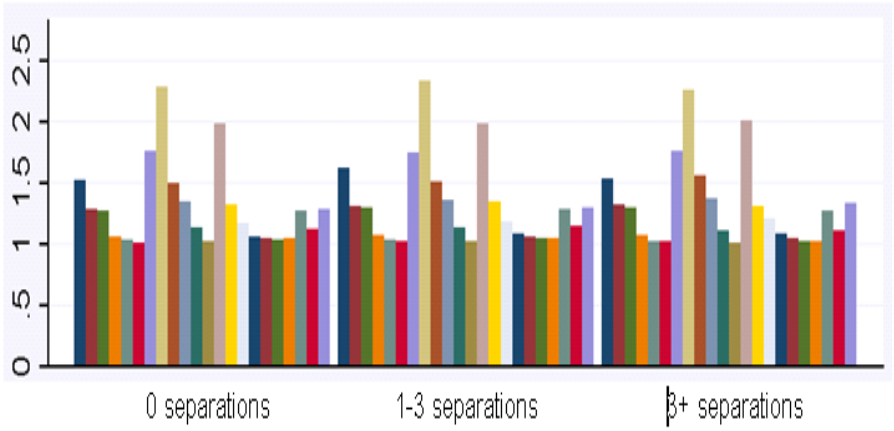
Sociodemographic Variables	Mothers in core ALSPAC sample (n=13,985)	Complete cases, mothers with data on separations and antisocial behaviour (n=3,961)	Completed cases separation anxiety and antisocial behaviour (n=3,360)
Maternal age at delivery, mean (s.d), yrs	27.97(5.07)	29.55(4.32)	27.62(5.64)
Maternal gestation at delivery, mean (s.d)	8.00(.65)	8.02(.37)	8.03(.35)
Parity			
Primiparous	44.75%	49.22%	52.33%
Multiparous	55.25%	50.78%	47.67%
Maternal Education, %			
CSE	14.92	7.40%	6.03%
Vocational	10.51	7.32%	6.61%
O-Level	36.86	35.72%	34.77%
A-Level	23.98	29.89%	31.37%
Degree	13.73	19.67%	21.22%

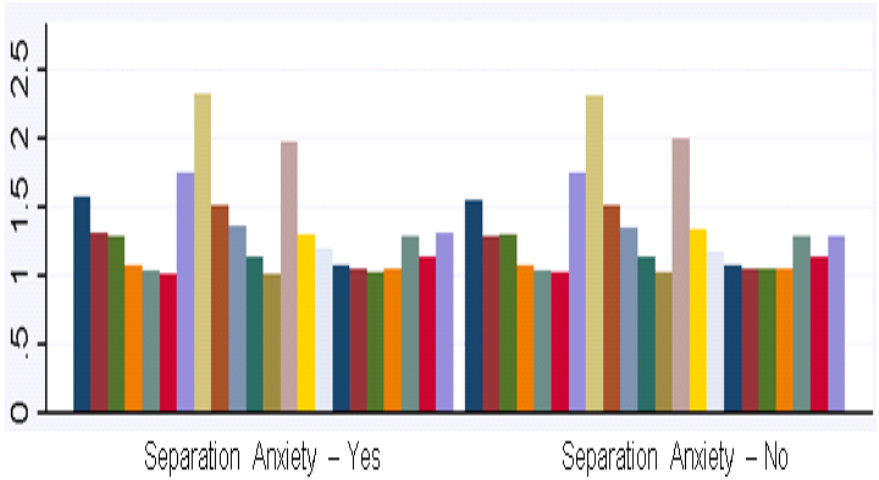
[14] Statistical analyses found significant differences between the wider ALSPAC sample and sample 2 on the variables parity, $t(12233)=-6.79$, $p=0.00$ (more likely to be primiparous mothers), greater maternal age, $t(10472)=9.51$, $p=0.00$, and higher maternal education, $t(11021)=23.76$, $p=0.00$, and between the wider ALSPAC sample and sample 3 with higher maternal education recorded, $t(11,721)=-25.23$, $p=0.00$, and more likely to be primiparous mothers, $\chi^2=102.80$, $p=0.00$.

Sociodemographic Variables	Mothers in core ALSPAC sample (n=13,985)	Complete cases, mothers with data on separations and antisocial behaviour (n=3,961)	Completed cases separation anxiety and antisocial behaviour (n=3,360)
Paternal Education, %			
CSE	17.70	11.84%	11.00%
Vocational	9.41	7.85%	7.86%
O-Level	23.69	22.61%	21.98%
A-Level	28.96	31.41%	31.74%
Degree	20.24	26.29%	27.42%
Gender, %			
Male	51.64	47.92%	47.47%
Female	48.36	52.08%	52.53%
Ethnic Group, %			
Maternal			
White	97.38	97.60%	98.60%
Non-white	2.62	2.40%	1.40%
Paternal			
White	96.04	98.36%	97.92%
Non-white	3.96	1.84%	2.08%
Child's			
White (1)	94.96	96.54%	96.88%
Non-white (2)	5.04	3.46%	3.13%
Social Class %			
Maternal			
I (1)	5.87	8.33	8.42
II (2)	31.48	37.42	38.07
III non-manual (3)	42.77	40.17	40.42
III manual (4)	7.80	5.86	5.60
IV (5)	9.86	7.12	6.40
V (6)	2.17	1.04	1.07
Armed Forces (7)	0.04	0.06	0.03
Paternal			
I (1)	10.91	14.58	15.45
II (2)	33.97	38.43	38.10
III non-manual (3)	10.87	12.71	13.10
III manual (4)	31.34	25.24	24.94
IV (5)	9.78	7.21	6.67
V (6)	2.87	1.71	1.70
Armed Forces (7)	0.26	0.11	0.06
Parental			
I (1)	2.74	4.17	4.17
II (2)	25.25	31.34	31.64
III non-manual (3)	33.53	35.57	35.21
III manual (4)	27.82	22.54	23.13
IV (5)	9.19	5.71	5.30
V (6)	1.23	0.52	0.48
Armed Forces (7)	0.25	0.14	0.09

Descriptive statistics. Descriptive statistics were generated on the number of early separations experienced by children from their caregivers. The mean number of separations experienced within the complete cases sample was 0.90 (s.d 1.2), with 10% of the sample experiencing more than three separations (see Appendix G for the distribution of data). Of the complete case sample (n=3,361), 29.89% showed symptoms of separation anxiety.

