Secondary Harms of Parental Substance Use on Children's Educational Outcomes

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Publications arising from this work

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Summary

Introduction Parental substance use, that is alcohol and illicit drugs, can place children at greater risk for mental illness, substance use, and injury. While studies document a negative relationship between parental substance use and the educational outcomes of children, many have not explored why this occurs. Interventions and family systems theory suggests that parenting and the family environment may be interrupted, which in turn may lead to lower educational outcomes. As educational outcomes can be associated with future life chances and adult socioeconomic status, there is a need for research in this area. This thesis aims to explore the relationship and mediators between parental substance use and children's educational outcomes.

Methods A secondary analysis of The Avon Longitudinal Study of Parents and Children and The Millennium Cohort Study was conducted. Structural Equation Modelling was employed to create an exposure variable, using latent class analysis, and latent variables for parenting and the family environment. The relationship was explored using regression and mediation analysis.

Results The latent class analysis showed that parents who use substances somewhat mirror each other's behaviours. The class which had the highest consumption of substances had no or a positive relationship with educational outcomes, but this was annulled once confounders were adjusted for. In contrast, SEM mediation models showed evidence for parenting and the family environment as indirect effects. However, the models had significant socioeconomic confounding, whereby higher socioeconomic groups showed little mediation effects, whereas low socioeconomic groups showed more. The findings across cohorts were similar, suggesting some replicability.

Conclusion This research highlights the importance of measuring substance use, the contribution of parenting and the family environment as mediators, and how this operates across socioeconomic contexts. These findings are important for interventions, policymakers, and stakeholders in understanding how to support families experiencing substance use.

Contents

Index of Tables

Index of Figures

List of Abbreviations

ACE – Adverse Childhood Experiences

AIC – Akaike Information Criterion

ALSPAC – The Avon Longitudinal Study of Parents and Children

AUDIT - Alcohol Use Disorders Identification Test

BIC - Bayesian Information Criterion

BLRT - Bootstrap Likelihood Ratio Difference Test

CAGE - Cut-Annoyed-Guilty-Eye questionnaire

CAPI – Computer-Assisted Personal Interviews

CASI – Computer-Assisted Self-Completion Questionnaire

CAST – Children of Alcoholics Screening Test

CCEI - Crown-Crisp Experiential Index

CI – Confidence Interval

CFI - The Comparative Fit Index

CFA – Confirmatory Factor Analysis

CPI – Child Poverty Index

DSM - Diagnostic and Statistical Manual

EFA – Exploratory Factor Analysis

ESRC – Economic and Social Research Council

FAS – Fetal Alcohol Syndrome

FSM – Free School Meals

GB – Great Britain

GDP - Gross Domestic Product

GP – General Practitioner

ICD-10 – International Classifications of Diseases

ITED - Educational Development Test

KS – Key Stage

LRT - Lo-Mendell-Rubin Adjusted Likelihood Ratio Test

MAR – Missing at Random

MCS – The Millennium Cohort Study

MRC – Medical Research Council

NHS – National Health Service

OR – Odds Ratio

PIAT - Peabody Individual Achievement Test

PPIE - Public-Patient Involvement and Engagement

PuP – Parents Under Pressure

QF – Quantity-Frequency

RMSEA - The Root Mean Square Error of Approximation

SADQ - Severity of Alcohol Dependence Questionnaire

SEM – Structural Equation Model(ling)

SDC – Statistical Disclosure Control

SMAST -Short form of the Michigan Alcoholism Screening Test

SREC - School Research Ethics Committee

SRMR - Standardized Root Mean Square Residual

TLI - Tucker-Lewis Index

UKDA – UK Data Archive

VLMR - Vuong-Lo-Mendell-Rubin Test

WHO – World Health Organisation

WRAT - Wide Range Achievement Test

WRMR - Weighted Root Mean Square Residual

Introduction

Alcohol and drug use, including illicit, prescription and novel psychoactive substances are at the forefront of the UK government's public health concerns (NHS 2018b). Using the Global Burden of Disease model, alcohol and drug use are the largest risk factor for premature death among those aged 15 – 49 years, accounting for almost a quarter of deaths (Public Health England 2017b). Alcohol alone is the third largest risk factor for illness and death in the UK (Public Health England 2016a). Likewise, drug use was related to 2,593 deaths in England and Wales in 2016, an increase of 58% since 2006, and a 5% increase since 2015 (NHS Digital 2018). Statistics from the UK in 2016 - 17 show that 6.6% (around 2.2 million) of people aged 16 – 59 have used cannabis, 760,000 (2.3%) have used powdered cocaine, and 492,000 (1.5%) have used ecstasy (Home Office 2017). The social and economic costs of alcohol in England is estimated at £21.5bn, equivalent to 1.3% GDP, (Public Health England 2016b), and £10.7bn for illicit drugs (Public Health England 2017a). This £32.2bn is attributed to the health disorders and diseases related to them, along with spending on enforcement and crime, a loss of productivity in the workplace, and the treatment of substance use (Public Health England 2016b; Public Health England 2017a).

While the social and economic costs accrued are largely related to the use of alcohol and drugs, there are many characterisations of 'use' which contribute. As discussed by Manning (2011), the body of research on alcohol captures use in terms of 'dependence', 'misuse', 'abuse', 'hazardous', 'harmful', 'problematic', 'binge', and 'moderate use'. Dependent use can be defined using the Severity of Alcohol Dependence Questionnaire (SADQ) (Stockwell et al. 1983) where mild, moderate and severe categories are calculated from questionnaire items regarding physical withdrawal symptoms, frequency, and behaviour following the morning after a drinking episode. Other, more recent methods, are using routine data to identify alcohol problems or dependence in medical records (Evans et al. 2020). For other types of substance use, the Alcohol Use Disorders Identification Test (AUDIT) asks questions on drinking behaviours and problems. It is often used to define 'hazardous' drinking, whereby a score of eight captures consumption which is harmful for the user or others (Saunders et al. 1993; Manning 2011). It is also used to identify harmful drinking, whereby a score of 16 indicates physical and mental health consequences (Saunders et al. 1993; Manning 2011). As in Manning (2011), the World Health Organisation (WHO) defines problem drinking as someone who fulfils the criteria for hazardous or harmful drinking.

Binge drinking is often defined as more than seven units in a single session for men, and more than five for women; three units often translates to a large glass of wine (12% strength, 250ml) or a pint of beer (5% strength) (NHS 2018a). To minimise the health risks associated with alcohol, the Chief Medical Officer for England recommends no more than 14 units for both men and women in a single week, and for the units to be spread over several days (Department of Health 2016). It is stated that even single episode alcohol use at high levels can cause intoxication, which may lead to risk behaviours or injury (NHS 2018a). For drug use, there are also characterisations, which often differ in terms of occasional use or dependent use. Dependent drug use is focused around daily use, inability to abstain, and withdrawal symptoms (Manning 2011). There is less variation in the characterisation of drug use which is likely related to its illegality, so even low, or occasional use of drugs is likely to be viewed as a risk for health.

These various characterisations of alcohol and drug use are also socioeconomically patterned, which has important implications for health and wellbeing. For instance, Bellis et al. (2016) found that less affluent groups were more likely to be binge drinkers compared to their more affluent counterparts; this was also supported in Lewer et al. (2016). Moreover, Poulton et al. (2002) found that alcohol dependence was greater among those who were persistently poor over-time, compared to groups that had fluctuated between socioeconomic groups. In contrast, research suggests that affluent groups use alcohol in greater quantities, but this is often in the form of moderate drinking, which is theorised to be less harmful for health (Collins 2016). Bellis et al. (2016) build on the alcohol harm paradox, whereby deprived groups not only engage in higher-risk alcohol use, but are more likely to smoke, and have unhealthy lifestyles, which cluster to increase the risk of ill-health. In addition to alcohol use, there are socioeconomic complexities in the conceptualisation of drug use by the Government and general public. Monaghan and Yeomans (2016) discuss how drug dependence is viewed as a problem for only deprived communities, and how the welfare and criminal justice system are constructed to disproportionately affect poorer people. As a result, while lower socioeconomic groups may not use substances in the quantities equivalent to their higher socioeconomic counterparts, they are at greater risk for ill-health and societal problematisation.

Alongside the individual harms and socioeconomic contexts, research has also brought a much needed attention to the secondary harms of alcohol and illicit drug use (Rossow et al. 2016). Research has consistently found that alcohol and illicit drug use has a profound impact on not only the individual, but the lives of others, including the user's partners, family, friends, work colleagues, and communities (Rossow et al. 2016, p.397). Velleman and Templeton (2007) estimate that 8 million family members endure the negative consequences of someone else's drug or alcohol misuse; the real figure could be much higher considering other affected parties are not considered i.e., close friends. The £32.2bn calculated above did not include the harms endured by others; however, the £21.5bn for alcohol does include costs related to 'family problems' and domestic violence. As a result, it is likely that the cost to society is much greater both financially and socially.

One group that is often exposed to substance use by others are children, who are greatly affected by the environment they are exposed to (Park and Schepp 2015). Manning et al. (2009) estimates that around 30% or 3.3 – 3.5 million children (those aged under 16) have lived with one binge drinking parent (more than five units of alcohol is consumed on one occasion) and 8% live with two binge drinking parents. 2.6 million (22%) lived with a hazardous drinker and 705,000 (6%) lived with a dependent drinker. Up to 978,000 (8%) children lived with an adult who had used illicit drugs; 335,000 of which, live with a drug dependent user. Moreover, those who take drugs may often drink to harmful levels (Home Office 2015). Therefore, the risk for the 3.6% who lived with a problem drinker who also used drugs may be cumulative (Manning et al. 2009).

The past 40 years of international research, both qualitative and quantitative, has illuminated that parental substance use has wide-ranging, negative impacts on children's health and wellbeing (Velleman and Templeton 2007; Park and Schepp 2015; Velleman and Templeton 2016; McGovern et al. 2018). The children of parents who use substances, alcohol, drugs or both together, are at risk for conduct disorders, that being behavioural problems and antisocial behaviour, sometimes referred to as externalising symptoms (Chassin et al. 1991; El-Sheikh and Flanagan 2001; Hussong et al. 2010). Alongside this, they are at a higher risk of having emotional difficulties such as depression or anxiety, sometimes referred to as internalising symptoms (Chassin et al. 1991; Chassin et al. 1999; Lee and Cranford 2008; Ellingson et al. 2015; Kelley et al. 2017). Furthermore, they are also at a higher risk for substance misuse themselves (Chassin et al. 1991; Sher et al. 1991; Chassin et al. 1999; Hoffmann and Cerbone 2002).

As a result, recent policy has acknowledged that parental alcohol and drug use can pose challenges for children. The Hidden Harms report in 2003 was the first major research to focus on children's needs rather than those of the substance use (Adfam 2013). More recently, the Troubled Families Programme 2015-2020 has been a large, wide-ranging, targeted government intervention in England to support families with "multiple problems, including crime, anti-social behaviour, truancy, unemployment, mental health problems and domestic abuse" (Bate and Bellis 2018, p.3). The Welsh government has pledged to support and protect families and children from substance misuse in the Substance Misuse Strategy for Wales 2008 – 2018 by protecting vulnerable children, supporting family interventions, supporting various programmes which help families and carers i.e. the Strengthening Families programme, supporting those who are a victim of domestic abuse, and making treatment programmes widely available (Welsh Assembly Government 2008).

Policy in this area is continually adapting to the growing research on this problem. A recent meta-analysis by Kuppens et al. (2020) explored the longitudinal evidence on parental substance use and child wellbeing, which included educational outcomes. The overarching finding was that parental substance use had an enduring effect on child wellbeing, along with there being a lack of longitudinal research on educational outcomes. One study by McGrath et al. (1999) was identified. They found that children of alcoholics had lower academic attainment over-time, however this study had a small sample. The limited number of studies is surprising considering that educational outcomes influence "health and social outcomes by affecting employment opportunities, socioeconomic status, access to health care and psychological wellbeing" (Burrows et al. 2017, p.372). Likewise, a review by McGovern et al. (2018) noted that there was limited research regarding non-dependent parental substance use and children's educational outcomes. Therefore, this thesis will explore potential secondary harms of parental substance use on children's educational outcomes.

The thesis spans of seven Chapters which aim to explore the secondary harms of parental substance use on children's educational outcomes. As the meta-analysis by Kuppens et al. (2020) found little evidence in this area, Chapter 1 compromises of a scoping review that was conducted to identify and describe literature; this chapter includes quantitative, qualitative, and grey literature which considers parental substance use and children's educational outcomes. Following this, Chapter 1 summarises that the literature consistently evidences a negative relationship, but there are some gaps in the field. The main limitations include the low number of studies which use longitudinal data, or consider parental poly-use, and the lack of research theorising and testing the mediators in this relationship. Chapter 2 uses the findings from Chapter 1 to frame the relationship in a socio-ecological framework. The synthesis of evidence in this chapter suggests that parental substance use has a negative relationship with parenting and the family environment, of which is imperative for educational outcomes in children. From this, it is theorised that parenting and the family environment should be explored as mediators in the relationship to identify potential mechanisms.

Chapter 3 discusses the methodological considerations for the research, including an evaluation of longitudinal research design, ethical implications, and ontological and epistemological considerations. It also includes a detailed discussion of the two longitudinal cohort studies used in this research, The Avon Longitudinal Study of Parents and Children (ALSPAC) and The Millennium Cohort Study (MCS). Following this, the analytical approach is discussed, along with the methods of conducting cross-cohort research. Chapter 4 includes the findings of the ALSPAC data in line with the research questions; Chapter 5 is a replication analysis of Chapter 4, using MCS data. Chapter 6 compromises of the exploratory analysis that was conducted following Chapters 4 and 5 findings. Moreover, it includes a cross-cohort analysis which summarises the findings from both ALSPAC and MCS in Chapters 4, 5 and 6. Lastly, Chapter 7 considers the empirical findings in relation to existing evidence, policy, and interventions. It concludes with recommendations for future research and the limitations of this research.

Chapter 1 Parental Substance Use and Children's Educational Outcomes: A Scoping Review

Reviews of research on parental substance use and child wellbeing often find that children experience disruption in their lives when their parents, or primary caregivers, engage in substance use (Velleman and Templeton 2007; Park and Schepp 2015; Velleman and Templeton 2016; McGovern et al. 2018). Research in this area has largely focused on children's mental wellbeing, or physical health outcomes (Park and Schepp 2015; Velleman and Templeton 2016; Kuppens et al. 2020) and there has been less focus on educational outcomes. For instance, only one study where educational outcomes were an outcome was found in a recent meta-analysis which examined longitudinal research (Kuppens et al. 2020). Likewise, a rapid-evidence assessment which examined non-dependent substance use only found three studies in relation to substance use and educational outcomes (McGovern et al. 2018). Therefore, this chapter presents a scoping review to address the question: What is the relationship between parental substance use, including alcohol and illicit drugs, and children's educational outcomes?

1.1 Scoping review methodology

The review of the literature has been conducted as a scoping review, as unlike a systematic review, there was no 'well-defined' question or quest to "provide answers to from a relatively narrow range of quality assessed studies" (Arksey and O'Malley 2005, p.20). When the scoping review was initially conducted in late-2017 through to mid-2018, no formal checklists were provided. The most developed guidance that was commonly used was Arksey and O'Malley (2005). However, since late-2018 improved guidance has been developed as the number of scoping reviews has increased, and it was recognised that better methodological guidance was needed (Tricco et al. 2018). In Tricco et al. (2018), a checklist was developed which includes justification, search strategy and charting of data. In this thesis most of the criteria is met - 24 out of 27; see Appendix A for the full checklist.

The scoping review was needed as little was discussed regarding educational and school outcomes in published reviews, and there was a need to "examine the extent, range and nature of research activity" (Arksey and O'Malley 2005, p.21). So, this review endeavours to identify research which focuses on both parental substance use and children's educational outcomes. From this, the overall research activity and findings can be understood, along with the research gaps in order to draw conclusions (Arksey and O'Malley 2005). Given that this was to understand general research activity, this scoping review was conducted in a more iterative and flexible nature compared to scoping reviews that are currently published where clear guidance is available (Tricco et al. 2018). In line with Bottorff et al. (2014), fewer search terms were used and literature had to be restricted given the limitations in a doctoral thesis; the quality of evidence is also not analysed, given that is not within the remit of a scoping review. In short, this scoping review mirrors Bottorff et al. (2014) in that the aim was to summarise the literature in terms of what can be learnt about parental substance use and children's educational outcomes.

Literature was identified using electronic databases; reference lists of key journals; citing sources of important journals (using Google Scholar), and a hand-searching of reports by organisations which focused on parental substance use and children's school or educational outcomes on both Google and Google Scholar. A search was conducted using keywords such as 'parent substance use', 'maternal alcohol', 'paternal alcohol', 'parental alcohol use', 'parental drug use', 'children of alcoholics', 'school attainment', 'school outcomes' and 'educational achievement'. The review was an iterative process whereby key literature was identified. Key literature was empirical and focused on the relationship between parental substance use and children's educational or school outcomes. From this, the references and citations of key literature was traced for further literature.

Educational and school outcomes were included if they explored areas of attainment, adjustment, behaviour, attendance, truancy, and academic self-concept. Measures of IQ and cognitive functioning were excluded as this coincided less with the school system, but more on individual characteristics. Reviews were included as they provided valuable references and context, but were not used in the synthesis of results. Doctoral theses and other grey literature were included as they are peer reviewed to some extent. The exclusion criteria included: undergraduate or masters theses, as they are not reviewed; articles which were not in English, or translatable to English, and research which was conducted before 1950. The keywords of school and educational outcomes are used interchangeably throughout.

Key literature was continually searched until a saturation point was reached where no new literature was identified (Arksey and O'Malley 2005). Once completed, the information was recorded in an excel sheet similarly to Arksey and O'Malley (2005): Author; year of publication; study location; study population (e.g. alcoholics in a treatment centre, prison); substance use measure (i.e. DSM-IV); aims of the study; methodology; outcome measures, and important results. The initial search was conducted between late-2017 and mid-2018, however when new literature was available it was included, and the references and citations were traced.

1.2 Findings of scoping review

Fifty-one empirical studies and eight reviews were identified (West and Prinz 1987; Smith 1993; Wilens 1994; Velleman and Templeton 2007; Park and Schepp 2015; Velleman and Templeton 2016; McGovern et al. 2018; Kuppens et al. 2020); reviews are excluded from the main findings but were used to identify literature. Most studies originated from the United States (26), five studies were from Canada, three studies were from Sweden, Denmark and two studies were from India, Spain, and the Republic of Ireland, only one study was found in Russia, Greece, Slovenia, Brazil, Australia, Finland, and New Zealand; some studies included two countries. No research was found in Scotland, England or Northern Ireland, but there was one recent study from Wales, UK. 19 studies were identified since 2000; 15 studies in the 1990s; eight studies in the 1980s; six in the 1970s, and three in the 1960s. Most of the literature focused on parental alcohol use (41); only five studies focused on parent's use of illicit drugs, and five focused on poly-use. The measurement of parental substance use varied from dependence to quantity-frequency. The findings are summarised in terms of the children's educational outcomes, which are categorised into attainment, adjustment and behaviour, attendance, academic self-concept and miscellaneous.