The types of antisocial behaviours engaged in across the two samples were found to follow similar patterns (see Figure 6). Higher frequency incidents included; “travelled on a train/bus without paying”, “said nasty things to someone they know, or slagged them off”, and “ignored someone they know on purpose or left them out”. Acts of antisocial behaviour that were less frequently reported across the two samples were more severe and rule violating behaviours, including; “broke into a car or van to try and steal something out”, “broken into a house or building to try and steal something” and “has stolen money or property that someone was holding/carrying”.





Key	Variable	Key	Variable
	YP has travelled on a bus/train without paying		YP has broken into a house or building to try and steal someth
	YP has written things or sprayed paint on property that did no		YP has hit/kicked/punched a brother or sister on purpose, in t
	YP has stolen something from a shop or store, in the last year		YP has hit/kicked/punched someone else on purpose with the int
	YP has sold an illegal drug to someone, in the last year		YP has deliberately damaged or destroyed property that did not
	YP has ridden in a stolen car/van/motorbike, in the last year		YP has sold something that didn't belong to them or that they
	YP has broken into a car/van to try and steal something out of		YP has stolen money or property that someone was holding/carry
	YP has ignored someone they know on purpose or left them out		YP has hit or picked on someone because of their race or skin
	YP has said nasty things to someone they know, or slagged them		YP has hurt or injured animals or birds on purpose, in the las
	YP has threatened to hurt someone they know, in the last year		YP has set fire or tried to set fire to something on purpose,
	YP has hit, spat or thrown stones at someone they know, in the		YP has carried a knife or other weapon with them for protectio
	YP has got other people to do these things to someone they kno		YP has been rowdy or rude in a public place such that people c

Figure 6. Pattern of antisocial behaviours by number of separations

Antisocial behaviour by number of separations. Logistic regression analyses were used to explore the effect the variable "number of separations from the caregiver in infancy", on adolescent antisocial behaviour (see Table 5). On a sample of 4,177, an OR=1.08 [CI=0.95-1.24], p=0.23) was found, with this risk moving in the direction hypothesised (OR=1.26 [CI=0.91-1.65], P=0.17) as the number of separations increased to three or more (see Figure 7), but the results remained non-significant. This finding remained consistent when adjusting for confounders, as outlined in sample 1.

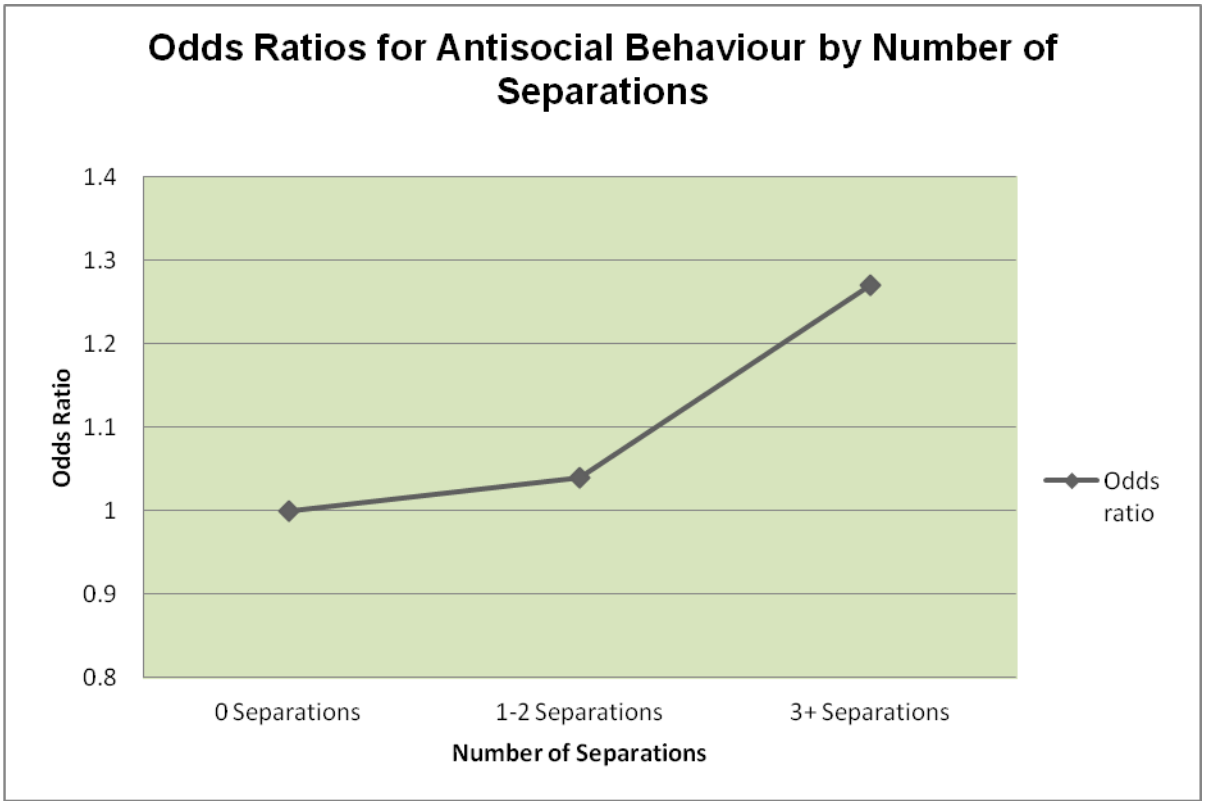


Figure 7. Graph to show odds ratios across separation categories on complete case sample.

Confounders were entered separately into the analysis, to ascertain whether any of the variables were confounding the relationship between number of separations and adolescent antisocial behaviour. Results for each confounder illustrated that the confounders had little effect on the longitudinal relationship when entered independently. An analysis on the complete case sample (n=3,961), adjusting for all confounders (gender, child's ethnic group, maternal qualifications, and trouble with police < 17), gave an OR=1.04

[CI=.85-1.27], p=.73 for 1-3 separations, and OR=1.22 [CI=.90-1.66], p=.20 for 3+ separations. The crude model completed on the complete case sample gave similar results OR= 1.04, [CI=0.85-1.27], p=.71 for 1-3 separations, and OR=1.27 [CI=94-1.71], p=0.12 for 3+ separations. The results infer that in this study the confounders were not found to have an effect on the relationship between the number of separations in childhood and later adolescent antisocial behaviour. Missing data (n= 213) was therefore found to have little effect on the analysis, and it was decided it was not necessary to impute scores for the missing data points.

Table 5

Odds ratios for antisocial behaviour by number of separations, with and without adjustments, on all available data and complete case sample

Analysis	**Maternal Sensitivity**					**Adjusted for Child's Ethnic Group**			**Adjusted for Maternal trouble with police < 17 yrs**		
	N	**% ASB**	**OR**	**CI**	**P**	**OR**	**CI**	**P**	**OR**	**CI**	**P**
Number of Separations											
0 separations	2,222	12.87	1.00*			1.00*			1.00*		
1-3 separations	1,538	13.26	1.04	0.85-1.26	0.73	1.03	0.85-1.26	0.75	1.02	0.84-1.24	0.84
3+ separations	417	15.35	1.26	0.91-1.65	0.17	1.21	0.89-1.63	0.22	1.23	0.92-1.66	0.16
Linear Term			1.08	0.95-1.24	0.23	1.08	0.94-1.23	0.29	1.08	0.94-1.23	0.26
Number of Separations											
0 separations	2,113	12.59	1.00*			1.00*			1.00*		
1-3 separations	1,456	13.01	1.04	0.85-1.27	0.71	1.03	0.85-1.26	0.74	1.03	0.84-1.26	0.78
3+ separations	395	15.44	1.27	0.94-1.71	0.12	1.25	0.93-1.70	0.14	1.26	0.93-1.71	0.13
Linear Term (complete case sample, n=3,961)			1.10	0.96-1.26	0.18	1.09	0.96-1.25	0.21	1.09	0.95-1.25	0.21

** Reference Category*

Antisocial behaviour by separation anxiety. Logistic regression analyses looked at the relationship between separation anxiety at the age of 81 months on the outcome variable of adolescent antisocial behaviour, yielded an OR=0.95 [CI=79-1.15], P=0.62, see Table 6. The results suggest that separation anxiety in middle childhood is not related to adolescent antisocial behaviour in this sample.

Confounding variables were entered into the analysis independently. Results adjusting for the potential confounders were unremarkable when compared to the crude analysis (see Appendix F), with no evidence to suggest that any of the variables adjusted for had an effect on the longitudinal relationship of interest. When all of the confounders were adjusted for in one analysis, the results were consistent with the crude analysis OR=1.00, [CI=0.80-1.26], P=0.98, and with the crude analysis conducted on the complete case sample (n=3,360, OR=1.01, [CI=0.80-1.26], P=0.96), suggesting that neither the confounding variables analysed nor the missing data (n=1,010) had little effect on the analysis.

Table 6:

Odds ratios for antisocial behaviour by separation anxiety, with and without adjustments on all available data and complete case sample

Analysis	Maternal Sensitivity					Adjusted for Conduct Disorder			Adjusted for Maternal trouble with police < 17 yrs		
	N	% ASB	OR	CI	P	OR	CI	P	OR	CI	P
Separation Anxiety											
No	1,252	13.98	1.00*			1.00*			1.00*		
Yes	3,118	13.41	0.95	0.79-1.15	0.62	0.99	0.81-1.21	0.93	0.97	0.80-1.17	0.73
Separation Anxiety											
No	937	12.81	1.00*			1.00*			1.00*		
Yes	2,423	12.88	1.01	0.80-1.26	0.96	1.03	0.82-1.29	0.82	1.01	0.80-1.26	0.96
(complete case sample)											

** Reference Category*

Analysis	Adjusted for Hyperactivity/Inattentiveness			Adjusted for Child's Ethnic Group		
	OR	CI	P	OR	CI	P
Separation Anxiety						
No	1.00*			1.00*		
Yes	0.98	0.80-1.19	0.83	0.95	0.79-1.56	0.62
Separation Anxiety						
No	1.00*			1.00*		
Yes	1.04	0.83-1.30	0.74	1.01	0.80-1.26	0.95
(complete case sample)						

** Reference Category*

Attrition and Missing Data

Over the course of the study a percentage of participants were naturally lost to follow-up, and a further percentage of participants were found to have incomplete data when accounting for confounders.

In sample 1, 16.79% (n=92) of participants were excluded due to incomplete data. This altered the direction of the results between the initial sample (n=548, OR=1.12 [CI=0.67-1.69], p = 0.67) to the complete case sample (n=456, OR=0.79, [CI=0.42-1.48], p=0.46). This discrepancy may be indicative of adolescents exhibiting antisocial behaviour being more prone to being lost to follow-up, as indicated in previous ALSPAC studies (Wolke, Waylen, Samara, Steer, Goodman, Ford, & Lamberts, 2009). Alternatively, it may signify that other variables, not identified in the study are mediating the relationship.

In sample 2, looking at the relationship between early separations and adolescent antisocial behaviour, only 5.17% of participants were lost when composing the complete case sample, which had little effect on the results found (OR=1.08 in initial analysis, OR=1.10 in the complete case sample). The last analysis, exploring the relationship between separation anxiety and adolescent antisocial behaviour, 23.11% of data were lost when controlling for confounding variables, which marginally increased the reported OR (from 0.95 to 1.01), but this was not found to alter the unadjusted estimate.

Although some of the levels of missing data/attrition recorded in these studies are relatively high, following review of the results, it was decided that imputing values for the missing data would not sufficiently enhance our understanding of the relationships between the attachment variables and antisocial behaviour. Previous research on this cohort, using multiple imputations, found that relationships were strengthened, but these were not significantly different to findings already drawn from the available data (Melotti, Heron, Hickman, Macleod, Ricardo, Araya, & Lewis, 2010; Wolke, et al., 2009).