1.2.1 Attainment

Attainment was the most common research outcome; it included school grades, scores, reports, performance, and academic achievement. The overarching finding suggested that children who reside with parents who misuse substances are at risk for poorer school attainment (Kammeier 1971; Sowder and Burt 1980; Rydelius 1981; Tarter et al. 1984; Knop et al. 1985; Marcus 1986; Johnson and Rolf 1988; McCarthy and Anglin 1990; Sher et al. 1991; Braggio et al. 1993; Chandy et al. 1993; Moss et al. 1995; Hogan 1997; Malo and Tremblay 1997; Puttler et al. 1998; McGrath et al. 1999; Gakhar and Jaswal 2000; Jacob and Windle 2000; Poon et al. 2000; Hogan and Higgins 2001; Casas-Gil and Navarro-Guzman 2002; Zanoti-Jeronymo and Carvalho 2005; Díaz et al. 2008; Brook et al. 2010; Serec et al. 2012; Gifford et al. 2015; Berg et al. 2016; Carbonneau et al. 2017; Mangiavacchi and Piccoli 2018; Evans et al. 2020; Raitasalo et al. 2020). However, some studies did not find statistically significant differences (Kammeier 1971; McLachlan et al. 1973; Schulsinger et al. 1986; Johnson and Rolf 1988; Murphy et al. 1991; Reich et al. 1993; Vitaro et al. 1996; Hill et al. 1999). Moreover, some studies only found this in specific subjects such as English (Knop et al. 1985; Zanoti-Jeronymo and Carvalho 2005), or for types of substance use outcomes, i.e. hospitalisation vs conviction (McGrath et al. 1999).

1.2.1.1 Recent, robust secondary analyses of attainment

A few studies conducted longitudinal analysis. The most recent evidence was from Evans et al. (2020) who used population-level data in Wales, UK to understand the effect of parental alcohol hospital admissions, or primary care admittance, on children’s attainment at age seven and ten years. They found that once adjusted for sociodemographic and school-level factors, the likelihood of not attaining the expected education outcomes at age seven years was greater, and endured at age ten years. Another paper by Raitasalo et al. (2020) investigated parental alcohol problems (ICD-10 codes) and child attainment. In adjusted models, the presence of parental alcohol problems reduced attainment by 8% in Denmark and 4% in Finland. Alongside this, they found that parental economic distress partially mediated the relationship, suggesting that socioeconomic status has an important role.

Other recent studies found similar results. Mangiavacchi and Piccoli (2018) used data on 5,000 households in Russia and concluded that parental alcohol use had a negative association with both the educational years completed and the probability of tertiary education. Every additional gram of pure alcohol per day consumed by the mother reduced education years by 6% and tertiary education by 27%; they interpreted this as every additional glass of vodka (15.57g of pure alcohol, equivalent to 2 units in the UK) would reduce schooling by almost one year. However, moderate drinking had a positive association on education years, which is likely to be attributed to socioeconomic status. Furthermore, they found that mothers' drinking was more strongly related to education compared to fathers' drinking. The transferability of findings to the UK is limited; however, this study is of high quality.

Likewise, Berg et al. (2016) used a large routine data sample (n=740,618), which is beneficial for representing marginalised groups, and found that parental alcohol-related hospital admission was associated with lower school attainment, and lower eligibility for secondary education; this risk was increased for those who had experienced social care. However, the study data was dated, being from 1991 – 1996, and only adjusted results were statistically significant. Similarly, Gifford et al. (2015) used national databases to understand the effect of a substance-related conviction charge on children's educational attainment, and whether the intervention of the drug court treatment mediated the effect. Conviction was negatively associated with end-of-year school tests, with children being around one to two years behind academically; no evidence was found for academic improvement following drug treatment intervention. However, adjusting for confounders led to this finding being non-significant in both studies. Carbonneau et al. (2017) found that the sons of alcoholic fathers showed lower academic performance at age 13. This was despite circumstances where the alcoholic father was no longer residing in the home; they suggest that there is a 'critical window' in this relationship, and that socioeconomic status provides a buffer to negative effects. The key limitation of this study is the use of a community sample (n=653).

Other research has also used smaller, community samples of children to understand this relationship. For example, using structural equation modelling Brook et al. (2010) (n=209) found that parental substance use (mother and father) had a negative association with the mother-child relationship. Subsequently, the mother-child relationship had a positive relationship to the child's personality attributes, including self-esteem and ego integration, which later was positively associated with achievement. Brook et al. (2010) argue that they are the first research study to explore pathways through parental substance use and children's academic achievement, supporting theories of parenting and intervention theory. They argue that the mother-child relationship is a key mediator in this pathway, and suggest that policymakers consider parental substance use in the context of parental education and the mother-child relationship when examining academic achievement in children.

1.2.1.2 Other secondary analyses of attainment

Hyphantis et al. (1991) used data on 36,000 students and found that children of alcoholics had poorer school performance. Likewise, Chandy et al. (1993) used data on 36,000 students and found a significant difference between the children of substance users and the general population. McCarthy and Anglin (1990) identified 756 men on a treatment programme for heroin; they found that men who had fathers who were frequently drunk had lower school attainment; a large amount of variance was predicted by ethnicity and family size, which may be related to socioeconomic status.

1.2.1.3 Observational studies which compare affected children and controls

One of the largest, most robust observational studies was conducted by Díaz et al. (2008) who compared 371 children of alcoholics to 147 controls. Participants were matched by age and socio-cultural status; mothers who drank more than five units in pregnancy per week were excluded due to prenatal symptoms in children. Children of alcoholics were nine times more at risk of poor performance and twice as likely to repeat a grade. Sher et al. (1991) collected responses from 3,156 first-time college freshman and screened them for paternal alcoholism. From this, they retained 490 students, 253 children of alcoholics and 237 controls; those who had experienced maternal alcoholism or parental psychopathology were excluded. Using school records, they found that the children of alcoholics had lower class ranks and test scores. However, McGrath et al. (1999) analysed 221 children with 196 demographically matched controls and found little academic differences. Although, years of problem drinking and number of drinking-related hospitalisation occurrences were linked to a lower grade point average; this suggests that extreme circumstances may be associated with attainment. McGrath et al. (1999) acknowledge that they faced difficulties in accessing school data which limits interpretation, which is similar to Fine et al. (1976), with lower coverage rates.

Many other observational studies were found; however, they often used smaller samples and did not match controls which makes generalisability difficult (McLachlan et al. 1973; Fine et al. 1976; Tarter et al. 1984; Marcus 1986; Johnson and Rolf 1988; Murphy et al. 1991; Reich et al. 1993; Moss et al. 1995; Vitaro et al. 1996; Malo and Tremblay 1997; Gakhar and Jaswal 2000; Poon et al. 2000; Zanoti-Jeronymo and Carvalho 2005; Serec et al. 2012). Nevertheless, most studies found that children of substance users had lower educational attainment. For instance, Zanoti-Jeronymo and Carvalho (2005) found that children of alcoholic parents had a 7-point difference in mathematics, but not in reading. In a similar study, Knop et al. (1985) used Danish birth records and identified 255 boys who had alcoholic fathers using the national psychiatric records; they matched 70 controls on mothers age, marital status at delivery and social class. Analysis of the teacher reports showed that sons of alcoholics were lower in verbal proficiency, but not math, and were also more likely to repeat a school year. A similar study was conducted by Schulsinger et al. (1986) who did not find significant differences in school attainment but did find children of alcoholics were more likely to repeat a grade.

Malo and Tremblay (1997) analysed four groups of children based on parental alcoholism and socioeconomic status. They used survival analysis to understand the rate of a child being classified as 'academically challenged'. The rate was fastest for the children who were from a low socioeconomic background and had an alcoholic father; the slowest rate was for children with a non-alcoholic father but were of a higher socioeconomic status. This study highlights that parental alcoholism can still affect the most affluent groups, but perhaps at a slower rate. Poon et al. (2000) analysed three groups: antisocial alcoholic families (n=30); non-antisocial alcoholic families (n=102), and controls (n=66). Children of antisocial alcoholic families had the lowest school attainment; children from non-antisocial alcoholic families did not attain as highly as the control families, highlighting the importance of co-existing adversities.

Other small experimental studies were consistent in that children with substance using parents had lower attainment (Miller and Jang 1977; Robins et al. 1977; Rydelius 1981; Tarter et al. 1984; Marcus 1986; Moss et al. 1995; Serec et al. 2012). However, some studies found no statistically significant differences in school attainment (McLachlan et al. 1973; Johnson and Rolf 1988; Reich et al. 1988; Murphy et al. 1991; Braggio et al. 1993; Reich et al. 1993; Vitaro et al. 1996; Hill et al. 1999). Some of these results could be due to small sample size, or the lack of matching controls by demographic aspects.

1.2.1.4 Qualitative and mixed-method research on attainment

Hogan and Higgins (2001) identified 100 parents in treatment centres or prisons who viewed themselves as problem opiate users and interviewed connected professionals. Parents said that they struggled to send their children to school on time due to being tired from withdrawal symptoms. Moreover, parents struggled with maintaining a routine in the home. Although, some parents explained that tangible needs were always met, i.e., having breakfast, getting dressed and attending school. Teachers' varied in their experiences. Some found that children put great effort into school and were reaching their full potential, whereas some children struggled, some of which was attributed to poor attendance and routine. Overall, the study suggests that some children of drug users face more problems at school.

Similarly, Hogan (1997) conducted a qualitative study which found that all teachers reported at least one area for concern in terms of academic progress for the children of drug users. Moreover, five children were identified as having serious problems in writing and mathematics; language skills were also a concern for four teachers, particularly as they explained that these problems might continue throughout the child's education. Similarly, Kolar et al. (1994) conducted a study on 70 children of opiate addicts and found that 41% of the children had repeated a grade in school. Likewise, Offord et al. (1978) found lower school performance in children who had alcoholic parents, and they attribute this to adverse family settings..

Overall, the studies do share some similarities, however comparing them is challenging due to variation in the measures used. Some studies used child self-reports of school attainment (McCarthy and Anglin 1990; Chandy et al. 1993; Díaz et al. 2008; Serec et al. 2012), whereas other studies used parent reports of their child's school attainment (Kolar et al. 1994; Hogan 1997; Hogan and Higgins 2001); these were conducted either by questionnaires or interviews. In other studies, psychometric instruments were used, argued to be associated with attainment (Casas-Gil and Navarro-Guzman 2002; Zanoti-Jeronymo and Carvalho 2005). Standardised tests (Sowder and Burt 1980; McGrath et al. 1999) such as the Wide Range Achievement Test (WRAT) (Johnson and Rolf 1988; Puttler et al. 1998; Hill et al. 1999; Poon et al. 2000), or the Peabody Individual Achievement Test (PIAT) (Tarter et al. 1984; Marcus 1986; Braggio et al. 1993; Moss et al. 1995), or the Educational Development Test (ITED) (Kammeier 1971) were also used. Alternatively, many studies used teacher reports, either by interview or questionnaire (Hogan 1997; Gakhar and Jaswal 2000), or school records (Fine et al. 1976; Offord et al. 1978; Rydelius 1981; Reich et al. 1988; Murphy et al. 1991; Sher et al. 1991; Vitaro et al. 1996; Jacob and Windle 2000). National records were used less (Gifford et al. 2015; Berg et al. 2016; Evans et al. 2020; Raitasalo et al. 2020) despite being less open to self-report bias, unless teacher assessments are used. Few studies used the measure of repeating a grade, which serves as a proxy of attainment. Nevertheless, research shows a negative relationship between parental substance use and children's educational attainment, despite inconsistency in measurement.

1.2.2 School behaviour and adjustment

A small number of studies suggested that parental substance use is associated with externalising symptoms in children (Chassin et al. 1991; El-Sheikh and Flanagan 2001; Hussong et al. 2010). Some studies have focused on suspensions and exclusions (Miller and Jang 1977; Kolar et al. 1994; Jennison 2014) or truancy (Haberman 1966; Kolar et al. 1994; Jennison 2014) or school dropouts (Díaz et al. 2008; Pinto and Kulkarni 2012; Jennison 2014). Others have focused on deficits in attention at school (Hogan 1997; Torvik et al. 2011), or conduct problems, such as being removed from class at school (Nylander 1960; Aronson and Gilbert 1963; Haberman 1966; Fine et al. 1976; Sowder and Burt 1980; Rydelius 1981; Connolly et al. 1993; Kolar et al. 1994; Hogan 1997; Puttler et al. 1998; McGrath et al. 1999; Hogan and Higgins 2001; Torvik et al. 2011).

1.2.2.1 Conduct problems

A Norwegian study by Torvik et al. (2011) used a population sample and found increased conduct problems in children who had reported frequently seeing their parent drunk. However, self-reports of substance use by the parents had no association with conduct problems. A smaller study by Puttler et al. (1998) (n=212) found that children of alcoholics had more conduct problems compared to controls. Other studies have also confirmed this in terms of alcohol (Nylander 1960; Aronson and Gilbert 1963; Haberman 1966; Fine et al. 1976; Rydelius 1981) and drug users (Sowder and Burt 1980; Hogan and Higgins 2001).

However, McGrath et al. (1999) did not find a significant difference in children of alcoholics and controls; they argue that the school environment promotes positive behaviour. Although, Kolar et al. (1994) used semi-structured interviews with 70 parents on methadone maintenance treatment and found that 29% of the children in the sample had discipline issues at school, usually fighting related. Hogan (1997) found that two children had problem behaviours, one child was particularly impulsive and had angry tendencies. Likewise, Connolly et al. (1993) found that the children of parents who had severe alcohol problems were much more likely to be reported by teachers as displaying high levels of problem behaviour. Interestingly, this was not found in the parent reports when compared with teacher reports, and the correlation was weak (R^2=0.13).

1.2.2.2 Attention, motivation, and interest problems

Torvik et al. (2011) found that the children of alcohol abusing parents had greater attention problems; this was particularly in terms of maternal drinking. In terms of possible explanations, or mediators, they suggest that maternal drinking (not paternal) is associated with mental distress which could lead to an attention deficit. They do suggest, however, that some children may use the school as an escape from a dysfunctional home environment, similar to McGrath et al. (1999). In Hogan's (1997) study, they also identified that some children with drug-using parents had concentration problems and lacked motivation and interest at school, but this was not the case for all children.

1.2.2.3 Suspension and exclusion

A large, recent study by Jennison (2014) found that parental alcohol misuse was associated with their children's permanent early departure from school. Moreover, there was a threefold increase in the risk of suspensions among youth from alcoholic family environments where the father was a heavy drinker, and the marital quality was poor. Kolar et al. (1994) also found that 30% of children whose parents were opiate users were suspended from school, and one child had been permanently excluded. Likewise, Miller and Jang (1977) found that the children of alcoholics were more likely to be suspended (46% compared to 31%) and three times more likely to be excluded. In a smaller study, Pinto and Kulkarni (2012) found that the children of alcoholics were almost twice as likely to drop out of school compared to controls; boys showed a greater likelihood. Furthermore, Díaz et al. (2008) found that children of alcoholics were twice as likely to drop out of school.

1.2.2.4 School attendance

Large studies such as McGrath et al. (1999) found that parental alcohol-related incarceration days and days drinking before treatment was related to child school attendance. Moreover, Gifford et al. (2015) found that children of substance users were at a greater risk for chronic absenteeism. Qualitative research also confirmed this as Hogan and Higgins (2001) also found that the academic progress for children of drug-users was slower due to poor attendance and routine; Hogan (1997) found that one child had missed two months of school, despite teachers raising this with the parent(s). Likewise, a small study (n=99) by Jeffreys et al. (2009) found that children of substance misusers (alcohol and drugs) who were harmed were more likely to miss school compared to children who were harmed but did not have substance using parents. Furthermore, Sowder and Burt (1980) found that 66% of the children of substance users missed school compared to 45% of controls. All studies referenced the effect lower attendance has on attainment, highlighting the interconnectedness of outcomes.

1.2.3 Academic self-concept

Gakhar and Jaswal (2000) found that children of alcoholics had poorer academic self-concept compared to controls; they theorise that alcoholism in a family is linked to children feeling inferior, insecure, and isolated. Likewise, Hyphantis et al. (1991) found that children of alcoholics were less likely to rate themselves as 'excellent' or 'very good' and more in the categories of 'good', 'moderate' and 'bad' at school.

1.2.4 School satisfaction and enjoyment

Torvik et al. (2011) found no association between parental alcohol use and school dissatisfaction while adjusting for demographic aspects. Smaller studies such as Sowder and Burt (1980) and Chandy et al. (1993) found that the differences in liking and disliking school were minimal between the children of substance-users and controls. However, Johnson and Rolf (1988) found that the children of alcoholics disliked school more (28%) compared to the controls (10%) and fewer children of alcoholics liked school (36%) compared to controls (65%); this study had a small sample (n=98).

1.2.5 Miscellaneous and less common findings

Less common outcomes included homework completion rate by the children of substance-users, of which was generally lower (Hogan 1997). Moreover, some studies found that the children of substance users were more likely to attend 'special classes', mostly for academic progress and discipline problems (Knop et al. 1985; Kolar et al. 1994; Malo and Tremblay 1997; Carbonneau et al. 2017). A few studies identified that the children of substance users were more likely to be referred to the school psychologist (Knop et al. 1985; Schulsinger et al. 1986) or specialist services such as mental health counselling (Sowder and Burt 1980). A consideration could be that the school are aware of the home circumstances and place these children in these classes to provide early support.

1.2.6 Concluding remarks

The most common outcome was attainment, but other outcomes included behaviour, attention, truancy, and suspensions or exclusions, whereby children of substance users often had poorer outcomes. All studies confirmed that attendance was lower for children with substance using parents. Research on academic self-concept found that children of substance-users had a lower perception of their academic performance. However, few studies found evidence for children of substance users liking school less. Nevertheless, these children struggled to complete homework to the expected standard, and were much more likely to attend special classes, and use specialist services at school. Therefore, this review has revealed that the children of substance-users face considerable challenges in their educational development; these findings have been summarised in Table 1.

Method	Substance use	Location			
Quantitative = 48	Alcohol = 41	Australia = 1	Finland = 1	Norway = 1	Sweden = 3
Qualitative = 2	Drug = 5	Brazil = 1	Greece = 1	Russia = 1	Republic of Ireland = 2
Mixed methods = 1	Poly-use = 5	Canada = 5	India = 2	Slovenia = 1	US = 26
		Denmark = 3	New Zealand = 1	Spain = 2	UK = 1

Outcome	Findings	Studies
School attainment	• Operationalised as grades, scores, reports, performance, and academic achievement • Most studies found that parental substance use was related to poorer school attainment • Some studies did not find this relationship. • Studies differed largely on study design • Some used routine or secondary data • Some studies collected primary data • Others collected data on children of substance users and compared them to controls (matched and unmatched)	Kammeier (1971); Sowder and Burt (1980); Rydelius (1981); Tarter et al. (1984); Knop et al. (1985); Marcus (1986); Johnson and Rolf (1988); McCarthy and Anglin (1990); Sher et al. (1991); Braggio et al. (1993); Chandy et al. (1993); Moss et al. (1995); Hogan (1997); Malo and Tremblay (1997); Puttler et al. (1998); McGrath et al. (1999); Gakhar and Jaswal (2000); Jacob and Windle (2000); Poon et al. (2000); Hogan and Higgins (2001); Casas-Gil and Navarro-Guzman (2002); Zanoti-Jeronymo and Carvalho (2005); Díaz et al. (2008); Serec et al. (2012); Gifford et al. (2015); Berg et al. (2016); Carbonneau et al. (2017); Mangiavacchi and Piccoli (2018); McLachlan et al. (1973); Schulsinger et al. (1986); Reich et al. (1993); Vitaro et al. (1996); Hill et al. (1999); Evans et al. (2020); Raitasalo et al. (2020); Brook et al (2010)

School behaviour and adjustment	• Operationalised as suspensions, exclusions, truancy, school dropouts, and attention-deficit or conduct problems • Most studies found that parental substance use was related to poorer school behaviour or adjustment • Some studies did not show evidence of this relationship	Chassin et al. (1991); El-Sheikh and Flanagan (2001); Hussong et al. (2010); Miller and Jang (1977); Kolar et al. (1994); Jennison (2014); Haberman (1966); Kolar et al. (1994); Jennison (2014) Díaz et al. (2008); Pinto and Kulkarni (2012); Jennison (2014); Hogan (1997); Torvik et al. (2011); Nylander (1960); Aronson and Gilbert (1963); Haberman (1966); Fine et al. (1976); Sowder and Burt (1980); Rydelius (1981); Connolly et al. (1993); Kolar et al. (1994); Hogan (1997); Puttler et al. (1998); McGrath et al. (1999); Hogan and Higgins (2001); Torvik et al. (2011)
School attendance	• Most studies evaluated how many days, weeks or months children had off school • All studies found that parental substance use was related to lower school attendance	McGrath et al. (1999); Gifford et al. (2015); Hogan and Higgins (2001); Hogan (1997); Sowder and Burt (1980); Jeffreys et al. (2009)
Academic self-concept	• Operationalised as how children rate themselves at school, e.g., ‘good’, ‘excellent’, ‘fair’, and ‘bad’. • Studies found that parental substance use was related to poorer academic self-concept in children • Few studies researched this	Gakhar and Jaswal (2000); Hyphantis et al. (1991)

School satisfaction	• Operationalised as children 'liking school' or 'being happy at school' • Most studies found that there was no difference in children's satisfaction at or with school. • One study did find these children liked school less	Torvik et al. (2011); Sowder and Burt (1980); Chandy et al. (1993); Johnson and Rolf (1988)
Miscellaneous	• Studies found that homework completion was lower, and special class or service attendance e.g., mental health counselling was higher for children with parents who use substances	Hogan (1997); Knop et al. (1985); Kolar et al. (1994); Malo and Tremblay (1997); Carbonneau et al. (2017); Schulsinger et al. (1986); Sowder and Burt (1980)

Table 1: Summary of scoping review findings

1.3 Scoping review: the limitations and gaps in the literature

The studies identified have highlighted challenges that children exposed to parental substance use face. However, most literature is dated, with a limited number of recent studies, and there were only a few studies on drug-using parents. The literature is largely focused on parental problem drinking, rather than general population household alcohol use. There also is a limited amount of research from the UK, with only one study that emerged recently; there were two qualitative studies from the Republic of Ireland, these had smaller samples but were rich in information. Alongside this, the methodological quality among studies varies. The measurement of the predictors and outcomes is inconsistent, which limits comparison. Also, some studies used small or specialised samples or failed to adjust for confounders, e.g., age, sex, socioeconomic status. Furthermore, no study identified why this relationship exists. As a result, the following sections will discuss the gaps and explore how this thesis will close them.

1.3.1 Limited research on the children of parents who use illicit drugs

This problem has been discussed by Barnard and Barlow (2003), who state that the child's experience of drug-using parents has rarely been considered. In this review, no studies used child reports of their parent's drug use, whereas child reports of parents alcohol use were more common (e.g. Chandy et al. 1993, Torvik et al. 2011). Barnard and Barlow (2003) explain that problem drug use tends to be hidden in families. They attribute this to illicit drug use being illegal, and criminal behaviour is often used to finance a drug dependence, and the result of this covert activity is reduced visibility of families (Bourgois 1995 cited in Barnard and Barlow 2003). They explain that children preserve this secrecy by not sharing information with others. From this, the effects of drug-using parents on child educational outcomes was a priority for this research.

1.3.2 Challenges around the measurement of substance use

The variation in the measurement is a challenge for reviews. The most common substance use measure was the Diagnostic and Statistical Manual of Mental Disorders III or IV (Tarter et al. 1984; Johnson and Rolf 1988; Reich et al. 1993; Moss et al. 1995; Vitaro et al. 1996; Malo and Tremblay 1997; Puttler et al. 1998; Hill et al. 1999; McGrath et al. 1999; Jacob and Windle 2000; Poon et al. 2000; Casas-Gil and Navarro-Guzman 2002; Díaz et al. 2008; Pinto and Kulkarni

2012). However, some studies used a screening tool to either aid the DSM diagnosis, or to conduct a reliability analysis between the screening tool and DSM (Vitaro et al. 1996; Malo and Tremblay 1997; Puttler et al. 1998; Jacob and Windle 2000; Poon et al. 2000). Some studies argued that screening tools were highly correlated with the DSM-III or IV; for instance, Carbonneau et al. (2017) used the Short form of the Michigan Alcoholism Screening Test (SMAST) to interview mothers about the father's alcohol use.

Other screening tools, such as the Cut-Annoyed-Guilty-Eye (CAGE) questionnaire was used by Torvik et al. (2011) to determine problem drinking rather than alcoholism; they also asked children how frequently they saw their parent(s) drunk using a five-category response (ranging from never to a few times a week). These were then compared and tested separately in analyses; the child measure proved to be associated with adjustment problems in children rather than the parent responses. Similarly, Serec et al. (2012) used CAST (Children of Alcoholics Screening Test) to validate children who had parents that had a ‘problem’ with alcohol; these were included in their study. Moreover, Chandy et al. (1993) identified alcohol problems in parents by sampling children who reported “hard liquor daily and whose families experienced problems related to drinking or drugs in the last five years” (p.509); they identified these children as “children of alcohol misusing parents… rather than alcoholics or alcohol-dependent” (Chandy et al. 1993, p.510); this was despite that questions also included drug use. Similarly, Hyphantis et al. (1991) asked student’s if they had someone in their close environment who had, or continued to have problems due to alcoholism; similar methods were seen by Kammeier (1971) and Aronson and Gilbert (1963) who focused on how parental substance use affected other life domains, i.e. economic functioning.

Some studies have sampled subjects from treatment centres (Fine et al. 1976; Sowder and Burt 1980; Marcus 1986; McCarthy and Anglin 1990; Murphy et al. 1991; Kolar et al. 1994; Hogan 1997; Hogan and Higgins 2001), or used data from them (Raitasalo et al. 2020). An example of a treatment centre is Alcoholics Anonymous (AA), or an outpatient alcoholism facility, presented in Marcus's (1986) study. Likewise, Kolar et al. (1994) used a methadone maintenance treatment centre to sample parents. Other studies sampled from official records such as hospital records (Nylander 1960; McLachlan et al. 1973; Berg et al. 2016; Evans et al.

2020), conviction records (Gifford et al. 2015) or psychiatric records (Knop et al. 1985). On the other hand, some studies interviewed parents about their substance use (Haberman 1966; Schulsinger et al. 1986; Brook et al. 2010), two of these were aided by psychiatrists or psychologists (Robins et al. 1977; Connolly et al. 1993).

Less common measures included the ICD-10, International Classification of Diseases (Zanoti-Jeronymo and Carvalho 2005; Raitasalo et al. 2020), or the Feighners diagnostic criteria (Offord et al. 1978). Casas-Gil and Navarro-Guzman (2002) used the Alcohol Use Disorders Identification Test (AUDIT) to screen the control parents for alcohol problems; this measure is a validated measure from the World Health Organisation (WHO) to identify alcohol-related problems. Only one study used the quantity-frequency measure (QF) (Mangiavacchi and Piccoli 2018), where the respondent identified how many 'glasses' of alcohol they have had per day, over the past 30 days. Some studies did not identify the exact criteria used to select substance users, and rather they followed up a pre-existing sample where users were already identified (Miller and Jang 1977; Rydelius 1981).

1.3.3 Challenges around school outcome measurement

Some studies used child self-reports (Brook et al. 2010; Torvik et al. 2011; Jennison 2014) or family-based reports (Haberman 1966; Connolly et al. 1993; Hogan 1997; Hogan and Higgins 2001; Pinto and Kulkarni 2012). Others had subjects interviewed by psychologists or other professionals (Kolar et al. 1994; McGrath et al. 1999; Díaz et al. 2008). On the other hand, some studies used teacher reports (Nylander 1960; Aronson and Gilbert 1963; Sowder and Burt 1980; Connolly et al. 1993; Hogan 1997; Hogan and Higgins 2001) or school records or databases (Fine et al. 1976; Miller and Jang 1977; Rydelius 1981), including national databases (Berg et al. 2016; Evans et al. 2020; Raitasalo et al. 2020). Furthermore, some studies used multiple methods, including interviews and questionnaires (Puttler et al. 1998). A similar variety of measures were also used for behaviour or adjustment outcomes, attendance, and the other outcomes identified.

1.3.4 *The problems from inconsistent measurement*

This variation in measurement has made the comparison among studies challenging. Particularly for the DSM-III or IV, or other clinical measures, as these studies have diagnosed parents as those who are dependent on substances. Whereas screening tools, such as CAGE, identify alcohol problems whereby the use of the substance is measured differently, and perhaps less hazardously. Likewise, child-reports of parents having alcohol or drug problems are likely to differ in comparison to dependence, and problem-use. This issue becomes more complex when the measures of school outcomes differ. For instance, test scores from a national school database are likely to be less biased compared to a teacher-based interview.

In addition to comparison, all measures have limitations in their use. For instance, the DSM-IV is a diagnostic tool which aims to define abuse and dependence. This measure has been criticised by Grant et al. (2007) as abuse symptoms are used as a screen for dependence which is problematic, as one is not a precursor or predictor of the other. Moreover, this measure does not screen for less harmful levels of substance use; only the extreme ends of the population are likely captured. Likewise, studies which use hospital records, or other national records, for understanding substance use may also be capturing more severe cases of substance use (Berg et al. 2016; Evans et al. 2020; Raitasalo et al. 2020). Furthermore, studies which use treatment groups as their sampling frame will be excluding populations who have not sourced support for their substance use.

Screening tools such as the AUDIT were designed to focus on “the beginning signs of trouble” (Bloomfield et al. 2013, p.6) and to “identify persons with hazardous or harmful alcohol consumption before dependence and serious harm have occurred” (Saunders et al. 1993, p.791); however what are hazardous or harmful levels? In addition to screening tools, the QF method is a common approach in substance use research. This method captures “the overall frequency of alcohol consumption within the reference period and… the usual number of drinks consumed on days when the respondent drank alcohol” (Dawson 2003, pp.19–20). However, Gruenewalk et al. (1996) argue that these measures do not produce an average total volume but rather modal values of frequency and quantity. Furthermore, it is not possible to identify substance use problems, abuse, or dependency from these measures; they are rather an indication of use which may be related to health or social problems.

Alongside this, self-reported substance use is contested in terms of the grounds of reliability and validity. Respondents demographics have been found to affect the reporting of alcohol (Del Boca and Darkes 2003). Moreover, these measures suffer from the accuracy of recollection (Del Boca and Darkes 2003), particularly if it is over a long period, e.g. a year. Some respondents may recall and count events, whereas some are only able to recall certain episodes and then they estimate their incidence, however some estimate a frequency of the event and turn it into a numerical value (Conrad et al. 1998). Thus, using these estimates can be problematic. This is where more objective measures, such as psychological diagnoses, treatment centres or national records, can be of better quality; however, as they only capture extremities they also can be limited. Nevertheless, "there is no single measure of alcohol use that is suitable for all research purposes and populations[,] [c]hoice of a particular approach must depend on degree of measurement precision required, on available resources, on respondent characteristics and on the data-collection setting" (Del Boca and Darkes 2003, p.9).

1.3.5 Sampling limitations

Some samples used treatment centres for identifying parents who had problems with substances. This method was quite common when researching drug use, which is likely to be associated with the difficulty in accessing these groups (Barnard and Barlow 2003). However, the characteristics of those from treatment centres can differ from the general population. A study by Campbell et al. (2013) found that the characteristics of an outpatient treatment sample had high rates of psychiatric co-morbidity, lower perceived physical health, and higher rates of sexual risk behaviours. Moreover, if participants had not reported illicit substance use in the last month, they were excluded, which corroborates with other research that suggests those in treatment centres have already achieved some period of abstinence. These limitations are also attributable to studies which used mental health treatment centres or prisons as their sampling frame.

Some studies have also used designs which compare outcomes for children of alcoholics or drug users to a control group. The main problems were the use of unmatched controls. For instance, the study by Reich et al. (1993) used only 54 children, with 20 controls and Zanoti-Jeronymo and Carvalho (2005) used 40 children, 20 of which were controls. Despite there being no magic number to determine the number of participants required to constitute a robust study, these numbers limit the ability to consider the findings more widely (Pearce 2016). The issue with small sampling or unmatched controls was a problem for many studies (Aronson and Gilbert 1963; Haberman 1966; McLachlan et al. 1973; Fine et al. 1976; Tarter et al. 1984; Marcus 1986; Johnson and Rolf 1988; Murphy et al. 1991; Vitaro et al. 1996; Malo and Tremblay 1997; Hill et al. 1999; Gakhar and Jaswal 2000; Pinto and Kulkarni 2012).

1.3.6 The lack of evidence from the UK

Despite that English, Welsh and Scottish government have alcohol and drug strategies (Scotland and Scottish Government 2008; Welsh Assembly Government 2008; Great Britain and Parliament 2012; Scotland and Scottish Government 2019; Welsh Government 2019) there was a lack of evidence on the relationship between parental substance use and children's educational outcomes. This is a pressing concern, as Manning et al. (2009) estimates near 30% of children live with at least a parent who uses alcohol or drugs in a binge, problem, hazardous or dependent manner. While worldwide research highlights a problem that is somewhat transferable, the government requires evidence on the extent of the problem in the UK.

1.3.7 Adjusting for confounding variables

It is imperative to adjust for variables which strongly predict school outcomes to isolate the effects of parental substance use and gain robust estimates. A considerable predictor of educational outcomes is socioeconomic status, which was adjusted for in many studies (Haberman 1966; Robins et al. 1977; Offord et al. 1978; Johnson and Rolf 1988; Moss et al. 1995; Malo and Tremblay 1997; Jacob and Windle 2000; Poon et al. 2000; Díaz et al. 2008; Berg et al. 2016; Carbonneau et al. 2017). However, some studies did not adjust for socioeconomic conditions (Chandy et al. 1993; Zanoti-Jeronymo and Carvalho 2005; Serec et al. 2012). Moreover, few studies considered prenatal alcohol use despite research suggesting it can affect the academic outcomes of children (Alati et al. 2013; Sayal et al. 2014). Likewise, prenatal drug use and cigarette use has been associated with attention problems (Noland et al. 2005). Some studies had excluded mothers from the research, or mothers that consumed a certain amount of units per week, or just focused on fathers (Aronson and Gilbert 1963; Murphy et al. 1991; Moss et al. 1995; Poon et al. 2000; Carbonneau et al. 2017). However, most studies have not considered prenatal effects in their research, despite that it could be conflated with the postnatal effects. This research must consider prenatal effects, aligning with more recent research (Torvik et al. 2011; Berg et al. 2016).

1.3.8 Why does the relationship exist? Mechanisms, mediators, and the black box

Understanding what causes poorer educational outcomes for children whose parents use substances is imperative to develop public health solutions, however these are largely undocumented. Successionist theories of causation would argue that causation is external and non-observable, but the identification of spurious associations should be the focus, mainly through experimental designs (Scott 2014). However, generative theories would argue that causal mechanisms can be identified, both internally and externally, describing a transformative potential of phenomena (Scott 2014). From this, it is understood that objects have a tendency to do *X*, which may be observed or unobserved by the researcher; these tendencies must be considered in terms of their replicability to other settings and contexts (Scott 2014).

Pearl (2000, p.47) explains that a *mechanism* is a set of other variables which determines each variable through a relationship that remains invariant when other mechanisms are subjected to external influences. Mechanisms have largely gone unknown in much research, with research using 'black box' methods "which ignores rather than explores the inside of the box" (Weed 1998, p.13) as the causal mechanism remains unknown ("black"), but its existence is implied ("box") (Skrabanek 1994). Examples of black box causality (Aalen and Frigessi 2007) studies are those who assess the direct effect of *A* on *B* or conducting "risk factor epidemiology" (Hafeman 2008). However, the mechanistic causality aims to explore the box and understand the mechanisms or processes which may explain this relationship (Aalen and Frigessi 2007). Mechanisms are rarely defined but are "intervening process variables" (Pelled et al. 1999, p.1). The identification of them can enable an understanding of the complex set of relationships which exist in each phenomenon. Mediation methods (Baron and Kenny 1986) are often used for testing mechanisms and are considered "one very practical way to open the black box, leading to improved causal inference" (Hafeman and Schwartz 2009, p.838), but they often do not fully explain the observed relationship between exposure and outcome; these methods are not without criticism (Skrabanek 1994; Weed 1998). In the relationship of parental substance use and children's educational outcomes, genetic transmission, fetal alcohol syndrome, and the family environment are theorised as potential mechanisms.

1.3.8.1 Genetic transmission, fetal alcohol syndrome and the family environment

Some research argues that children of substance-users are genetically vulnerable, along with white matter microstructure differences (O'Connor and Scott 2007; Díaz et al. 2008; Torvik et al. 2011; Daw et al. 2015; Park and Schepp 2015; Rossow et al. 2016; Quach et al. 2017; Mangiavacchi and Piccoli 2018). However, it has been argued that the appearance of environmental influence is only due to the gene-environment correlations (Daw et al. 2015). This research will align with Daw et al. (2015 p.433) that "no environment or gene operates in a vacuum… we can conclude that key characteristics of families, schools, and neighbourhoods exert substantively important moderating influences on… academic achievement". Alongside this, Fetal Alcohol Syndrome (FAS) or prenatal illicit drug, or tobacco use has been suggested as a potential mechanism. Mangiavacchi and Piccoli (2018) found that FAS mediated post-natal maternal alcohol use, and had a negative association with educational outcomes.