Discussion

The aim of the first analysis (using sample 1), was to establish whether there is evidence for a longitudinal relationship between maternal sensitivity in infancy and adolescent antisocial behaviour. Results in the unadjusted analysis were not found to support an association between the variables, despite previous research advocating that negative maternal sensitivity increases the incidence of adolescent antisocial behaviours (Ainsworth, 1978; Bowlby, 1944; Trentacosta & Shaw, 2008; Wakschlag & Hans, 1999). After adjusting for potential confounders, there were no identified factors, found to be mediating the relationship between maternal sensitivity and adolescent antisocial behaviour. Analysis on the complete case sample illustrated a small, but non-significant, association away from the direction hypothesised,. However, in sum, the results from this study do not support the hypothesis posited.

The remaining analyses (using sample 2 and 3) explored the longitudinal effect of an early secure attachment relationship in infancy on adolescent antisocial behaviour, by looking at the effect of multiple separations and separation anxiety. Hypotheses derived from both theoretical and empirical research evidence, suggesting disruptions in the early caregiver relationship contributing to a greater incidence of behavioural difficulties and antisocial behaviour (Bowlby, 1944; Douglas 1975; Kooman & Hoeksma, 1993; Quinton & Rutter, 1976), were not significantly, by the findings in this study. As hypothesised, as the number of separations increased in infancy, the relationship with adolescent antisocial behaviour moved in the direction hypothesised, but no significant results to support findings from previous research (Loeber & Dishion, 1983).

Separation anxiety in middle childhood was found to have little effect on the outcome of adolescent antisocial behaviour, with the odds ratio remaining close to the linear term. It was hypothesised that separation anxiety would increase the likelihood of adolescent

antisocial behaviours, but there was no evidence of an association, even after adjusting for confounders.

With regard to clinical implications, the study highlights the complexity of factors associated with the development of attachment and later subsequent problematic, delinquent and antisocial behaviours. The null results found in this analysis may be indicative of different causal pathways developing across the life course, influenced by multiple factors (Moffitt, 1993). Furthermore, despite the theorised importance of a secure attachment in infancy, measured in this study using the three component measures at different time-points, the results suggest that this is not a strong predictor in this community sample. In terms of targeting, managing and intervening to decrease the occurrence and impact of antisocial behaviours on individuals, families and society, attachment theory may be useful for informing clinical assessments (Zeanah, Berlin & Boris, 2011), within a wider biopsychosocial approach considering multiple factors.

A strength of this study was the sample size, with all analyses adequately powered to ensure that any observed effect sizes in the data would be represented in the analysis process. The large sample, using a population based cohort study increases the ecological validity of the findings, with the research sample found to compare favourably to British Census Data (Golding, 2004). The use of longitudinal cohort data allows for cause and effect to be inferred, overcoming recall biases and problems with reverse causality.

In addition to the large sample size, all measures used in the study are well-validated measures (e.g. SDQ (Goodman et al., 1997), DAWBA (Goodman et al., 2000); Thorpe Interaction Measure); with high validity in regard to measuring the constructs identified in the ALSPAC study. Utilising video material to record maternal sensitivity is a measure that is not commonly used, due to it being resource intensive to collect and code. However, the measure offers a reliable and in vivo measure, which may be subject to some social desirability bias, but less so than self-report questionnaire data and retrospective attachment

measures, which aim to reconstruct autobiographical memories (Van IJendoorn et al., 2007). The maternal sensitivity measure has been found to correlate with other measures of attachment (Bigelow et al., 2010; Ruth-Lyons, 1996; Meins, 1999), with maternal sensitivity been found to be a key component for a secure attachment relationship. As the research utilised longitudinal cohort data, it was not possible to control which attachment measures were used in the study. Hence, measures chosen reflect the best data available to map onto the constructs of interest.

Self-report data collected on antisocial behaviour also utilised a well-validated measure (Smith & McEvie, 2003), exploring a range of antisocial behaviours (from minor to severe), allowing the adolescent to report anonymously and in confidence. It is an effective approach in attempting to capture antisocial behaviour data that is not recorded through more formal methods (e.g. school incidents, police reports), and overcomes subjective reports from parents, carers or teachers.

Within the studies it was possible to adjust for a diverse range of confounders and sociodemographic factors, which have been found to correlate with adolescent antisocial behaviour. Data on these variables were adjusted for in the analyses, with no particular factors found to be mediating any of the relationships, thus eliminating interaction effects. It is possible that the lack of effects found for some variables may be due to small sample sizes, for example mothers who have been in trouble with the police prior to the age of 17, with the analysis therefore underpowered (Davies & Crombie, 2009), but this is beyond the scope of the study.

Exploring the null results, and results away from the direction hypothesised, results from sample 1 suggested that negative or neutral sensitivity observed in early infancy causes movement away from the direction hypothesised. One explanation for this finding may be related to the sample, and the inevitable attrition rate experienced in studies using longitudinal cohort data, with systematic attrition explored on the ALSPAC sample found

those with disruptive behavioural disorder were more likely to be lost (Wolke et al., 2009). Therefore, it is probable that children at greater risk of adolescent antisocial behaviour were disproportionately represented in the group lost to attrition, and if this is the case the effect may have been overlooked. Alternatively, it may be that children with non-positive maternal sensitivity in infancy may have exhibited childhood limited externalising behaviours, and grown out of antisocial tendencies by adolescence (Moffitt, 1993).

Participants retained at follow-up in sample 1, were children with mother's with higher levels of education, parents with higher social class status with a higher proportion of primiporous mothers, in comparison to the wider ALSPAC sample. There is substantive research to suggest that exposure to environmental risk factors can increase the risk of later adolescent behaviour (for example; parental criminality, Farrington, 1989), and we can hypothesise that these participants may have been less likely to engage in all data collection. Previous research supporting the relationship between poor maternal sensitivity and later behavioural problems, have failed to go beyond the age of 11 years, and have been found to represent homogeneous samples (Trentacosta & Shaw, 2008) consisting of children from high-risk groups, low socioeconomic status families, with the focus mostly on male antisocial behaviour. It is therefore not surprising that with this sample differing on many sociodemographic factors, that the results are inconsistent with the literature.