The third theoretical explanation, and the main focus of this thesis, is the family environment (Offord et al. 1978; Hogan 1997; Hogan and Higgins 2001; Brook et al. 2010; Gifford et al. 2015; Kuppens et al. 2020). Jennison (2014) found that marital quality was poorer in households which had a heavy drinking father; these children had lower educational outcomes. Brook et al. (2010) is the first study to explore mechanisms using path analysis and mediation. They found that parental substance use had a negative association with the mother-child relationship, and that mother-child relationships were positively associated with personality attributes, which was then associated with educational outcomes. While this study is instrumental, it uses a small dataset (n=209) of African Americans and Puerto Rican families, so the generalisability is limited.

Interventions in parental substance use have focused on enabling the parent to reduce, and ideally stop, the use of the substance while improving child outcomes via family-level or school-level interventions (Smith 1993; Dawe et al. 2003; Niccols et al. 2012). Parents under Pressure (PuP) is a programme which "targets problems at the level of the individual parent, family relationships and the social context and lifestyle of the family" (Dawe et al. 2003); it also involved a methadone-maintenance treatment for those who had children aged two to six years. The parenting skills focus on employing non-punitive methods for managing problem behaviours which include limit-setting and non-punitive consequences for disruptive behaviour (Dawe et al. 2003). The results of the intervention proved positive, particularly for parental functioning, stress, substance use levels and child behaviour improved. School-level interventions are also argued to be important for child outcomes and involve positive teacher-student relationships, particularly if children have had few positive experiences with their caregiver(s), alongside the creation of more routine (Smith 1993). Therefore, this thesis explores some of the mechanisms which exist between parental substance use and children's educational outcomes, with a particular emphasis on parenting and the family environment.

1.4 A summary of the research findings and limitations

i. Parental substance use is related to lower school attainment, adjustment and behaviour difficulties, low attendance and higher rates of truancy, suspension, and exclusion.
ii. There are few studies on the relationship between parental drug use or poly-use and children's educational outcomes.
iii. The measurement of substance use varied across studies; with dependence being the most common measure.
iv. One study from the UK was identified, despite being needed by government.
v. Some research did not adjust for confounders, such as socioeconomic status.
vi. One study tested mediators between parental substance use and children's educational outcomes.

The next chapter (Chapter 2) will address the limitations and provide a theory for how parental substance use could be related to children's educational outcomes.

Chapter 2 Theorising Mechanisms in the Relationship of Parental Substance Use and Child Educational Outcomes: A Socioecological Approach

Six summary points were made in the scoping review (section 1.4). Following this, the thesis aims to address the gaps and build on the research identified. Key gaps include the lack of evidence on parental drug use and education outcomes and the shortage of research which explores the mediators, or potential mechanisms in the relationship. To attend to the gaps, the socio-ecological model, developed by Bronfenbrenner (1979), has been applied to frame and identify aspects which influence educational outcomes. Each layer of the framework is applied and discussed in relation to parental substance use and children's educational outcomes, and then summarised in terms of an overarching system.

2.1 Socioecological perspective: understanding and application

Bronfenbrenner (1979) developed the socio-ecological model with the main argument that settings and systems both modify individual behaviour and vice-versa. It offers an alternative perspective for health promotion research which has been criticised for being driven by an individualised, victim-blaming ideology (McLeroy et al. 1988). The principle is that settings and systems exert their influence, and are a *dynamic entity* which moves and restructures the social environment in which they reside (Bronfenbrenner 1979). Using the metaphor of Russian dolls, Bronfenbrenner describes the system as nested; the main components being the micro-, meso-, exo-, and macrosystems. While systems are considered equal in terms of influence, their effect on the individual is different, and some systems could be more influential than others.

The microsystems are the closest context to the individual; it is *experienced* and is a complex of relations between the developing person and the environment (Bronfenbrenner 1977; Bronfenbrenner 1979). Examples of microsystems include the family environment, school and the workplace; they are settings in which individuals engage in particular activities and roles - for example, a school constitutes a setting (Bronfenbrenner 1977). The mesosystem is the interrelation among settings such as the family and the school (Bronfenbrenner 1977); it is considered a system of microsystems. The exosystem is an extension of the mesosystem (Bronfenbrenner 1977). This context does not contain the individual but is a setting which impinges and encompasses the immediate settings and hence, influences, delimits, and determines what exists in a given setting (Bronfenbrenner 1977). Examples are the workplace, neighbourhood, mass media and agencies of government (Bronfenbrenner 1977).

Bronfenbrenner describes the over-arching structure of these settings as the macrosystem. Unlike the previous systems described, it is not experienced by the individual directly. Instead, it exists in the culture or subculture, as one school classroom looks and functions like others (Bronfenbrenner 1977). He describes this as the blueprints of society, whereby laws, regulations and rules are the formal processes, whereas ideology and unwritten cultural contexts are the informal and implicit processes of the macrosystem. As a result, macrosystems exist in structural terms and as ideology that both explicitly and implicitly provide meaning and motivation to particular agencies, social networks, roles, activities and their interrelations (Bronfenbrenner 1977). Hence, this enables the researcher to understand individual behaviour in relation to contexts and wider settings.

McLeroy et al. (1988) have developed Bronfenbrenner's (1977) perspective and designed a framework which can be applied to social problems. Dahlgren and Whitehead (1993) illustrate these ideas in Figure 1. As the individual is a part of the microsystems (Bronfenbrenner 1977), McLeroy et al. (1988 p.355) have defined this as intrapersonal factors, which include characteristics such as knowledge, attitudes and behaviours. Within the microsystem, there are interpersonal processes, and these are network systems such as the family (McLeroy et al. 1988); this is demonstrated in the second ring of Figure 1 and defined as the mesosystem in Bronfenbrenner (1977). The exosystem is the third ring of the diagram 'living and working conditions' – it includes institutional factors, community factors and public policy at all levels (McLeroy et al. 1988). The final ring is the macrosystem, constituting of socioeconomic, cultural, and environmental conditions. Although not clear in the diagram, these rings of systems are continuously influencing each other and are bidirectional.

This framework will be applied to theorise how the layers of society influence educational outcomes. It will address how individual characteristics such as gender, ethnicity and genetics influence educational outcomes. Moreover, it considers how interpersonal relationships influence educational outcomes which include parenting and the family environment, along with peers. Furthermore, it considers the school system, socioeconomic status and cultural conditions.

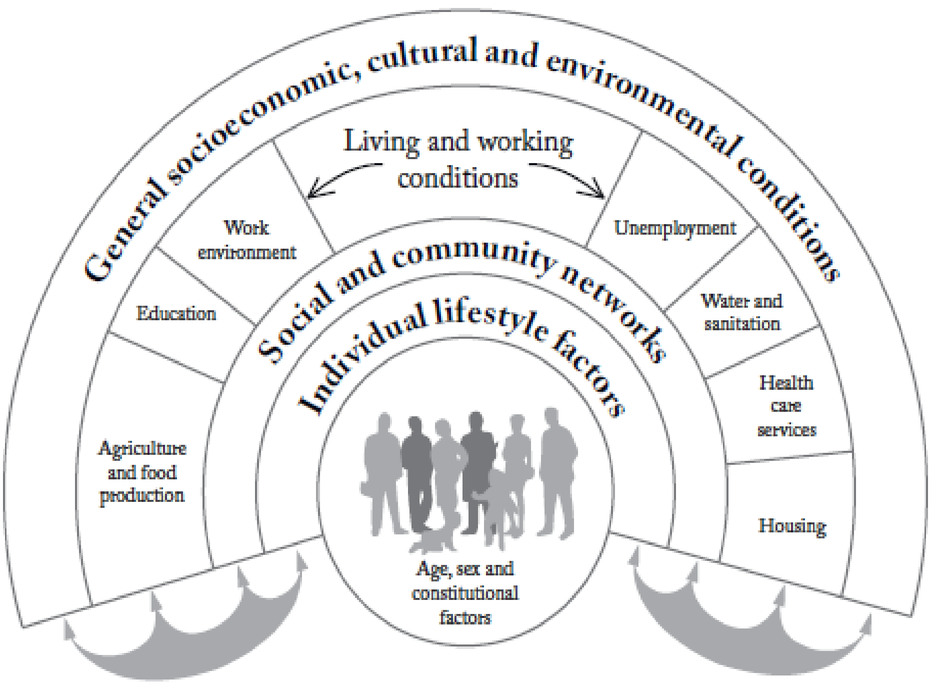

Figure 1: Socioecological perspective; diagram by Dahlgren and Whitehead (1993)

2.2 Individual factors that impact educational outcomes

Individual characteristics are known to unequally impact educational attainment (Sammons 1995; Berrington et al. 2016). The Department of Education reported that females are more likely to reach the UK benchmark of 5 A* - C's including English and Maths (Sylva et al. 2014); but, no statistically significant differences are found in maths (Sylva et al. 2014). In the same report, Bangladeshi, Indian or Pakistani students had higher attainment compared to students with a White heritage. However, 49.5% of Black Caribbean heritage children achieved 5 A* - C's compared to 57.4% Black-African children, 71.2% Indian children, and 58.1% White children. However, these statements are not intersectional. White working-class boys tend to be the 'casualty' of education attainment (Sylva et al. 2014); suggesting that class, ethnicity and gender all influence outcomes. Some research suggests that class operates in the same manner for each ethnic group (Berrington et al. 2016). Moreover, the patterning in individual characteristics is argued as a product of how power is distributed between groups via structural influences. Therefore, while individual characteristics of gender and ethnicity are predictive, the unequal distribution of power among groups is largely responsible for the patterning observed.

Outside of power distribution, genetics research suggests that children of alcoholics are at increased risk for being genetically vulnerable. This includes behavioural problems and impulsive sensations, along with white matter microstructure differences (Park and Schepp 2015). Studies in this area argue that these factors are essential when assessing child wellbeing outcomes (O'Connor and Scott 2007; Díaz et al. 2008; Torvik et al. 2011; Daw et al. 2015; Park and Schepp 2015; Rossow et al. 2016; Quach et al. 2017); however, few studies can isolate the genetic influences from confounding factors (Sellers et al. 2019b). As discussed in Chapter 1, the influence of genes compared to the environment is not clear, and both are likely to influence outcomes. Therefore, this research will align with Daw et al. (2015) that no environment or gene operates in a vacuum as families, schools, peers, and neighbourhoods mutually influence educational outcomes through multiple systems.

2.3 Interpersonal factors that impact educational outcomes

All socioecological levels focus on outcomes which occur at the level of the individual but, the interpersonal focuses on the relationships. Models include physiological processes and interpersonal influences, i.e. models of smoking acquisition (McLeroy et al. 1988). In McLeroy et al.'s (1988) they discuss how interpersonal factors can be used in interventions to improve individual outcomes, such as peer counselling programmes (Elder and Stern 1986). Many explanations underpinning the interpersonal understanding, as outlined by McLeroy et al. (1988), are from sociological, psychological or behavioural genetics literature.

2.3.1 The role of parents

Parental behaviours and the family environment are highly influential for child outcomes, however over-time this becomes less influential due to increased autonomy in adolescence. Numerous theories underpin the influence of parents and caregivers on children. Earlier theories have been instrumental to understanding, such as Social Cognitive Theory (or Social Learning Theory) (Bandura 1971) and Attachment Theory (Harlow and Zimmermann 1958; Bowlby 1969; Ainsworth et al. 2015).

Bandura (1971) argues that patterns of behaviour are developed through experiencing and observing other behaviours. This was illustrated well through the 'Bobo doll' experiment, which showed that aggressive role modelling was associated with aggressive behaviours in the exposed children, despite aggressive arousal post role modelling for all children (Bandura et al. 1961). It concluded that behaviour is learnt by direct experience, sometimes by rewards or punishment, previous experiences, through modelling, observing actions and their consequences (vicarious reinforcement). However, he notes that the learner is not passive, and cognitive, environmental, and other behaviours all influence the individual (reciprocal determinism). Research has shown that social learning/cognitive theory exists in adolescent goal setting and career choices (Rogers et al. 2008; Lawson et al. 2015). Therefore, parental behaviours, such as attending university, and values, such as prioritising work over social events, of education, are likely to be highly influential to their child.

Attachment theory is another widely used theory within the parenting literature. Bowlby (1969) defines attachment as a deep and enduring bond connecting people (Ainsworth et al. 2015). Bowlby (1969) views parents as a 'secure base' defined as a foundation where children are "welcomed when he [or they] gets there, nourished physically and emotionally, comforted if distressed, reassured if frightened" (p. 12). In contrast, if unavailable, the child's wellbeing can be affected; monkeys simulated this in Harlow and Zimmermann's (1958) study. Parent-child interactions that are warm, secure and positive can foster children who are well-adjusted (Bowlby 2012). Various attachment types have been identified, first by Hazan and Shaver (1987), and further by Bartholomew and Horowitz (1991) as discussed in Vungkhanching et al. (2004). Bartholomew and Horowitz (1991) argue the four types of attachment are: secure;

fearful-avoidant – unable to become emotionally close; preoccupied - obsessed with relationships; and, dismissing – rejecting of intimacy. The secure type of attachment shows positive associations with wellbeing and adjustment (Vungkhanching et al. 2004). Hence, it may be that parental substance use can weaken the attachment between the parent and child, leading to poorer wellbeing outcomes (Schindler 2019).

The next sections will outline theories which are relevant to both educational outcomes and parental substance use. The sections aim to synthesise literature on the relationship between parenting and child educational outcomes, and the relationship between parental substance use and parenting and the family environment. Together, these literatures combined provide a theory of mechanisms in the relationship between parental substance use and children's educational outcomes, with a particular focus on educational attainment.

2.3.1.1 Baumrind and parenting styles

Baumrind is arguably the dominant model in terms of research on the parent-child relationship and parenting (O'Connor and Scott 2007). The premise is that parenting has two dimensions of warmth and control. Baumrind (1967) used these concepts to distinguish parenting typologies (O'Connor and Scott 2007) as authoritative, authoritarian and permissive. Maccoby and Martin (1983) built on this and developed a fourth typology. It identified parenting which was similar to permissive parenting however, the main component of warmth and responsiveness was much lower than permissive parenting, termed as *indulgent* by Maccoby and Martin (1983); this is used interchangeably with neglectful.

Baumrind (1971, 1967) argued that authoritative parents maintained control over their children and placed demands upon them, but were able to maintain warmth and rational and receptive responses to the child's needs. Secondly, authoritarian parents were detached and less warm. Thirdly, permissive parents were not controlling, nor demanding but relatively warm. Children of authoritative parents were on average the most self-reliant, controlled, explorative and content. In contrast, those of the permissive parents were on average the least self-reliant, explorative and self-controlled and, those of the authoritarian parents tended to be discontent, withdrawn and distrustful (Baumrind 1971, 1967). Research has used these parenting styles to explore how they impact child wellbeing (Baumrind 1967; Baumrind 1971; Kandel 1990; Baumrind 1991; Masud et al. 2015).

Research continually finds that authoritative parenting is associated with better child wellbeing. Baumrind (1991) found that parents who adopt this style had adolescents who were more accepting of this control style compared to authoritarian control styles. For instance, girls with a more authoritative upbringing were more independent than boys, who benefited from less enforcement of authoritative parenting (Baumrind 1971). In terms of educational attainment, permissive parenting inhibited achievement-orientated behaviour for boys; however, for girls, the opposite effect was observed (Baumrind 1971). However, permissiveness may lead to adolescents having fewer boundaries and behave immaturely or diffusely. Overall for education, authoritative parenting is positive for educational attainment (Baumrind 1967; Baumrind 1971, p.19; Shucksmith et al. 1995; Spera 2005; Masud et al. 2015). Young people who have authoritative parents were more optimistic about school whereas those who had indulgent parents were more likely to be disaffected with school (Shucksmith et al. 1995); there were little differences in those who had authoritarian or permissive parenting.

A systematic review by Masud et al. (2015) confirms this. They found that authoritative parenting has a positive effect on adolescent academic achievement compared to other styles, arguing that it is more responsive to the social and cognitive needs of children (Masud et al. 2015). They found that the children of authoritative parents had developed self-enhancing attributes and higher intrinsic motivation, which resulted in more devotion to their studies (Masud et al. 2015). However, Asian, including Chinese and Asian American, cultures tend to have more effective academic achievement when authoritarian parenting styles are used (Masud et al. 2015). However, Dornbusch et al. (1987) found no differences in their study, and Smetana (2017) summarises that the differences in parenting across ethnicities could also be due to socioeconomic status whereby authoritarian practices are a response to dangerous neighbourhoods (Lee et al. 2014). Despite the differences across ethnicity, authoritative parenting is often associated with higher psychosocial abilities, educational attainment, and lower behavioural, psychosocial, and depressive scores.

2.3.1.1.1 Going beyond Baumrind: parenting styles, behaviours, and goals

While useful, Darling and Steinberg (1993) argue that the categorisation of parenting styles alone does not allow for the identification of the mechanisms which affect child and adolescent wellbeing. They argue that holistically understanding parenting allows for mechanisms to be theorised and recognise that parenting is a series of interactions between the parent and child. They argue that parenting styles, practices and behaviours, and parental goals and values are critical components of parenting.

First, they explain that parenting styles are a characteristic which alters the efficacy of the parent's socialisation efforts, and this moderates the child's behaviour (Darling and Steinberg 1993, p.488). Hence, parenting styles represent a 'constellation of attitudes' towards the child; these attitudes form an *emotional climate* in which the parent's behaviours and practices are conducted (Darling and Steinberg 1993, p.488). These have a direct effect on the development of child behaviours and characteristics and are mechanisms through which parents directly influence their children's socialisation goals (Darling and Steinberg 1993). Parental goals and values are "internal representations of desired states or outcomes that parents hold for their children" (Spera 2005, p.131).

They argue that the three components are mutually re-enforcing. For instance, the goals and values parents attain influence the parenting practices utilised, and the parenting style moderates this relationship. Darling and Steinberg (1993) use the example of adolescent school performance. They describe this as influenced by parental involvement (parenting practice), and the effectiveness of the practice is greater among authoritative parents, of whom may value academics. From this, parental values towards educational achievement reflect the importance they place on academics (Spera 2005). For instance, parents may set goals or aspirations for their children, such as doing well in math or graduating from university. They also are then likely to communicate these values with the intent that their children will adopt these values (Spera 2005). Astone and McLanahan (1991) explain that parenting practices and styles are somewhat reliant on the educational aspiration's parent's hold for their children, with external strains impacting single, or lower socioeconomic families.

Alongside parental goals and styles, Darling and Steinberg (1993) discuss that parental behaviours are essential for child wellbeing; the behaviours are often motivated by their goals, aspirations and values. For educational attainment, the literature shows little consensus on what parental practices and behaviours are effective; however, there is continual reference to parental involvement. Epstein's parental involvement framework illustrates how the school, family and community can work together to foster child development socially, emotionally, and academically. It draws on parenting, communication, parental volunteering, learning at home, involving parents in the school decision process, and community collaboration (Epstein 2002).

Research from the Education Endowment Foundation (Axford et al. 2019) summarises a large volume of literature on parental engagement and involvement, which builds on Epstein's work. They explain that the home learning environment is the primary environment for parents to engage with their child's learning. They highlight that this engagement changes over-time, whereby earlier ages often engage in reading, playing with letters or numbers, and drawing whereas older children value enrichment outings, computer use, and communication about school work (Axford et al. 2019). They summarise that communicating with children, supervising and checking homework, attending school activities, communicating with the school, and creating a positive home learning environment are likely to be important for educational outcomes. Moreover, they found that this positive association between engagement and the child's learning existed regardless of socioeconomic position. Furthermore, they state that there are very few high-quality interventions which demonstrate the impact of parental engagement interventions on children's attainment, but note that there are encouraging findings for parental school involvement, and interventions which promote children's social, emotional and behavioural outcomes in this area.

Other studies also draw on parental involvement. Mau (1997) explains that parental involvement is providing support, encouragement, and direct instruction in the home alongside maintaining communication with the school. Gonzalez-pienda et al. (2002) use six dimensions which focus on parental expectations of child achievement. They define this as help with homework, both level and type, satisfaction with academic achievement, and the reinforcement of child's academic behaviours. They found that parental involvement has a positive association with self-concept, academic aptitudes and perceptions of success and failure; however, only academic aptitude was associated with academic achievement. A review by Van Voorhis et al. (2013) illustrated that family involvement is positively linked to children's outcomes in their early educational years, particularly in literacy and math. Likewise, a meta-analysis by Castro et al. (2015) found that the strongest associations were high expectations by parents for their children, the development and maintenance of communication regarding school activities and schoolwork, and promotion of reading habits; they did not find that supervision, control of homework, and attendance of school activities strongly associated with achievement. However, this review did not include studies pre-2000, which could have excluded some of the emerging parenting literature.

Wong (2008) found an association between parental involvement and autonomy support with child academic performance, which was mediated by effortful child control and regulation. Other studies that tested for mediation, such as, Magdalena (2014) found that warmth, supervision, parent-child communication and autonomy predicted 85% of the variation in child school performance. She argues that parent-child communication is more critical than parent-school relations; however, the study sample size is small, so generalisations for this study are limited (n=106). Other studies, such as Zellman and Waterman (1998) explain that parents need to evaluate when their children need help to make a useful contribution. Moreover, Scott-Jones (1995) suggests that parental monitoring is essential for children to develop self-monitoring and management skills, i.e. planning time spent on homework. Furthermore, if parents are overly demanding, this may be overwhelming to the child and harm school readiness (Parker et al. 1999).

In summary, the values, and goals parents hold are communicated implicitly by their behaviours, which is moderated by their style of parenting. However, the socio-ecological model also recognises that socioeconomic status and culture can also impact these three aspects, e.g., the strain of living in a dangerous neighbourhood or being on low-income (Smetana 2017). Overall, the literature suggests that the following practices influence educational outcomes, specifically attainment: i) communication regarding school, ii) the development of learning habits, iii) enthusiasm for learning, and helping with homework (disputed), iv) supervision of children (disputed), v) balancing supervision of the child whilst promoting autonomy, and vi) taking an interest in the school as a system.

2.3.1.2 Not a one-way street: The parent-child relationship

While the power balance is more towards the parent influencing the child, a series of interactions exist which affect the parent's influence on the child. Decades of research has shown that an effective parent-child relationship is the foundation for personality development and socialisation characterised as one that is supportive and positively associated with social, emotional and behaviours outcomes (Bowlby 1969 cited in Murray 2009; Baumrind 1971; Maccoby 1992; Murray 2009; Ainsworth et al. 2015). Moreover, these supportive relationships positively influence wellbeing outcomes (Sroufe 1983 cited in Murray 2009; Armsden et al. 1990; Cassidy and Shaver 2002; Murray 2009; Sameroff et al. 2014 cited in Murray 2009; Ainsworth et al. 2015). Parker et al. (1999) state that an "effective parent-child relationship is one that would include high levels of emotional warmth and encouragement of independence and low levels of strictness" (p. 415). Whereas parents who desire to feel in control of their children without taking care of their child's needs or perspective (parent-orientated goals) tend to have lower-quality relationships with their children (Duncan et al. 2009). The definitions of parent-child relationships often have some overlap with parenting behaviours.

Murray (2009) argues that positive relationships with parents create healthy competence and autonomy, which transfers to school outcomes (Garcia-Reid et al. 2005; Connell & Wellborn, 1991 cited in Murray 2009). Supportive relationships also cultivate emotional security, stability, and confidence, which later develops into healthy adaptation and exploration at school (Pianta 1999). On the other hand, a non-supportive, distant parent-child relationship may not foster effective behaviours for achievement; the child may have poorer social, emotional, and behavioural outcomes, and lack school readiness. Hence, when the parent-child relationship is less positive, the risk for poorer wellbeing is higher across all domains.

2.3.1.3 A summary

Authoritative parenting styles paired with a warm and encouraging parent-child relationship seem to cultivate educational outcomes, specifically attainment. However, parenting which is less warm, with greater control is less positive; parenting styles which are authoritarian, permissive, and neglectful are associated with less educational success. Although, the parent-child relationship is bidirectional whereby the parent influences the child's behaviour and vice-versa. Nevertheless, these styles are not intrinsic to the parent, as they may reside in circumstances where their parenting can be affected. For example, poverty is often a predictor of increased strictness and aggravated parenting (Parker et al. 1999), which suggests that external strains, e.g. neighbourhood deprivation or access to resources, can alter parenting and the parent-child relationship. Therefore, whilst parenting and the parent-child relationship influence educational outcomes, the socioecological layers of society also do.

2.3.1.4 The role of the family environment

The family environment encompasses many aspects, with family cohesion, social support, stimulating environment, community involvement being identified as positive influences (Benzies and Mychasiuk 2009). The relationships that occur in the household are a focal point. These relationships are often positive, such as learning how to foster supportive relationships. However, there are some instances where witnessing relationships can be harmful for the child. For instance, interparental conflict is negatively associated with children's mental wellbeing, behaviour, and academic attainment (Cummings and Davies 1994; Grych et al. 2001; Cosgaya et al. 2008; Sturge-Apple et al. 2008). Theories centre around the 'direct path hypothesis' and the 'indirect path hypothesis' (Sturge-Apple et al. 2008). The direct path is where the child witnesses' destructive relationships characterised by hostility and disengagement, putting the child's psychological wellbeing at risk. Second, the indirect path theorises that interparental conflict reduces parenting capacity, which later undermines the child's functioning (see Grych et al. 2001). Sturge-Apple et al. (2008) tested these pathways in the relationship between interparental conflict and school avoidance and classroom difficulties. They found the direct pathway was more predictive of the relationship; however, there was partial support for the indirect pathway (Sturge-Apple et al. 2008).

Alongside parental relationships, Yucel and Yuan (2015) explored the effect of siblings on socio-emotional development and educational aspirations using longitudinal UK data. They found that adolescents with half, step siblings, or younger siblings are more likely to have lower socio-emotional development. Moreover, adolescents with adopted or foster siblings are less likely to aspire for college. Sibling relationship quality had significant and positive effects on socio-emotional development. Research is evolving to explore other relationships such as grandparents (Davey et al. 2009), but this is a niche area.

Alongside relationships in the household, household routines such as family meals, obtaining adequate sleep and doing activities together (Anderson and Whitaker 2010) are also crucial. Breakfast has been identified as proxy for the quality of a child's home environment and parenting (Rogers 2016), which later is associated with educational attainment (Littlecott et al. 2016). Similarly, feeling rested at school, and typical bedtimes were associated with improved school functioning (Meijer et al. 2000). Children who did not have difficulty in wakening for school showed more achievement motivation (Meijer et al. 2000). Similar to other parenting literature, children residing in lower socioeconomic households have less consistent bedtimes which may contribute to poorer sleep quality which is related to other outcomes, e.g. concentration (Hale et al. 2009).

2.3.1.5 The family as a system

The previous sections outlined how parenting, relationships, and family organisation can affect child wellbeing. Family systems theory developed by Bowen (1974, p.115) theorises that "the family is a system in that a change in the functioning of one family member is automatically followed by a compensatory change in another family member. Systems theory focused on the functioning of a system and its component parts". Bowen uses the example of family member illness, stating that this member will be "automatically compensated by other family members who over-function until the sick one recovers" (Bowen 1974, p.116). Following this, he explains that if this illness is chronic, or permanent, then a long-term imbalance will begin to exist in the system, and the over-functioning of members can create under-functioning in other areas. In more detail, the theory has some core components: 1) Emotional fusion and differentiation of the self, 2) Triangles, 3) Nuclear family emotional system, 4) Family projection process, 5) Emotional cut off, 6) Multigenerational Transmission Process and, 7) Sibling positions; all of which Brown (1999) covers in considerable depth, along with how it is applied in family therapy.

These eight concepts allow for application to parental substance use. The premise of family systems theory is how well families are 'fused' and how they adapt to stress. The family must have a balance of setting aside individual choices for harmony whilst having autonomy. A stressful event may cause families who have less individual autonomy unable to deal with the problems it poses. The notion of 'triangles' theorises how parents use other outlets to deal with stress, e.g., talking to friends, or spending more time at work. While triangles can be useful for a short-term outlet until resolution, they can also be harmful if they overspill into other areas of life. This overspill can lead to conflict, which later may cause the projection of problems on to children where the "child responds anxiously to the tension in the parents' relationship, which in turn is mistaken for a problem in the child" (Brown 1999, p.96). In more recent years, the theory has also addressed the ethnic differences in systems and the lack of a 'gender-sensitive lens', alongside addressing the socioeconomic differences in families (Brown 1999).

If a parent is using a substance to harmful levels, which is conceptualised as an illness, this will place pressure on the family system. While addiction is not an individual choice, it may create overspill and disrupt 'homeostasis' (Lander et al. 2013). This could lead to a reduction in household income, or increased time spent intoxicated unable to perform the role expected, with individuals in the family, such as children, performing roles which are traditionally not expected of them e.g., putting their parent to bed who is intoxicated (Lander et al. 2013). Also, the parent who is unaffected by substance use may over-function to accommodate the loss of the other parent. This over-functioning could lead to under-functioning in other areas, such as less time spent with children, and the parent may also experience lower wellbeing, which could negatively affect children. Hence, the stress placed on the family system by substance use may cause overspill, conflict, and over-functioning, which leads to multiple indirect processes which harm child wellbeing (Lander et al. 2013).

2.3.1.6 Beyond single trauma: the role of Adverse Childhood Experiences

While parental substance use can be an individual adverse event, other adverse childhood experiences (ACEs) are relevant. Without being exhaustive, Felitti et al. (1998) were one of the first to research ACEs, defined as the presence of emotional, physical or sexual abuse; violence towards the mother; living with substance users or those who had a mental illness, or imprisoned. These occurrences were self-reported, and this study treated each ACE as equal. To analyse the impact, the researchers cumulatively tallied how many ACEs an individual had and used these to predict health outcomes. They found that increased ACEs were a risk for the leading causes of death, including heart disease, cancer, chronic lung disease, fractures, and poor self-rated health. This literature has now vastly expanded, with Kelly-Irving and Delpierre (2019) illustrating that the Web of Science saw one publication referring to ACEs in 1985, compared to two hundred and one in 2018.

Bellis et al. (2014) showed that in Wales, near 50% of adults sampled had one ACE, and 9% had four or more. They showed a clear deprivation gradient in ACEs, with 4.8% in the most affluent quintile experiencing four or more ACEs, compared to 12.7% of the most deprived quintile. Findings show, irrespective of deprivation, that ACEs contributed to one in six individuals smoking and one in seven with poor diet and binge drinking (Bellis et al. 2014). In addition, they also found evidence for the intergenerational transmission of ACEs, where individuals had experienced unintended pregnancy, which is further related to poorer parenting skills and stress. A recent study by Bellis et al. (2018) used a similar approach and found that ACEs impact school absence, with those with four or more ACEs being seven times more likely to have high school absenteeism, and poorer mental health. Furthermore, Tan et al. (2017) found that ACEs were negatively associated with academic functioning – but this was partially mediated by parenting stress, with parental substance use disorder being the strongest factor associated with the construct of ACEs.

While useful, this research is criticised. First, it is irrational to equate sexual abuse to parental separation in terms of wellbeing effects. Second, a considerable amount of ACEs are experienced in poverty, and thus, they could be mutually reinforcing (Kelly-Irving and Delpierre 2019), and perhaps intergenerational (Bellis et al. 2014). The term 'ACEs' is somewhat trivialised. It has evolved as a buzzword, with Scotland and Wales having an 'ACEs Hub', and through this, we have seen a more deterministic approach to understanding ACEs which can have negative implications (Kelly-Irving and Delpierre 2019). In light of these criticisms, this research will attempt to align with the following: "The potential health consequences of ACEs is a research topic where the targeted level for intervention must be the structural social context in which children are exposed to ACEs and socioeconomic disadvantage" (Kelly-Irving and Delpierre 2019, p.453).

2.3.1.7 Parental substance use and the coexistence with other wellbeing domains

Within the literature, parents who abuse substances are more likely to have children who are exposed to other adversities (Dube et al. 2001). Moreover, these parents are more likely to have psychological problems (Kandel 1990) and this has been related to poor psychological outcomes in children (Schepman et al. 2011). Evidence suggests that parents who have poor mental health may also experience difficulty in parenting (Baumrind 1991; Edwards et al. 2009; Borre and Kliewer 2014). In terms of its relationship to substances, Klee et al. (2002) explain that a third of drug misusing women reported depression; some of which may be related to withdrawal. Moreover, children whose parents had comorbid disorders with alcohol were at greater risk compared to parents who were just alcoholics (Hussong et al. 2007; Hussong et al. 2008; Park and Schepp 2015). Hence, the coexistence of social problems is useful in terms of research and intervention development.

2.3.1.8 A summary of parenting and the family environment

Bowen argues that families are a system, with each member having interrelationships with others. Within this system, there are behaviours which shape the child. Parenting styles are essential; they moderate the effect of parenting behaviours, which are primarily shaped by the parent's goals and values; all of which are influenced by the system, such as socioeconomic conditions. In parallel, the family system affects the child through a series of interactions and household routines. These activities may be positive, but in some cases, can be negative, e.g. parental substance use, which places stress on the family. How the family operates under stress must be explored to understand child educational outcomes, which begs the question how does the family operate when parents use substances?

2.3.1.9 Parenting and the family environment when parents use substances

The use of substances by parents varies widely, with research describing it as recreational, social, harmful, hazardous, and dependent use, and each use is not fully understood in how it impacts children's wellbeing, particularly educational outcomes. Some research suggests that 'moderate' use of alcohol can be beneficial for children's academics, but that is often a proxy for higher socioeconomic groups cultural practices and behaviours (Scholder et al. 2014). Most research suggests that dependent substance use is detrimental to children's educational outcomes. However, other use, such QF, problem use, or abuse shows mixed results. While the effect is largely unknown, research argues that these behaviours and unhealthy emotions can directly affect their family members, specifically their children as they are easily influenced by their environment (Park and Schepp 2015). From this, the next section will explore the parenting styles, behaviours, and goals, along with the family environment, in parents who use alcohol or illicit drugs.

2.3.1.9.1 Changes to parenting styles, behaviours, and goals

Darling and Steinberg (1993) and Baumrind (1967, 1971) argue that parenting is a multifaceted concept which is consistent throughout the life course. Gutman and Feinstein (2010) critique this notion that there are enduring qualities of parenting. They argue that specific life stressors can change the context of parenting, and conclude that the ability for parents to modify their behaviours may be influenced by the circumstances they reside in.

The parenting styles often utilised by parents who use substances can be harmful to child wellbeing (Cleaver et al. 2007). While the literature is sparse on parenting styles, Baumrind (1991) found that some parents who used illicit drugs had adolescents who were nonconforming, emancipated and also used drugs themselves. Likewise, Kandel (1990) found that maternal substance involvement is linked to poorer parenting styles, including less supervision, punitive forms of discipline, less closeness, discussion and positive involvement. However, Kandel (1990) found the opposite for fathers whereby positive parenting techniques positively correlated with heavy drinking and drug use for increased supervision, positive involvement and decreased punitive discipline; although, a decrease in affection was observed. In the article, they attribute the unexpected findings to the halo effect and bias.

However, a longitudinal study by Edwards et al. (2009) found that fathers' binge drinking was associated with high levels of paternal and maternal over-reactivity, suggesting harsher and more demanding parenting. They argue that poor child outcomes could be partially attributable to disrupted parenting in heavy drinking families. Also, Arria et al. (2012) found that parental substance-related impairment was associated with a decreased likelihood of positive parenting behaviours such as coercive control, harsh discipline and failure to follow through. They also found that these parents had ineffective control of children's behaviours and problems regulating their child's aggression.

Holmes and Robins (1987) theorise that harsh discipline may be a result of immediate, impulsive actions which was invoked by anger; interestingly, they found this was similar in parents with other disorders, i.e. depression. In addition, Finzi et al. (2000) explain that drug addicts are difficult to apprehend and may put the child under 'constant anxiety', as they must anticipate when the parent is likely to become violent or self-destructive. Gest et al. (2004) suggest that harsh discipline, specifically spanking inhibits children's language comprehension skills. Likewise, Dodge et al. (1990) also found that physical harm affects child development, with children being more likely to develop biased and deficient patterns of processing social information.

Alongside discipline, the supervision and monitoring of children have been evidenced to be less positive among substance using parents, a fundamental parenting behaviour for educational outcomes (Magdalena 2014). Windle (1996) theorises that parental monitoring establishes appropriate behaviours and structure for adolescents, and when absent, adolescents may struggle to distinguish healthy from unhealthy choices. Research finds that adolescent substance use is mediated by parental monitoring generally (Beck et al. 1999; van der Vorst et al. 2006; Moore et al. 2010; Dever et al. 2012; Carroll et al. 2016), but also in families with alcohol problems (Chassin et al. 1993; Chassin et al. 1996; Arria et al. 2012). For instance, Chassin et al. (1993) found that alcoholic parents were less likely to monitor their adolescent's activities, and these adolescents had an affiliation with drug-user peers; some of these effects can be gendered (van der Vorst et al. 2006).

The supervision of children exists in a milieu with parental involvement. Hogan (1997) defined parental involvement as homework involvement, attendance at school and general parent-school involvement. She found that parental involvement was generally low in parents who used substances. Moreover, teachers generally thought these parents tended to not help with homework or to be committed to getting children to school; in two cases siblings who had previously dropped out of school took the child to school. One case did, however, have a very involved mother. This study elicits how qualitative research can be useful in illustrating processes in the family environment.