Exploring the effect of missing data in sample 2 indicated that despite the level of attrition, the results between the initial analyses and complete case analyses showed little difference, suggesting that the missing data had little effect on the outcome. In contrast to sample 1, the sample size for the analyses in sample 2 and 3 was initially much larger, and may be associated with the use of questionnaire data which is less resource intensive to collect.

The results from sample 2 suggest a possible increase in risk of adolescent antisocial behaviour as the number of separations increases (although this is non-significant), is

congruent with previous research. Periods of separation during early childhood interrupt the attachment relationship as the child learns that the caregiver is not consistently, and predictably available to them.

The transition to adolescence marks an important transition for children as their peer attachments become more central as they move towards becoming more autonomous and independent. Such peer attachments rely on the child's ability to empathise with others, to regulate their emotions, and have the capacity for reflective functioning (Farrington, 2000), which have been found to occur more often in children with a secure attachment style. It is likely that peer competence, empathy and self-regulation are all factors mediating the relationship between separation and antisocial behaviour, and exploring these further may illustrate the observed effects. Therefore, the absence of an observed relationship between maternal sensitivity or separation anxiety with antisocial behaviour, may be a by-product of children becoming more autonomous during childhood. Thus developing the ability to regulate their own behaviour outside of the home (Sroufe, 2005), engaging in a larger social network, and forming secure peer relationships (Lansford et al., 2003). This may be influenced by other attachment relationships with peers, teachers and the school (Hirschi, 1989).

Despite utilising a design to overcome the methodological limitations of previous research, there are still some limitations of the study, which need to be accounted for when disseminating the research findings, and planning future research. In this study, focusing on risk factors associated with attachment security (including; the mother's maternal sensitivity and responsiveness to their infant, periods of separation in early childhood, and the presence of separation anxiety symptoms in middle childhood), the cumulative, and interaction effects of other variables are overlooked. This may be a particularly pertinent point to consider in regard to the length of the study, and the concurrent natural development of a child's abilities and competencies during this time. For example, increasing social competence, autonomy, school achievement (Gaik et al., 2010) and peer attachments

(Liaible, 2007; Laible, Carlo & Roesch, 2004), as suggested by previous research. The availability of this data within the ALSPAC cohort lends itself to future research, on a larger scale, to look at modelling the interactions between multiple variables.

Although the maternal sensitivity measure used in this study has been found to be a reliable and valid measure, consideration needs to be given to determining specific aspects of maternal sensitivity that the measure is tapping into. Maternal sensitivity has been found to be multimodal, drawing on the mother's ability to respond both sensitively and consistently to their infant's needs, at the right time, thus matching their behaviour to the appropriate zone of proximal development for their infant (Meins, 1993). Measuring the concept of maternal sensitivity, and how this abstract construct relates to the wider theory of attachment, brings with it some degree of subjectivity, with maternal sensitivity observed within the constraints of a clinic setting, which may only be measuring a one dimensional aspect of maternal sensitivity being played out (Bigelow et al., 2010).

Furthermore, in sample 1, those completing the measure were found to be a sub-sample with slightly higher maternal education and social class, with much of the research into maternal sensitivity and mind mindedness using similar community samples (Laranjo, Bemiera & Meins, 2008). Therefore, research that supports the use of targeted interventions to improve maternal sensitivity, and to decrease externalising and delinquent behaviours (Morretti & Obsuth, 2009), are likely not be representative of more at risk children, from more vulnerable backgrounds.

To extend this research, following-up the sample lost to attrition, would allow for further exploration of the effect that missing data is having on the analyses. Previous studies in ALSPAC have implemented multiple imputations to estimate values for missing data, which were found to make minor changes in the strengths of relationships between variables studied, in the same direction as found prior to imputing data (Melotti, Heron, Hickman, Macleod, Araya, & Lewis, 2010). It may be plausible, in terms of expected gains,

to impute missing data for study one, to test further the hypothesis that more antisocial behaviour children are lost to follow-up than children not exhibiting antisocial behaviour, but this may pose a challenge in terms of selecting variables to calculate the imputation values. A criminal records check at age 25 years for the identified sample, and the wider cohort would be a more reliable and valid extension to this research, to ascertain if, the sample lost to follow-up; have engaged in a greater number of antisocial or offending behaviours.

To conclude, this study is the first study to look at the relationship of early attachment on the outcome of adolescent antisocial behaviour, using three different measures; maternal sensitivity, separations from caregiver in infancy and separation anxiety in middle childhood, on a large population based sample. It adds to the current evidence base, as well as reflecting on how research in this area could be extended.

Key Findings:

1. There is no conclusive evidence, from using a large, longitudinal, population-based cohort sample, that negative or neutral maternal sensitivity observed in infancy increases the likelihood of adolescent antisocial behaviour.
2. A greater number of separations experienced by the infant from their mother, between the age of 31 and 51 months, found a slightly higher incidence of adolescent antisocial behaviour, with three or more separations increasing the risk (although this relationship was not found to be statistically significant).
3. Separation anxiety in middle childhood was not found to have an effect on later adolescent antisocial behaviour.
4. This study provides a large, longitudinal population based sample to test the hypothesis of an insecure attachment in infancy increasing the risk of adolescent antisocial behaviour. Despite the sample overcoming previous sampling biases, attrition may have underestimated some of the effects found.

Acknowledgements

The author is grateful to the participants and researchers involved in the ALSPAC study, and their dedication in collecting and maintaining a comprehensive and resource rich dataset, and for the privilege of accessing the data set for this research. Furthermore, to thank both Dr Julian Walker and Professor Glyn Lewis for their on-going support, encouragement, and sharing of knowledge and expertise during the course of this study. Thanks to the ALSPAC staff for providing high quality training, in the use of the ALSPAC data, and to research tutors at Exeter University for additional support and consultation.

Dissemination Statement

Throughout the research process, the importance of designing and carrying out a clinically relevant research project was held in mind, with the effectiveness of research relying on the effective dissemination of the results to the relevant audience (McHugh & Barlow, 2010).