Alongside less involvement and supervision, the communication and closeness of the parent-child relationship is generally lower (Kandel 1990; Finan et al. 2015). Family cohesion was measured as closeness to the rest of the family, and communication was based on parental listening and child openness (Finan et al. 2015); conceptualised as family functioning by Finan et al. (2015). Finan et al.'s (2015) study show that parental drinking negatively predicted family cohesion. In turn, family cohesion negatively predicted adolescent rule-breaking and aggressive behaviours. In terms of communication, both maternal and paternal drinking negatively influenced communication between girls and their mothers; only paternal problem drinking adversely influenced communication between boys and their fathers (Finan et al. 2015). Windle (1996) explains that substance misusing parents may disrupt healthy emotional development in their children by being ‘emotionally unavailable’. Both Magdalena (2014) and Castro et al. (2015) explain that parent-child communication is essential for positive educational outcomes. Furthermore, Roisman (2002) found that family closeness was moderately related to school outcomes.

Along with cohesion, child abuse, or cruelty, is often associated with parental substance use. Adults with a history of drug or alcohol problems were almost three times more likely to have reported committing child physical abuse; this is despite controlling for other social and demographic factors, such as socioeconomic status (Chaffin et al. 1996; Walsh et al. 2003, p.1411). The presence of alcoholic fathers and mothers increased the likelihood of sexual abuse and non-familial sexual abuse, respectively (Fleming et al. 1997; Walsh et al. 2003). Whilst this pathway is not well developed, Coohey et al. (2011) argue that it can have serious adverse effects on education outcomes.

Outside of parental behaviours and styles is the goals and values held by parents, which was discussed in Darling and Steinberg (1993). Little research was identified in the area of goals and values in substance using parents, however Kandel (1990) explains that the expectations of parents tend to be high, but potentially unrealistic. Given this information, it could be assumed that the practices and styles observed in the literature could be influenced by ill-perceived goals which are unlikely to be understood or internalised by the child. Alongside the parenting styles, behaviours and goals, the family environment was also a key component.

2.3.1.9.2 The family environment when parents use substances

Harold et al. (2007) state that little is known about how the family operates to influence school achievement. However, we do know that children are often caught up in-between much of the conflict in the family environment. Almeida et al. (1999) explain that events inside and outside of the family, e.g. work stress, impact family relationships through the spill over of tension (Margolin et al. 1996; Bronfenbrenner 1989 and Brown and Harris 1978 cited in Almeida et al. 1999). These stressors may raise parental demands for adaptation which may lead to marital tension and negative interactions with children (Almeida et al. 1999) which links to the indirect hypothesis in Sturge-Apple et al. (2008). They conclude that the spill over is when "tensions in a particular family subsystem are stressors that lead to additional problems in another family subsystem" (Almeida et al. 1999, p.50). Their findings confirm this, where increased marital tension leads to negative interactions with their children, which differs compared to Sturge-Apple et al. (2008).

Likewise, Kachadourian et al. (2009) found that the use of substances placed additional strain on relationships, which is believed to increase marital conflict, and overall marital dissatisfaction; little is known about drug use. Keller et al. (2008) also found that paternal problem drinking was associated with greater marital conflict one year later. They theorise that parental drinking problems may expose children to higher levels of aggressive and unresolved marital conflict. This marital conflict may be related to children reacting to this conflict in manners which can be harmful for wellbeing (Davies et al. 2002; Cummings et al. 2003; Davies et al. 2004; Keller et al. 2008; Sturge-Apple et al. 2008).

A study by Davies et al. (2002) showed that interparental conflict was associated with child internalising and externalising symptoms; they theorise this may be related to child self-blame, i.e. 'it is usually my fault when my parents argue' and appraisals of threat, i.e. 'when my parents argue I worry what will happen to me'. Davies et al. (2004) also found that children emotionally responded to interparental conflict by freezing, showing anxiety, sadness, or anger. The research base regarding internalising and externalising symptoms is quite clear; however, how parental conflict may interrupt other wellbeing domains is less clear (Harold et al. 2007). Nevertheless, Harold et al. (2007) argue that high levels of interparental conflict and hostility place children at risk for low academic attainment.

Alongside tension, the density of parental substance use also is related to poorer outcomes in children (Díaz et al. 2008; Park and Schepp 2015; Velleman and Templeton 2016). For instance, a household where two parents are alcohol dependent, or an alcoholic mother with a drug-using sibling. Hussong et al. (2007) found that increased family density of substances had a significant effect on the externalising behaviours of children. Likewise, Edwards et al. (2006), found that two-parent alcoholic families had greater externalising symptoms compared to one or non-alcoholic families; however, they found that boys' aggression was higher than girls. If the household is compromised whereby the main carers are not able to care for their children, the children may take up parental roles (Clark et al. 2008). Godsall et al. (2004) found that children of alcoholics who take on parental roles are at increased risk for low self-concept, social isolation, and emotional disruption. Equally, Hill (2015) and Järvinen (2015) identified that a caring role had negative associations with child wellbeing, specifically educational outcomes. Therefore, given the effect parental substance use has on parenting and the family environment what is being done to support them and their children?

2.3.1.9.3 Interventions for parents who use substances

Examples of substance use reduction in the UK include NHS treatment schemes and Alcoholics Anonymous (AA). For the majority, interventions focus only on the reduction of the substance.

However, it is argued that whole-family approaches are essential. Neger and Prinz (2015) used a conceptual framework to connect parental substance use and child maltreatment. They theorise that substance use is linked to deficits in parenting knowledge, emotional regulation, and a decreased pleasure from the parenting role, whilst highlighting the accumulation of psychological stressors that exist in the environment that are linked to substance use. They state that substance abuse may relate to parents inaccurately understanding their children's behaviour, leading to unfair expectations and attributing misbehaviour to malicious intent (Kerwin 2005; Pajulo et al. 2006; Neger and Prinz 2015). Neger and Prinz (2015) conclude that emotional regulation needs to be developed before teaching the specifics of parenting behaviours but argue that whole-family approaches are practical.

Whole-family approaches address the parental need for support of both substance use and other stressors, such as parenting. Arria et al. (2012) explain that substance use may create a traumatic, chaotic and unpredictable household, and their study found that substance use was associated with difficulty in cultivating parental warmth, discipline, and having a relationship with the child. More importantly, they found that only intervening in the substance use behaviour did not significantly develop positive parenting behaviours in fathers. Arria et al. (2012) summarise that interventions are limited as they are developed for mothers with young children. Furthermore, there is limited evidence on the short and long-term feasibility and effectiveness of these interventions.

Moreland and McRae-Clark (2018) focused on the parenting outcomes of parenting interventions in integrated substance use programs. They found eighteen studies which evidenced that while overall substance use decreased, parenting outcomes were mixed. They argue that parental stress is typically higher in substance use samples, and projects which reduce this have shown success. The project Parents under Pressure (PuP) significantly reduced this, arguing it is a potential mechanism and primary direct outcome of substance use which may affect children. This also had a positive impact on their children's behaviour, which they attribute to reduced stress in parents (Dawe et al. 2003). The review found mixed outcomes for psychological adjustment, depression and child abuse and they attribute this to the potential lack of adaptation in parenting interventions for substance use parents; arguing that many interventions used general population interventions for a high-risk group which is not feasible.

Following Arria et al. (2012), Neger and Prinz summarises the current field well in their systematic review and argue that:

> *"T]here is not yet a consensus as to a single conceptual model that captures the interrelationship between parental substance abuse and parenting difficulties. A number of different conceptuali[s]ations could be reasonably be postulated to describe the pathways of influence between parental substance abuse and parenting difficulties including share putative underlying causes as well as an established reciprocal relationship in which substance abuse compromises effective parenting and child behaviour difficulties may cause parents to cope with frustrations by turning to substance abuse* (Neger and Prinz 2015, p.73)

Other difficulties include that although many families may show improvement in parenting capacity, this change varies across families (Dawe and Harnett 2007, p.388). As a result, they suggest that interventions should consider a case-by-case basis and adapt to families needs.

However, that is impractical when a considerable number of children could be at risk for parental substance use. Adaptation must be explored for various household circumstances and attempt to create intervention models closest to the issue presented. Also, families often present with many risk factors and can be against engaging in treatment (Dawe and Harnett 2007). Often engagement with a substance use intervention will require a certain amount of readiness and acceptability. For interventions to improve, the mediators in the relationship between parental substance use and child outcomes is needed. In particular, research that includes parenting stress, psychosocial adjustment, parental depression, child abuse potential, parenting behaviours, and parent-child interactions (Moreland and McRae-Clark 2018, p.58).

2.3.1.10 Pathways to educational outcomes

As shown, parental substance use and parenting are associated with other wellbeing outcomes. Harold et al. (2007) explain that once we know parents' behaviour can affect one domain, we must move forward to think about how this affects other domains. For instance, the link between parental substance misuse and aggression in children (Park and Schepp

2015), and how aggression is negatively associated with academic attainment (Risser 2013). Alternatively, another example is the increased risk for mental illness and substance use, and how that might influence educational outcomes. (Park and Schepp 2015). McLeod et al. (2012) found that behavioural problems and substance use have the most impact on academics when controlling for other factors such as social disadvantage; they conclude that disadvantage develops into distress (McLeod et al. 2012).

2.3.1.11 Protective factors and a rejection of determinism

While considerable research shows poorer outcomes, it also evidences the positive impact of a trustable or stable adult. Werner and Johnson (2004) found that a family member who was unaffected by substances provided vital support to children, and siblings enabled children to become competent and confident people (Werner and Johnson 2004; Hall 2008; Park and Schepp 2015; Velleman and Templeton 2016). Building on this, it is also unwarranted to vilify parents who use substances. A considerable amount of UK policy focuses on protecting children and identifying parents as inadequate and removing children if necessary (Rhodes et al. 2010). While this is important, the harm related to removing children is ignored, and the impact of family-level interventions to reduce drug use is almost not explored (Rhodes et al. 2010). Rhodes et al. (2010) build on damage limitation to illustrate how drug-using parents attempt to shield their children from harm. Their findings show that parents use drugs away from children, carried out vigorous cleaning, and ensured that children had visible necessities, such as food and school uniform. Therefore, it is important not to pathologise families, or view parental substance use in a deterministic sense, but to develop research which can aid the support of parents who are experiencing illness and strain.

2.3.2 The role of peers

Throughout an individual's life course, the relevance of interpersonal relationships changes. As the child becomes more autonomous and independent, their peer's behaviours and values begin to impact them, and the parent-child relationship begins to change. Arnett (2014) describes that this period is often associated with a desire to be part of a cohesive peer group and responsiveness to opinions of peers is key. Often, peers are those who tend to have similar characteristics (Hallinan 1983). Whilst this may be positive in settings where academic achievement is high, for low-achieving students this may reinforce behaviours which contribute to low achievement, e.g. disruption in the classroom (Dishion et al. 1996; Liem and Martin 2011). Likewise, Garcia-Reid et al. (2005) found that peer support exerts an individual influence on school engagement; it was half the impact of teacher support, but a better predictor compared to parent support. Furthermore, peers have each shown to be a protective factor against externalising problems in family conflict situations (van der Zwaluw et al. 2008).

2.4 The role of the school and the teacher-student relationship

The school as a system can influence outcomes, alongside the teacher-pupil relationship. Research often discusses the importance of school connectedness, and the need for individuals to have feelings of belonging (Baumeister and Leary 1995). Deci and Ryan (2000) developed Self Determination Theory to wellbeing and argue that a sense of relatedness amongst individuals is required for positive outcomes. Niehaus et al. (2012) found that school connectedness was associated with positive academic achievement, with teacher support being particularly important. Likewise, Moore et al. (2018) found that positive relationships with teachers were associated with subjective wellbeing, and lower risk of substance use; this research highlights the importance of teacher relationships in circumstances where family support is lower. Similarly, Strøm et al. (2013) found that teacher support had a positive impact on adolescent academic performance. However, Niehaus et al. (2012) note that peer relationships become increasingly important towards academic success over adolescence, and this may contend with the adult-child relationship. Although, Garcia-Reid et al. (2005) found that teacher-support was a better predictor of school engagement compared to parent support and peer support.

As in Garcia-Reid et al. (2005), the school is often viewed as a potential mechanism for aiding the effects of inequality, e.g. for depressive symptoms (Goodman et al. 2003; Nielsen et al. 2015). For children of substance uses, some school-level interventions have been effective. Smith (1993) found that increasing teacher support, classroom organisation, school counselling and creation of routine are some examples of effective school-level interventions. There is a constant debate on whether schools should be hosts in which to eradicate inequality, and whether it is useful. Research is limited in how schools can aid children whose parents use substances, nevertheless the school exerts a considerable influence on children's educational outcomes and broader wellbeing which could have protective aspects for wellbeing.

2.5 Socioeconomic status and educational outcomes

Socioeconomic conditions are arguably the most extensive environmental and cultural predictor of educational outcomes, particularly attainment, alongside other wellbeing outcomes such as mental health (Reiss 2013). Despite how it is defined, whether it is income, parental education, neighbourhood deprivation, percentage of those entitled to free school meals, the evidence shows a strong relationship; specifically that children with a lower socioeconomic status are less likely to attain the expected education attainment (Broer et al. 2019). A systematic review by Nieuwenhuis and Hooimeijer (2016) found that all four measures of neighbourhood deprivation influenced educational outcomes; however, demographic and parenting variables were also important. Also, Polderman et al. (2010) conducted a systematic review and found that socioeconomic status was one of the largest indicators of attention problems, strongly connected to academic problems. Furthermore, Sirin (2005) conducted a systematic review of the relationship and found the mean correlation to be moderate (0.30), which was very similar to a comparable review conducted by White (1982) who also found a moderate correlation. It is not entirely clear how socioeconomic status operates, but there are several theories which apply to various socioecological levels, including environmental, school, and family.

Neighbourhood deprivation relates to material deprivation and social deprivation. At the neighbourhood level, this can be measured by an array of factors, but some include the percentage of households with no car, or over crowdedness (Stafford et al. 2003). Social deprivation draws on social cohesion and social capital of a neighbourhood (Stafford et al. 2003). Primarily developed by Bourdieu (1985), social capital is heavily related to resources available via social networks, this may be via access to information, or financial resources (Stafford et al. 2003), for instance having a neighbour that is a lawyer would prove helpful when needing advice. Social cohesion is based on quality interactions, trust and norms (Stafford et al. 2003). Barnes et al. (2006) found that neighbourhood deprivation that is social and economic was associated with school disorder and attainment.

At the school level, more deprived schools – which is usually measured by the percentage of pupils receiving free school meals (FSM) in the UK – on average have lower overall attainment. The Sutton Trust (2009) found that ‘highly able’ pupils at more deprived schools achieved two grade A and six grade B GCSE’s compared to ‘highly able’ (not defined) students at affluent schools who achieved seven A’s and one A*. Pupils receiving FSM generally achieve similarly across the deciles of school deprivation (The Sutton Trust 2009), suggesting socioeconomic inequality may be a stronger determinant than school aspects. Some theories suggest that more affluent schools have better-quality teaching or compromise of more academically able students, and thus a peer effect is prevalent; solutions include more resources and equal distribution of academically able students (The Sutton Trust 2009). Nevertheless, school deprivation seems to be a weaker socioeconomic predictor of achievement compared to family socioeconomic status, but perhaps more important than neighbourhood deprivation (Barnes et al. 2006). This is evidenced by deprived children attending more affluent schools but achieving similar outcomes academically (The Sutton Trust 2009), and on wellbeing more broadly (Moore and Littlecott 2015); suggesting that neighbourhood, school and family socioeconomic status all exert independent and combined influences.

The gradient observed could be due to that school outcomes are partial results of the practices that exist within the home. Grand theorists Bourdieu and Bernstein have posited that ‘cultural capital’ and language is transmitted across classes, having consequences for academic outcomes. Bernstein discusses how linguistics differ across the classes, specifically the middle-class and lower working-class (Bernstein 1960). As stated in Language and Social Class, “the typical, dominant speech mode of the middle-class… facilitates the verbal elaboration of subjective intent, sensitivity to the implications of separateness and difference, and points to the possibilities inherent in a complex conceptual hierarchy for the organization of experience” (Bernstein 1960, p.271). In reverse, the working classes may be less likely to use this language, using ‘descriptive’ rather than ‘abstract’ concepts. This writing developed into the understanding of ‘elaborated’ and ‘restricted’ code. While Bernstein does not argue that one is better, the difference is that restricted code is tacit, whereas elaborated code is thorough and explicit, meaning no shared experience or assumptions are needed (Bernstein 1971). This is important as the social and educational consequences of speech access include the educational system rewarding elaborated codes rather than restricted (Bernstein 1971; Bernstein 1975).

While, the school may provide an extension of access to elaborated codes, Bernstein argues that this transmission occurs through families, particularly as access to elaborated code via the school system is controlled by the class system (Bernstein 1971). In a similar vein, Bourdieu explains that individuals retain 'habitus', and families transmit 'cultural capital' to their children. This is well defined by Lee and Bowen (2006) who explain that:

> *Habitus can be thought of as a characteristic (or set of characteristics) pertaining to an individual. Although cultural capital is possessed by an individual or a family, it is more a function of the concordance of the educational aspects of the family's habitus with the values and practices of the educational system with which the family interacts.* (Lee and Bowen 2006, p.197)

Bourdieu explains that habitus is the strong sense of social and cultural messages, and field is a structural system of social relations (both micro and macro) (Grenfell and James 1998). These systems (or fields), then have social products such as thoughts and actions, and capital is the "the social products of a field or system of relations through which individuals carry out social intercourse" (Grenfell and James 1998, p.18). The capital is then the harmony between a system, such as a school and family practices, i.e., visiting a museum or reading classic texts. Therefore, the greater the cultural capital, the more advantage in life.

The inequality in cultural capital can be due to the inherited wealth and cultural distinctions from upbringing and family networks (Grenfell and James 1998). That is, middle-class families tend to transmit their values, actions and thoughts to their children, and these are in-line with the systems that favour these, whereas those with less capital, often working-class families, will face challenges to gain capital, and thus access to opportunities. Lee and Bowen (2006) apply Bourdieu's theory and found that that parental involvement at school and higher educational expectations were associated with school achievement, and this, in turn, was held by the dominant (affluent) groups.

Building on this, studies show that parenting styles, behaviours and goals are influenced by socioeconomic conditions (Shucksmith et al. 1995; Sylva et al. 2014; Mayo and Siraj 2015). Sylva et al. (2014) state that parents of higher socioeconomic status had greater aspirations for their children, which was associated with more ambitious career aspirations in their children. Also, they found that higher socioeconomic families provided more enrichment activities in the home during key stage three (age 13 or 14 years). Likewise, Kiernan and Mensah (2013) found that children in poverty have lower rates of positive parenting, and achieved less at school; however, in circumstances where positive parenting was present, the child did better at school, despite being in poverty. They conclude that interactive, engaged parenting is critical for the development of children whose mothers have less education. These findings corroborate that engaged parenting offers protection for more disadvantaged children (Gutman and Feinstein 2010). Furthermore, maternal education was highlighted as a significant moderator for the relationship between involved, engaged parenting and children's outcomes. Therefore, interactive parenting may have a protective role for children whose mothers have lower education (Gutman and Feinstein 2010).