This research will be disseminated through the ALSPAC academic and research community at Bristol University, and the DClinPsych community at Exeter University. Following feedback from examiners, it will be submitted for publication, with the research paper targeting the Journal of Child Psychiatry and Psychology (impact factor 4.281, 2011), to contribute to the existing research.

It is hoped that the write-up and the presentations reflect both the contribution of the participants in the study, and the contribution of the research to the topic area.

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Appendix

Appendix A Instructions to Authors for Target Journal (Manuscript)

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Kiernan, C. (1981). Sign language in autistic children. *Journal of Child Psychology and Psychiatry*, *22*, 215-220.

Thompson, A. (1981). *Early experience: The new evidence*. Oxford: Pergamon Press.
Jones, C.C., & Brown, A. (1981). Disorders of perception. In K. Thompson (Ed.), *Problems in early childhood* (pp. 23-84). Oxford: Pergamon Press.

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Appendix B B1 Exeter Ethical Approval

Psychology Research Ethics Committee

Psychology, College of Life & Environmental Sciences

Washington Singer Laboratories
Perry Road
Exeter
EX4 4QG

Telephone +44 (0)1392 724611
Fax +44 (0)1392 724623
Email Marilyn.evans@exeter.ac.uk

To: **Julia Salt**

From: **Cris Burgess**
CC: **Julian Walker & Glyn Lewis**

Re: **Application 2011/586 Ethics Committee**
Date: **September 17, 2013**

The School of Psychology Ethics Committee has now discussed your application, ***2011/586*** **– How does maternal sensitivity in infancy and actual or feared separation in childhood affect adolescent antisocial behaviour?*.*** The project has been approved in principle for the duration of your study.

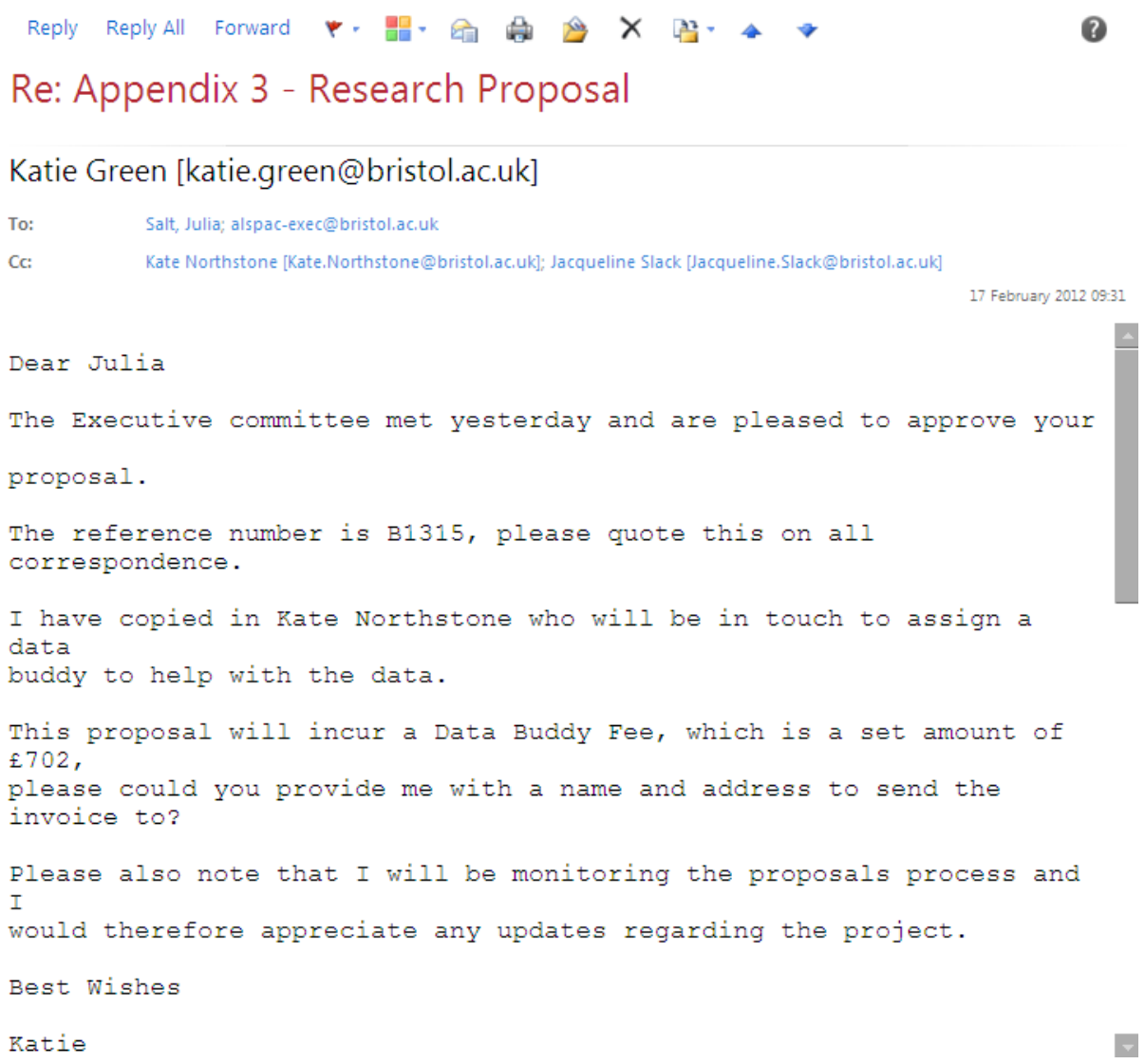
The agreement of the Committee is subject to your compliance with the British Psychological Society Code of Conduct and the University of Exeter procedures for data protection (http://www.ex.ac.uk/admin/academic/datapro/). In any correspondence with the Ethics Committee about this application, please quote the reference number above.

I wish you every success with your research.

Cris Burgess

Chair of Psychology Research Ethics Committee

Appendix B B2 Bristol/ALSPAC Approval



Reply Reply All Forward

Re: Appendix 3 - Research Proposal

Katie Green [katie.green@bristol.ac.uk]

To: Salt, Julia; alspac-exec@bristol.ac.uk

Cc: Kate Northstone [Kate.Northstone@bristol.ac.uk]; Jacqueline Slack [Jacqueline.Slack@bristol.ac.uk]

17 February 2012 09:31

Dear Julia

The Executive committee met yesterday and are pleased to approve your proposal.

The reference number is B1315, please quote this on all correspondence.

I have copied in Kate Northstone who will be in touch to assign a data buddy to help with the data.

This proposal will incur a Data Buddy Fee, which is a set amount of £702, please could you provide me with a name and address to send the invoice to?

Please also note that I will be monitoring the proposals process and I would therefore appreciate any updates regarding the project.

Best Wishes

Katie

Appendix C Antisocial Behaviour Measure

Questionnaire copied from: Documentation prepared by the ALSPAC Study Team (June 2011); from the TF3 File, Data Collected at *TeenFocus 3; TeenFocus Express; TeenFocus Outreach,* at around 15 ½ years.

Original Source: EdinburghStudy of Youth Transitions and Crime (1998); questionnaires can be retrieved from: http://www.law.ed.ac.uk/cls/esytc/data/young.htm

Question Number	Question Text	Answer Set
2060	The next section is about THINGS YOU HAVE DONE	-
2070	How often IN THE LAST YEAR have you... travelled on a bus or train without paying enough money or using someone else's pass?	23
2080	How often in the last year have you... written things or sprayed paint on property that did not belong to you?	23
2090	How often in the last year have you... stolen something from a shop or store?	23
2100	How often in the last year have you... sold an illegal drug to someone?	23
2110	How often in the last year have you... ridden in a stolen car or van or on a stolen motorbike?	23
2120	How often in the last year have you... broken into a car or van to try and steal something out of it?	23
2130	How often in the last year have you... ignored someone you know on purpose or left them out of things?	23
2140	How often in the last year have you... said nasty things to someone you know, or slagged them off or called them names?	23
2150	How often in the last year have you... threatened to hurt someone you know?	23
2160	How often in the last year have you... hit, spat or thrown stones at someone you know?	23
2170	How often in the last year have you... got other people to do these things to someone you know?	23
2180	How often in the last year have you... broken into a house or building to try and steal something?	23
2190	How often in the last year have you... hit, kicked or punched a brother or sister on purpose?	23
2200	How often in the last year have you... hit, kicked or punched someone else on purpose with the intention of really hurting them?	23
2210	How often in the last year have you... deliberately damaged or destroyed property that did not belong to you?	23
2220	How often in the last year have you... sold something that didn't belong to you or that you knew was stolen?	23
2230	How often in the last year have you... stolen any money or property that someone was holding, carrying or wearing at the time?	23
2240	How often in the last year have you... hit or picked on someone because of their race or skin colour?	23
2250	How often in the last year have you... hurt or injured animals or birds on purpose?	23
2260	How often in the last year have you... set fire or tried to set fire to something on purpose?	23
2270	How often in the last year have you... carried a knife or other weapon with you for protection or in case it was needed in a fight?	23
2280	How often in the last year have you... been rowdy or rude in a public place so that people complained or you got in trouble?	23

Appendix D Life Events Measure

Questionnaire taken from ALSPAC documentation (1993), prepared by the ALSPAC study team. Used in the questionnaire entitled “My Son/Daughter”

SECTION D: UPSETTING EVENTS

Below are listed some events that might upset some children. Please state whether any of these happened since he was 18 months old.

		Yes and he was very upset	Yes and he was quite a bit upset	Yes and he was wasn't upset	Yes but he happen upset	No did not
D1.	He was taken into care*	1	2	3	4	5
D2.	A pet died	1	2	3	4	5
D3.	He moved home	1	2	3	4	5
D4.	He had a shock or fright*	1	2	3	4	5
D5.	He was physically hurt by someone*	1	2	3	4	5
D6.	He was sexually abused*	1	2	3	4	5
D7.	He was separated from his mother for at least a week*	1	2	3	4	5
D8.	He was separated from his father for at least a week*	1	2	3	4	5
D9.	He acquired a new parent*	1	2	3	4	5
D10.	He had a new brother or sister	1	2	3	4	5
D11.	He was admitted to hospital	1	2	3	4	5
D12.	He changed carer/care giver	1	2	3	4	5
D13.	He was separated from someone else*	1	2	3	4	5
D14.	He started a new creche or nursery	1	2	3	4	5
D15.	Something else*	1	2	3	4	5

If yes, to any marked *, please give details below:

.....

Appendix E Separation Anxiety Measure

Questionnaire taken from ALSPAC study documentation. Originally source: Goodman R, Ford T, Richards H, *et al*. (2000) The Development and Well-Being Assessment: Description and initial validation of an integrated assessment of child and adolescent psychopathology. *Journal of Child Psychology and Psychiatry*, **41**, 645-55. Questionnaire can be retrieved from: http://www.dawba.info/b0.html.

SECTION D: SEPARATION ANXIETY

Many teenagers are particularly attached to one person or a few key people, looking to them for security, and turning to them when upset. They can be mum and dad, grandparents, favourite teachers, neighbours etc.

D1. Who would you say your study teenager is particularly attached to? (tick all that apply)

Very attached to:	**Yes**	**No-one**	
a) mum/mother figure	1	2 →	**If no-one, go to E1 on page 18**
b) dad/father figure	1		
c) grandparent(s)	1		
d) teacher	1		
e) older brother or sister	1		
f) aunt or uncle	1		
g) family friend	1		
h) other (please tick & describe) Do not include pets or toys here	1		

.....

Most children have some worries about being separated from the people they are most attached to. We would like to know how your study teenager compares with other teenagers of her age. **We are interested in how she is usually - not the occasional "clingy day" or "off day".**

D2. Overall in the past month, has she been particularly worried about being separated from any of the people ticked in D1 above?