This becomes increasingly complex when considering adversity. Not only is socioeconomic status correlated with parenting, but parental substance use also is. Whether this is due to material deprivation, strain, or intergenerational patterns, evidence suggests a strong link. For instance, adult drug users are more likely to live in large urban areas, defined as one million or more (Substance Abuse and Mental Health Services Administration and Office of Applied Studies, 2004). Disadvantaged urban areas often have neighbourhood risk factors (often referred to as concentrate effects) that increase the likelihood of illegal activity (Sampson, 1987). Moreover, criminal activities associated with drug use place the parent at risk for arrest and imprisonment. In comparison to alcohol-dependent patients, individuals who primarily abuse drugs other than alcohol have reduced functioning across a range of psychological and social aspects (Miller, 1993). Jacob and Windle (2000) note that children of alcoholics also had lower socioeconomic status and rates of employment.

This relates to the 'alcohol harm paradox' which has been a research focus for 40 years (Smith and Foster 2014). Research consistently shows that lower socioeconomic groups are more likely to endure alcohol related harms, including hospital admissions and deaths (Probst et al. 2020). Yet, there are instances where lower socioeconomic groups use alcohol in similar, or lower quantities. However, it has also emerged that lower socioeconomic groups may engage in episodic, or binge drinking which is related to alcohol harms (Jefferis et al. 2007). Moreover, Jefferis et al. (2007) found that patterns of alcohol use were more pronounced when participants were in their 20s, compared to their 30s, and this trajectory was more prominent for women. However, there is disagreement that the paradox is entirely explained by average consumption or drinking patterns (e.g. episodic drinking) (Boyd et al. 2021).

A systematic review by Boyd et al. (2021) found that research considered an array of 'causal mechanisms' in which to understand the paradox. A number of papers focused on individual theories such as how alcohol is used as a coping strategy, or how those in lower socioeconomic positions may abstain from alcohol due to previous health conditions, or the biological effects of social inequality which leads to higher mortality in primates. Numerous studies also discussed behaviours, with a particular focus on heavy, episodic drinking, and a clustering of health behaviours. Most studies found that episodic drinking and unhealthy behaviours contributed to the paradox, but studies were inconsistent in the extent these behaviours fully explained the paradox. A small number of studies focused on neighbourhood poverty, and found those in more deprived areas reported greater negative alcohol consequences. Other studies found that early disadvantage, or disadvantage during adulthood, or prenatal factors contributed to alcohol disorder risk. Research which discussed macro-level explanations often did not test theories empirically, but there was a small amount of evidence that suggested economic stressors were associated with mortality in lower socioeconomic groups, and how these groups often have more hazardous working conditions. Boyd et al. (2021) suggest that further research on the impact social support or access to healthcare is required, as much of the literature currently focuses on individual risk behaviours, which do not fully explain the relationship observed.

2.6 The culture of substance use in the UK

Encapsulated in all of this are the cultural norms of substance use in the UK. Without over-simplifying, anthropologists saw the use of alcohol to a state of drunkenness as "a socially appropriate, culturally comprehensible event that was not necessarily pathological" (Hunt and Barker 2001). This was criticised by Room et al. (1984). He argued that anthropologists had liberal understandings of alcohol, he named these *wet generations*. It was argued that these notions ignored the biological and social implications, e.g. alcohol use as deviant behaviour (Room et al. 1984). These ideas developed into *regions*. Areas, where drinking was frequent and reasonably heavy, were conceptualised as wet, and dry regions consisted of very heavy, infrequent alcohol use, linked to violence and social disruption (Room 2010). However, it is now thought that wet and dry distinctions have blurred (Room 2010).

These regions have further developed more widely in terms of nutrition, expectations, cultural positions, social control of drinking, and the management of substance use treatment (Room and Mäkelä 2000). Recent research by Holmes et al. (2016) used latent class analysis and found eight typologies of drinking cultures such as drinking at home with family, drinking alone, drinking with friends, with food and others. They found the greatest likelihood of high-risk drinking was found in 'mixed location heavy drinking,' i.e., nights out, and using alcohol before entering bars or clubs (known as pre-drinking). This analysis has advanced how we understand drinking cultures in the UK and the types of use which is more dangerous to health. However, more work is needed, which explores the use of illicit substances, which is growing (Sañudo et al. 2015; Melendez-Torres et al. 2018; Karlsson et al. 2019), along with the use of substances by parents (Lowthian et al. 2020), and the context of parental substance use, such as use from stress vs. socialisation.

2.7 Summary of the socioecological model and theoretical arguments posed

Bronfenbrenner (1979, p.3) summarises the overarching argument of this chapter well: "A child's ability to learn to read in the primary grades may depend no less on how he [or she] is taught than on the existence and nature of ties between the school and the home". Through this chapter, protective and risk factors for children's educational outcomes, specifically attainment, have been summarised; these are listed in Table 2. Notably, parenting behaviours, values and goals are essential for academic outcomes which are somewhat dependent on the parenting style; authoritative was the preferred style. Parental involvement, support, interaction, interest, and monitoring was explicitly associated with educational outcomes, specifically attainment, alongside familial relationships, and routine. It was identified that these processes can be altered by parental substance use, with the parenting styles, behaviours, goals, and values adopted in these families being less positive for educational outcomes. Hence, this research will focus on the pathways from parental substance use to educational outcomes via parenting and the family environment.

However, given that layers in the socio-ecological framework are mutually influential there will be consideration for other influences. Socioeconomic conditions are heavily researched to influence educational outcomes, with more affluent children attaining the expected level. Through both school-level and family-level deprivation, children in lower socioeconomic conditions may have less access to educational resources, enrichment activities and language styles which are valued by the education system. Moreover, socioeconomic status also can increase the risk of maladaptive parenting, and other adverse childhood experiences. Hence, this research will explore the parenting and family environment pathways within the relationship of parental substance use and child educational outcomes across different socioeconomic contexts. While other factors also influence educational outcomes, such as peer or teacher-relationships, they will not be the focus of the research given a wealth of research specifies that familial and socioeconomic conditions are paramount for educational outcomes, and there is a need to further understand this area. However, individual factors, such as gender, ethnicity, will be further explored in this research given the strong evidence to include them.

As a result, this thesis explores whether parenting and the family environment are mediators and potential mechanisms in the relationship between parental substance use and children's educational outcomes. Focusing on educational attainment will provide useful, given that is a key measure of social class, which is related to numerous health and diseases, and the persistence of health inequalities (Marmot 2005; Cohen and Syme 2013). The theoretical arguments presented for each socioecological level are shown in Table 2, and Figure 2 shows hypothesised pathways discussed, adapted from Scott-Jones (1995).

	Protective mechanisms	Mechanisms of risk
Individual	• Female (intersectional with class and ethnicity) • Ethnicity or cultural practices (intersectional with gender and class) • Genetics • High academic self-concept • High self-esteem	• Male (intersectional with class and ethnicity) • Ethnicity or cultural practices (intersectional with gender and class) • Genetics • Low academic self-concept • Low self-esteem • Disabilities (depending on type)
Family	• Secure attachment • Positive behaviour modelling • Authoritative parenting style (within cultural contexts) • High parental involvement and engagement – e.g. supervision, communication, reading, drawing • Clear academic goals for the child • Valuing of educational attainment • Secure parent-child relationship • Good parental physical health and mental health • Positive family communication and relationships • Positive childhood experiences	• Insecure attachment • Negative behaviour modelling • Authoritarian, permissive, or neglectful parenting style (within cultural contexts) • Low parental involvement or engagement • None or low academic goals for the child • Low valuing of educational attainment • Insecure/no parent-child relationship • Parental physical illness or mental illness • Family conflict (e.g. inter-parental conflict) • Adverse childhood experiences
Peers	• Peers who value educational attainment • Peers who are academically able • Secure friendships	• Peers who do not value educational attainment • Peers who have low attainment
School factors	• School connectedness • Teacher support • Pupil involvement • Teacher-pupil relationship	• Low school connectedness • Low teacher support • Lack of pupil involvement (more a risk factor for low socioeconomic status schools)

	• High teacher-pupil ratio	• Poor teacher-pupil relationships • Low teacher-pupil ratio
Socioeconomic status	• Affluent neighbourhood • Positive social setting • High social cohesion • School-level affluence, including more resources, high teaching quality, and access to academically able peers • Family affluence including access to material needs, use of elaborated language, cultural capital and higher socioeconomic status behaviours	• Neighbourhood deprivation • Social deprivation • Low social cohesion • School-level deprivation, including less resources, low teaching quality, and low access to academically able peers • Family deprivation including material deprivation, language barriers, cultural capital, and behaviours
Cultural	• Alcohol use awareness • Low use of alcohol in social settings • Regions based on low alcohol use	• Drinking regions based on episodic alcohol use • Mixed location heavy drinking as in Holmes et al. (2016) • Criminal activity related to illicit drug use • Low social awareness of alcohol use in pregnancy

Table 2: Protective and risk mechanisms associated with educational outcomes across each socio-ecological level

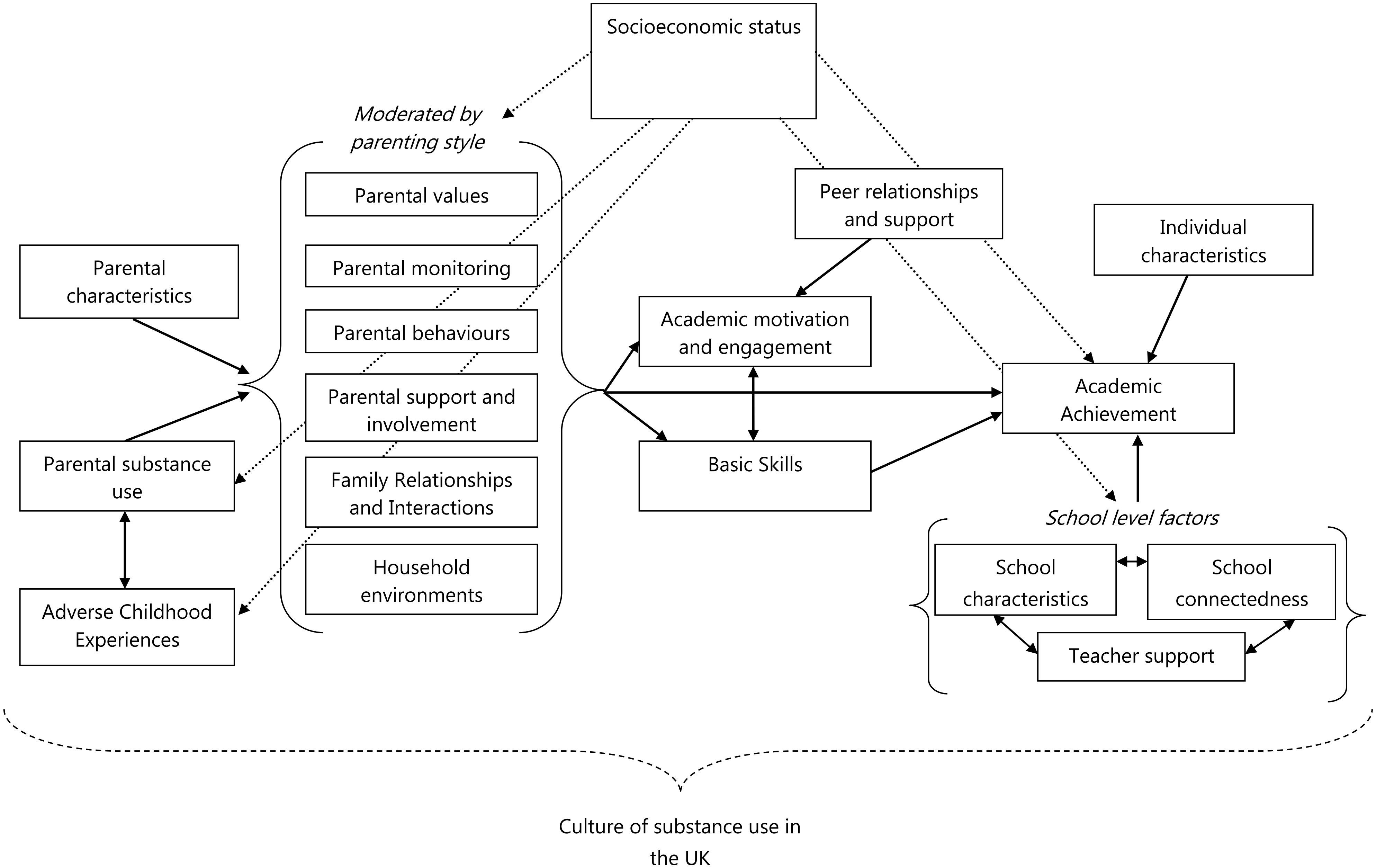

Figure 2: Diagram of the pathways to academic achievement - adapted from Scott-Jones (1995)

2.8 Research questions

The scoping review (Chapter 1) identified the research findings and gaps, and this Chapter has synthesised bodies of literature in a socio-ecological framework to propose a theory. Together they have informed the following questions:

Research question one

What is the relationship between parental substance use and children's educational attainment?

Research question two

What is the relationship between parental substance use and children's educational attainment once adjusted for environmental and demographic factors?

Research question three

Do parenting and the family environment mediate the relationship of parental substance use to children's educational attainment?

Research question four

Does the relationship between parental substance use and children's educational attainment differ across socioeconomic contexts?

Research question five

How do the findings compare across cohort studies in terms of replicability?

The next chapter (Chapter 3) will describe how the research questions presented are addressed.

Chapter 3 Methodological and Analytical Approach

This chapter uses the knowledge generated in Chapter 1 and Chapter 2 to develop a methodological and analytical approach. This includes a discussion of the quantitative research design aspects, including the use of longitudinal data, secondary analysis, and ethical implications. Following this, the ontological and epistemological foundations of this research are discussed. The chapter then follows with information on the Avon Longitudinal Study of Parents and Children (ALSPAC) and the Millennium Cohort Study (MCS) and finalises with the analytical approach.

3.1 Considerations of conducting quantitative research

This section will consider longitudinal research design, secondary analysis, and the ethical implications of quantitative research. General discussions are provided in this section, with a detailed discussion of the datasets used in later sections.

3.2 Longitudinal research design

Both datasets in this thesis are longitudinal, defined as "multiple snapshots of the same units of observation… [this] may be individuals, households, firms, schools, countries, and so on" (Nandi and Longhi 2015, p.3). Both datasets are of a cohort design "wherein some or all individuals in a defined population with similar exposures or outcomes are considered overtime" (Caruana et al. 2015, p.537). These studies offer the ability to model change over time, reducing recall bias (Caruana et al. 2015), and the problem of reverse causality (Nandi and Longhi 2015). For these reasons, longitudinal data "has been encouraged among family scholars as a way to better understand family process and to measure changes in family structure and relationships over time" (Miller and Wright 1995, p.921).

However, incomplete data poses challenges in longitudinal research. A key issue with longitudinal research is attrition, where the "units of observation drop out of the study permanently" (Nandi and Longhi 2015, p.6). This initially has obvious problems in terms of sample size. However, this becomes a more pertinent problem "if those who drop out have unique characteristics such that the remaining sample ceases to be representative of the original sample" (Miller and Wright 1995, p.921). If the participants are not missing at random (MNAR), extra consideration needs to be given in regards to data management and analysis to avoid bias and erroneous results (Liu 2015). The attrition of both ALSPAC and MCS are considered in this research.

3.3 Secondary data analysis

The analysis of datasets created for other purposes by other organisations has become increasingly popular (Kiecolt and Nathan 1985). This avoids issues of over-funding and wasting participant time (Kiecolt and Nathan 1985). As a result, the researcher has access to high-quality data, which is often cleaned and validated by a workforce (Kiecolt and Nathan 1985). Also, the data often consists of information on a wide range of topics, in some cases at no cost. This enables the researcher to "bring a fresh perspective to the strengths and limitations of any dataset, and be more innovative in his/her exploitation of [or use] of it" (Hakim 1992, p.24). The use of secondary data is invaluable given primary data collection of the cohorts used in this study would take at least 16 years; a timeframe not achievable in most research.

However, secondary datasets do have some disadvantages. Arguably the most pertinent is the restriction placed on the researcher when using a dataset created for other purposes. As explained by Hakim (1992, p. 24) "the scope and depth of the study will be constrained by the material available: particular aspects of a study may have to be dropped if unanticipated data limitations merge during the course of a project". For example, is the wording and framing of the survey items appropriate? Other drawbacks include bias in the data which can emerge from the fieldwork (Vartanian 2010) and problems in regards to the validity of the dataset, i.e. top coding or data-entry errors. Nevertheless, as researchers we often "trade control over the conditions and quality of the data collection for accessibility, convenience and reduced costs in time, money and inconvenience to participants" (Vartanian 2010, pp.16–17).

3.4 Ethical consideration in quantitative research

This thesis adhered to the following frameworks – School Research Ethics Committee (SREC) (School of Social Sciences, Cardiff University 2017), the Economic and Social Research Councils Framework for Research Ethics (ESRC) (ESRC framework for research ethics. 2015) and the Data Protection Act (1998) throughout the research. The ethical approval for these studies was sought from Cardiff University's School of Social Sciences separately due to the differences in access policies between the datasets. The subsequent discussion will focus on informed consent, harm and anonymity – the main considerations of the SREC's ethical guidance (School of Social Sciences, Cardiff University 2017).

First, informed consent must be given by the participants, meaning researchers must have provided sufficient information about the research and ensure that there is no explicit or implicit coercion so that participants can make an informed decision (ESRC framework for research ethics. 2015, p.29). Within this, researchers must ensure that this information is legible and sufficient time is given for participants to consider their participation (ESRC framework for research ethics. 2015). Also, the researcher should ensure that participants are competent and autonomous (O'Leary 2004) with greater consideration where research participants are vulnerable or marginalised (ESRC framework for research ethics. 2015). The research should also be conducted free from deception (ESRC framework for research ethics. 2015), and participants should be informed that they can discontinue at any point (O'Leary 2004).

Secondly, in terms of harm, the definition in social science generally refers to emotional or psychological harm (O'Leary 2004). The main considerations are any negative emotions, such as anxiety or fear, that arise from the research (O'Leary 2004). Although this is minimised in secondary analysis, the researcher must consider the issue of the disclosure of sensitive information; this is associated with the consideration of anonymity. Anonymity is the process of making information, data, and responses unidentifiable (O'Leary 2004). It is vital in secondary analysis research as it prevents harm via disclosure. Techniques have been employed to reduce the risk of the disclosure, but the "risk is never completely eliminated… [and] all research inherently carries some degree of risk" (O'rourke et al. 2006, p.64). This has led to discussions on whether the use of data is ethical (Brownell and Jutte 2013). However as strict policies and procedures exist, and providing they are adhered to, the risk of harm from this research is small.