Yes 1 No 2

D3.	**In the past month, compared with other teenagers of the same age:**	**No more than others**	**A little more than others**	**A lot more than others**
	a) Has she often worried about something unpleasant happening to these people, or about losing them?	1	2	3
	b) Has she often worried that she might be taken away from any of them, e.g. by being kidnapped, taken to hospital or killed?	1	2	3
	c) Has she often not wanted to go to school in case something nasty happened whilst she was still at school to a person(s) she is attached to? (Do not include reluctance to go to school for other reasons, e.g. fear of bullying or exams)	1	2	3
	d) Has she worried about sleeping alone?	1	2	3
	e) Has she come out of her bedroom at night to check on, or to sleep near any of these people?	1	2	3
	f) Has she worried about sleeping in a strange place?	1	2	3
	g) Has she been afraid of being alone in a room at home without one of the people she is attached to (even if you or they are close by)?	1	2	3
	h) Has she had repeated nightmares or bad dreams about being separated from any of these people?	1	2	3
	i) Has she had headaches, stomach aches or felt sick when she had to leave a person she is attached to, or when she knew it was about to happen?	1	2	3
	j) Has being apart or the thought of being apart from a person she is attached to led to worry, crying, tantrums, clinginess or misery?	1	2	3

* **If you have ticked '<u>a lot more than others</u>', to ANY of the answers in D3, continue below.**
If not, go to E1 on page 18

D4. a) How long has she had worries about separation?

Less than 1 month [1] 1-5 months [2] 6 months or more [3]

b) Was she like this before the age of 6?

Yes [1] No [2]

D5. How much do you think these worries have upset her?

not at all [1] only a little [2]
quite a lot [3] a great deal [4]

D6. How much have these worries interfered with her day-to-day life?

Have they interfered with:	**Not at all**	**Only a little**	**Quite a lot**	**A great deal**
a) how well she gets on with you and the rest of the family?	[1]	[2]	[3]	[4]
b) making and keeping friends?	[1]	[2]	[3]	[4]
c) learning or school work?	[1]	[2]	[3]	[4]
d) playing, hobbies, sports or other leisure activities?	[1]	[2]	[3]	[4]

D7. Have these problems put a burden on you or the family as a whole? [1] [2] [3] [4]

Appendix F Logistic Regression Analyses

Table 1 (Appendix F)

Odds ratios for antisocial behaviour by maternal sensitivity: unadjusted model, confounder model and unadjusted model on complete cases sample

Analysis	No. of observations	OR	CI (95%)	P value
Maternal sensitivity	548	1.12	0.67-1.89	0.67
Confounder model	456			
Maternal Sensitivity		0.72	0.37-1.39	0.33
Gender		0.34	0.17-0.68	0.00
Social class (parents)		1.32	0.92-1.90	0.14
Mum's highest qualification		1.22	0.87-1.72	0.25
Trouble with police <17		9.91	2.67-36.7	0.00
Crude model on completed cases	456	0.79	0.42-1.48	0.46

Table 2 (Appendix F)

Odds ratios for antisocial behaviour by number of separations and separation anxiety: unadjusted model, confounder model and unadjusted model on complete cases sample

Analysis	No. of Observations	OR	CI (95%)	P value
Number of separations	4,177	1.08	.95-1.24	0.23
Confounder analysis				
Number of separations	3,961	1.08	0.94-1.24	0.26
Gender		0.48	0.39-0.58	0.00
Child's ethnic group		1.44	0.92-2.27	0.11
Maternal qualifications		0.92	0.84-1.00	0.04
Trouble with police < 17		1.85	1.12-3.06	0.02
Crude model on completed cases	3,961	1.10	0.96-1.26	0.18
Separation anxiety	4,370	0.95	0.79-1.15	0.62

Confounder model	3,360			
Separation Anxiety		1.00	0.80-1.26	0.98
Gender		0.45	0.37-0.56	0.00
CD		1.32	0.93-1.88	0.12
Hyperactivity/inattentiveness		1.38	1.00-1.90	0.05
Child's ethnic group		1.23	0.71-2.13	0.46
Combined social class		1.10	1.00-1.22	0.60
Trouble with police < 17		2.13	1.18-3.83	0.01
Crude model on completed cases	3,360	1.01	0.80-1.26	0.96

Appendix G Distribution of Separation Data

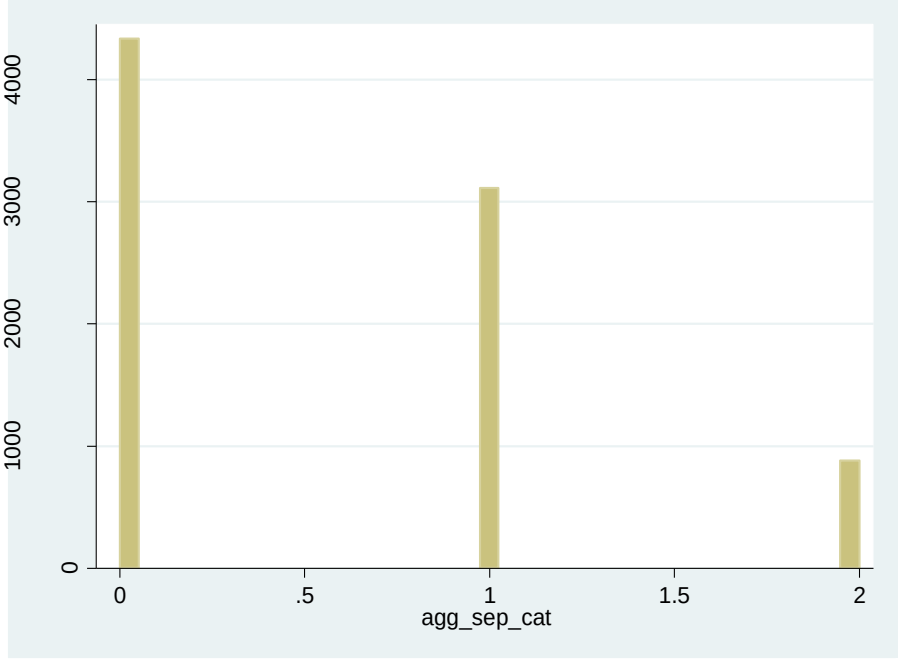


Figure 1: Appendix G: Graph to show distribution of number of separations following data being recoded into three categories: 0=0 separations; 1=1-3 separations; 3=3+ separations.