To reduce the risk, data from ALSPAC was stored and accessed from the university drive only, and any analysis was conducted on the university server. The data from MCS was accessed via the UK Data Archive's Secure Lab; I attended a 'Safe Researcher' training course to access the data. All outputs were reviewed by the Secure Lab team for safety and data protection. Statistical Disclosure Control (SDC) policies are adhered to for both datasets to protect individuals, with cells <5 being masked for ALSPAC and <10 for MCS. Any unintentional breaches were communicated to data owners; ethical approval documents are in Appendix B.

3.5 Ontological and epistemological considerations

Following the design considerations, it is pertinent to consider how the findings from quantitative research are viewed both ontologically and epistemologically. Given the nature and design of quantitative research, it has traditionally been viewed ontologically as an objective, and deductive. It focuses on testing hypothesises to develop causal arguments and general laws about phenomena (Bergman 2008). Positivism and empiricism have been traditionally associated with quantitative research; however, this is now largely challenged. Pragmatism asserts that the research questions should be the impetus for choosing a research design, not a method or paradigm (Muncey 2009, p.13); this is viewed by some as a solution to the critiques of positivism (Morgan 2007). Pragmatists argue that "the connection between epistemological concerns about the nature of the knowledge that we produce and technical concerns about the methods that we use to generate that knowledge" (Morgan 2007, p.73) is how we should conduct research. Hence, the *metaphysical paradigm* and top-down privileging of ontological assumptions are rejected, and pragmatism deviates from an epistemological stance (Morgan 2007).

However, this separation has led to inconsistencies in how ontology and epistemology is considered in pragmatism. It is argued that epistemology is equal to the methods employed as we make "choices about what is important… [and] these choices inevitably involve aspects of our personal history, social background, and cultural assumptions" (Morgan 2007, p.69).

While some argue science can operate without developed philosophical understandings (Lipscomb 2008), this vagueness may leave the researcher questioning how findings are effectively validated (Modell 2009). This begs the question: what other ontological or epistemological arguments can support quantitative research?

3.5.1 Critical realism: ontology and epistemology

Critical Realism (CR) rejects the possibility of *naïve* realism (Modell 2009) and is identified as *post-positivist*, arguing that positivism commits the *epistemic fallacy* - misconstruing the ontological understanding of what exists and the epistemological understanding of how we know it (Cruickshank 2012). Bhaskar, an important contributor to the development of CR, explains that empirical observations are not direct observations of reality (Archer 1998) but rather, a stratified ontology which is divided into a tripartite system of the *Real*, the *Actual* and the *Empirical*.

The Empirical is the experienced (Collier 1994), although it is contingent on whether we know the Actual (Sayer 2000). This is because only a certain extent of what we know is observable, and there are aspects of social phenomena that we, as social scientists, do not capture. As a result, claims to knowledge relies mostly on observable events. The Actual is the multiplicity of mechanisms operating to bring about a series of events; they are real but unobserved (Collier 1994). Despite being unobserved, social science employs causal criteria for the Actual as we "would never get out of the Empirical if we did not" (Collier 1994, p.44).

Following this, the Real is what happens when the Actual is activated, which is explained by Sayer (2000) as: "[W]hatever exists, be it natural or social, regardless of whether it is an empirical object for us, and whether we happen to have an adequate understanding of its nature…. The real is the realm of objects, their structures, and powers… they have certain structures and causal powers… capacities to behave in particular ways" (p. 11). Sayer (2000) explains that the structures and powers are what we aim to identify in social science; realists seek to identify both the necessity and possibility – what things go together and what could happen. Therefore, phenomena in social science is understood via the use of the Empirical and the *actualising* of mechanisms in order to develop our understanding of the real; these enable our understanding of the *generative mechanisms* (Bhaskar 1979; Bhaskar 1989).

Uncovering the generative mechanisms is the essence of CR (DeForge and Shaw 2012). However, this is complex. Firstly because these mechanisms may not always be empirically observable – but their potentialities may still exist whether activated or not (Bhaskar 1998). Secondly, there are a multiplicity of mechanisms in an open system – they are part of *strata* (three domains), are layers of nature, and are ordered (Collier 1994). Thirdly, structures and mechanisms interact, so understanding phenomena becomes complicated with the same causal power producing different outcomes in different contexts (Sayer 2000). So, as realists, to deal with the problem of identifying causal responsibility in complex open systems we must ask questions around necessity, i.e. could object *A* exist without *B* (Sayer 2000). As a consequence, we are not interested in whether *A* causes *B*, but understanding and realising the process and conditions under which *A* causes *B* - if at all (Volkoff et al. 2007 and Sayer 1992 cited in Zachariadis et al. 2013).

3.5.2 Critical realism: a solution

CR values *demi-regularities* which are context-specific conditions (Lawson 1999) – "the actualities of demi-regularities emerge from the complex and imperfectly consistent constituents of the domain of the real" (DeForge and Shaw 2012, p.85); hence, CR is separated from the extremity of positivism as it acknowledges conditional space-time contexts. From this, quantitative research is of value in CR, as explained by Modell (2009), because it provides "surface depictions of the effects of causal powers in a particular social context. Statistical techniques may reveal co-variations between variables which are indicative of the tendencies resulting from the causal powers embedded in real mechanisms" (p.213). Hence, this thesis attempts to identify the potential *demi-regularities,* i.e., the direction of the effect, effect size, and any mediators, and potential mechanisms, in the relationship between parental substance use and children's educational outcomes, being attentive to the notion that *A* tends to do *X* in certain space-time contexts.

Following this, the next sections will discuss the methodological considerations of ALSPAC and MCS.

3.6 The Avon Longitudinal Study of Parents and Children (ALSPAC)

The study was originally a WHO Europe-wide initiative; this study aimed to investigate the gene-environment influences on child health and development (Golding et al. 2001). Funding for this study had originally come from WHO, the MRC, and various charities such as the Wellcome Trust, the British Heart Foundation, and the University of Bristol (Boyd et al. 2013). The study has followed pregnant mothers for almost 30 years and is still collecting data on mothers and children, alongside the children of the children who originally participated.

3.6.1 Sampling and recruitment

The initial sampling procedure recruited women as "no convenient sampling frame to support systematic invitation of all eligible individuals was available" (Boyd et al. 2013, p.113). Women were eligible for recruitment if they were resident in a defined geographical area in the South West of England who expected to give birth between 1 April 1991 and 31 December 1992 (Fraser et al. 2013); women who left shortly after enrolment were omitted from follow-up (Golding et al. 2001). Posters were displayed in chemists, libraries and GP rooms asking women to get in touch with the study. Women were also approached when they attended their routine ultrasound examination or midwifery appointments. ALSPAC also advertised via local and national media, and as a final attempt, staff approached mothers post-delivery (Boyd et al. 2013). The mother completed a form with some key information, e.g. date of birth and delivery (Golding et al. 2001), and received a brochure stating the choice to opt-out (Golding et al. 2001; Boyd et al. 2013).

Alongside the initial sample, there were further efforts to recruit the mothers who had not replied to any of the previous advertisement (Boyd et al. 2013). To find these mothers - maternity, birth, and child health records were evaluated retrospectively (Boyd et al. 2013). From this, ALSPAC found that the opportunistic nature led to the recruitment not being complete. Subsequently, attempts were made to recruit the remaining women and children when the children reached seven years of age (Focus@7). Following this, ALSPAC managed to enrol 75.8% of eligible pregnancies in total, and 71.8% of this was from the initial sample. The sampling procedure lends itself to issues around contacting more concealed populations, for example, marginalised groups. Nevertheless, the recruitment procedure is expected, considering that there was no effective sampling frame in that period (Boyd et al. 2013).

3.6.2 The ALSPAC participants

The ALSPAC cohort is complex, the initial sample (recruited in 1991-1992) managed to enrol 14,541 pregnancies (out of 20,248 eligible pregnancies) (Boyd et al. 2013). These pregnancies resulted in 14,062 live-born children, of which 13,988 were alive at one year old; however, Boyd et al. (2013) note that the miscarriage rates are likely to be under-represented. Re-recruitment phases managed to recruit an extra 456 children from 452 pregnancies at age 7, and 257 children from 254 pregnancies later. In total, there were 15,247 enrolled pregnancies by the time the children were 18 years old. Therefore, the enrolled sample consists of 14,775 live-born children from 15,247 pregnancies; ALSPAC has collected data on 14,009 children. The participants included the mothers, their partner's, children, and teachers; the involvement of the partner was at the discretion of the mother's consent, of which has limitations.

3.6.3 The data collection method

Data collection commenced as early in pregnancy as possible. Self-completed questionnaires were distributed to mothers and their partners (Golding et al. 2001). Administrative records were also linked to the data, e.g., medical records. Moreover, 'hands-on assessments' were conducted, but these were not used in this research; they included measures of the home, in-depth interviews, and biological samples. Only the self-reported questionnaires and linked educational data were used in this research.

The self-reported questionnaires were sent at the same time point for mothers and their partners, while child-based questionnaires were sent in-between these times, and teacher questionnaires were sent when the child was aged 7 to 8 years old, and 10 to 11 years old, respectively. The questionnaires were sent to homes and schools via post and were returned in the same way. This mode of data collection is common in social science due to its time and cost efficiency (Sim and Wright 2000). In some cases, postal questionnaires may well be quicker as a large population can be contacted both quickly and economically (Bowling 2014). Moreover, they may well be beneficial as sensitive questions can be answered privately, rather than having to disclose potentially socially undesirable behaviours to interviews, i.e. interparental conflict (Tourangeau and Yan 2007). Furthermore, postal questionnaires are convenient as respondents can complete them in their own time, and they allow time for participants to collect information that may not have access to during an interview (Sim and Wright 2000).

Although the presence of an interviewer can be problematic, the absence of one is not error-free. An interviewer is sometimes employed to provide motivation and encourage respondents to process the survey item, along with reducing task difficulty by offering support and additional explanations of what is needed (Hope et al. 2014, p.1). Hence, a consequence of the absent interviewer is poorer motivation, item nonresponse or incorrect responses, i.e. lack of clarity over what the question is asking (Bowling 2014). Incorrect responses include the issue of satisficing. Narayan and Krosnick (1996) explain that weak satisficing is when respondents take shortcuts such as selecting the first response option which constitutes a reasonable answer whereas strong satisficing is where respondents miss out whole components such as selecting 'don't know' for numerous questions (Hope et al. 2014).

Outside of item-related problems, postal questionnaires also pose other issues. For example, they tend to retain smaller response rates (Bowling 2014). Moreover, they assume that respondents are literate to the standard of the questions given and all speak a common language (Bowling 2014). However, ALSPAC provided a telephone number for participants to call if they have problems related to the study (Golding et al. 2001), this suggests that difficulties with the questionnaire could be rectified – providing respondents had the motivation, or access. Despite the potential for bias, postal questionnaires were suitable for the required data collection in terms of cost and geographic coverage.

Alongside the self-completed questionnaire, data was retrieved from administrative sources. Administrative sources are, as explained by Elias (2014):

[D]ata which derive from the operation of administrative systems, typically by public sector agencies. They cover activities such as health maintenance, tax and social security, housing, elderly care, vehicle and other licensing systems, educational progress, etc. While such data are not designed for research purposes they often have significant research value, especially when linked to other datasets or to user-generated surveys (Elias 2014, p.47)

ALSPAC link to routine health, administrative and environmental records (ALSPAC Access Policy. 2017). To do this, ALSPAC "enter into data usage agreements with the relevant data owners… [who] specify the conditions under which ALSPAC can share these data with third parties (e.g., researchers)" (ALSPAC Access Policy. 2017, p.7). The administrative data used in this thesis are the children's educational records from the National Pupil Database (NPD) or Local Authorities.

Administrative data is a valuable resource to address fundamental questions and contribute to the evidence base (Connelly et al. 2016). It often is collected from an entire population rather than a sample, so it can provide data on those who are hard to reach (Connelly et al. 2016). Moreover, it has cost-efficiency and participant time-saving capabilities (Connelly et al. 2016). However, there are legal and ethical issues (Connelly et al. 2016) as sometimes the participants have not provided consent for the use of their information, whether personal or not (Elias 2014). Moreover, data may suffer from internal inconsistencies (Elias 2014). Therefore, despite administrative data being a valuable data resource, the ethical, legal and limits of it must be carefully considered.

3.6.4 The ethical considerations of using ALSPAC

Ethical approval for using ALSPAC data was granted by the School of Social Sciences Research Ethics Committee of Cardiff University on the 18th April 2018 (see confirmation letter in Appendix B) and the ALSPAC team. This section considers the ethical implications of using ALSPAC in a secondary analysis in terms of consent, harm, and anonymity.

The consent process was in two stages. First, through recruiters (e.g. midwives) and second, through a brochure if the first recruitment was successful (Golding et al. 2001). The brochure emphasised the confidential nature of the information, and that there was no compulsion for her to take part, and the freedom to stop participating at any point (with contact details). The consent procedure has been seen to be opt-out as the ALSPAC team assumed that women would take part unless they were informed otherwise (Golding et al. 2001). As a result, the consent procedures appear valid, with deception and coercion being avoided. Potential harm in ALSPAC is limited due to the study being a postal questionnaire. However, the study has asked sensitive questions such as childhood sexual abuse, which may evoke unpleasant or distressing memories (Mumford 1999). To avoid harm, the ALSPAC team placed these questions in a separate section of the questionnaire, which warned participants that the subsequent questions could be sensitive and distressing (Mumford 1999).

In terms of anonymity, ALSPAC has devised an access policy document which must be signed by the user (see ALSPAC Access Policy. 2017). The user must sign the confidentiality form - agreeing not to identify participants, adhere to the data security guidance, and not share data with unauthorised researchers (or anyone else). Also, they must share any derived variables with ALSPAC, securely destroy the data after use, and be aware of the institution's security policy. After this was completed, the data file was transferred via an encrypted zip-file which was password protected. The data was then stored and accessed only on the university network. The access policy was adhered to throughout the research, and any issues were communicated promptly to the ALSPAC team.

3.6.5 Key methodological limitations with ALSPAC

This section discusses the attrition, retention, and representativeness of ALSPAC.

3.6.5.1 Attrition

ALSPAC have employed methods to avoid attrition. However, their current enrolled sample has several biases (Boyd et al. 2013; Fraser et al. 2013). The child response rate to clinical assessments and questionnaires has decreased over time, despite remaining somewhat constant through early childhood to late childhood. However, in late childhood, the response rate started to slowly decline with the slope becoming steeper once children entered adolescence; see Figure 3 (Boyd et al. 2013). Mothers responses about their children were greatest in infancy, but this has declined slowly over-time with adolescence showing a steeper decline (Boyd et al. 2013); see Figure 4. ALSPAC attribute this attrition to study fatigue and the increased length of the questionnaires due to increased collaborations (Fraser et al. 2013).

Alongside participation rates, Boyd et al. (2013) found that the enrolled sample and those who are still participating were systematically different from a national sample. They found that the children in the ALSPAC have higher educational attainment at age 16 years compared to the average in the NPD records. However, this difference is not as pronounced when the eligible sample are compared, however these are participants who do not consistently participate (Boyd et al. 2013) which suggests that the original enrolled sample was not systematically different. However, both the enrolled and participating children are more likely to be white and less likely to be eligible for FSM (Boyd et al. 2013); likewise, those lost to attrition are more likely to male and eligible for FSM. As a result, the current sample is likely to be biased towards white, more affluent groups.

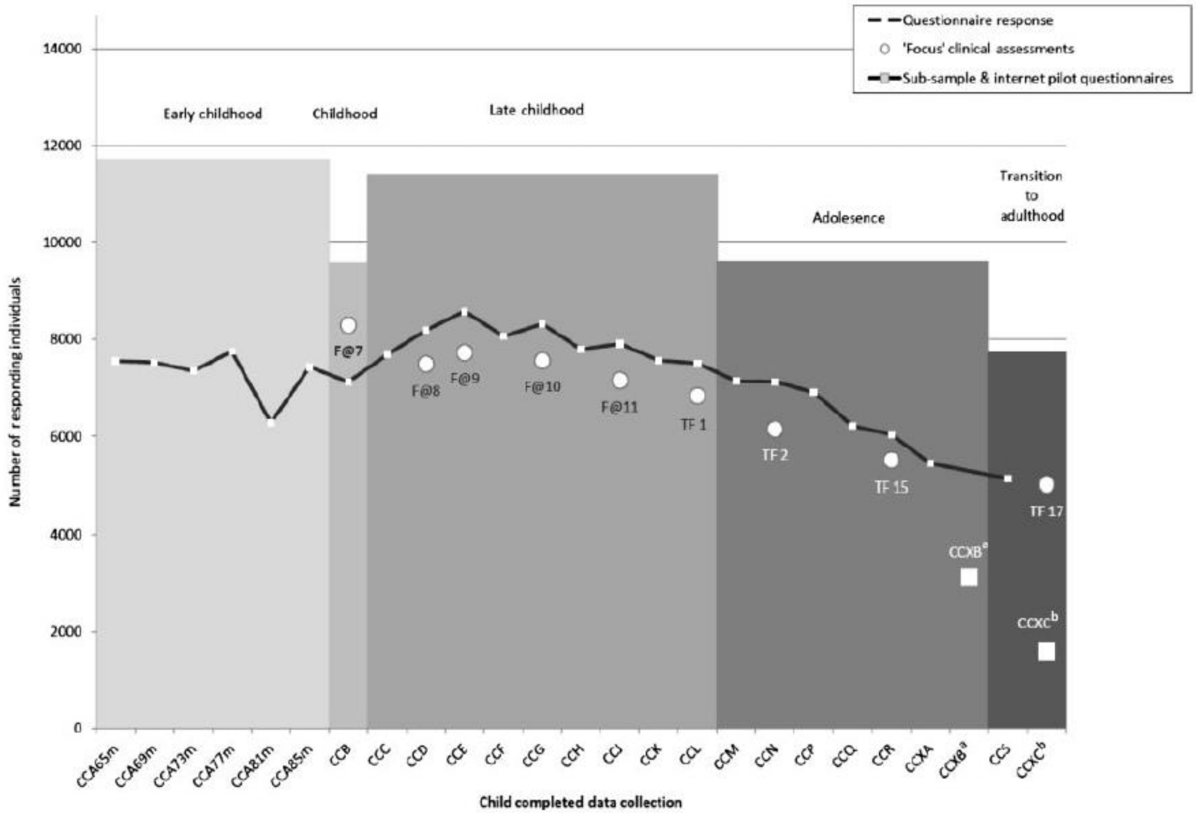

Figure 3: Child completed data collection rates from Boyd et al. (2013)

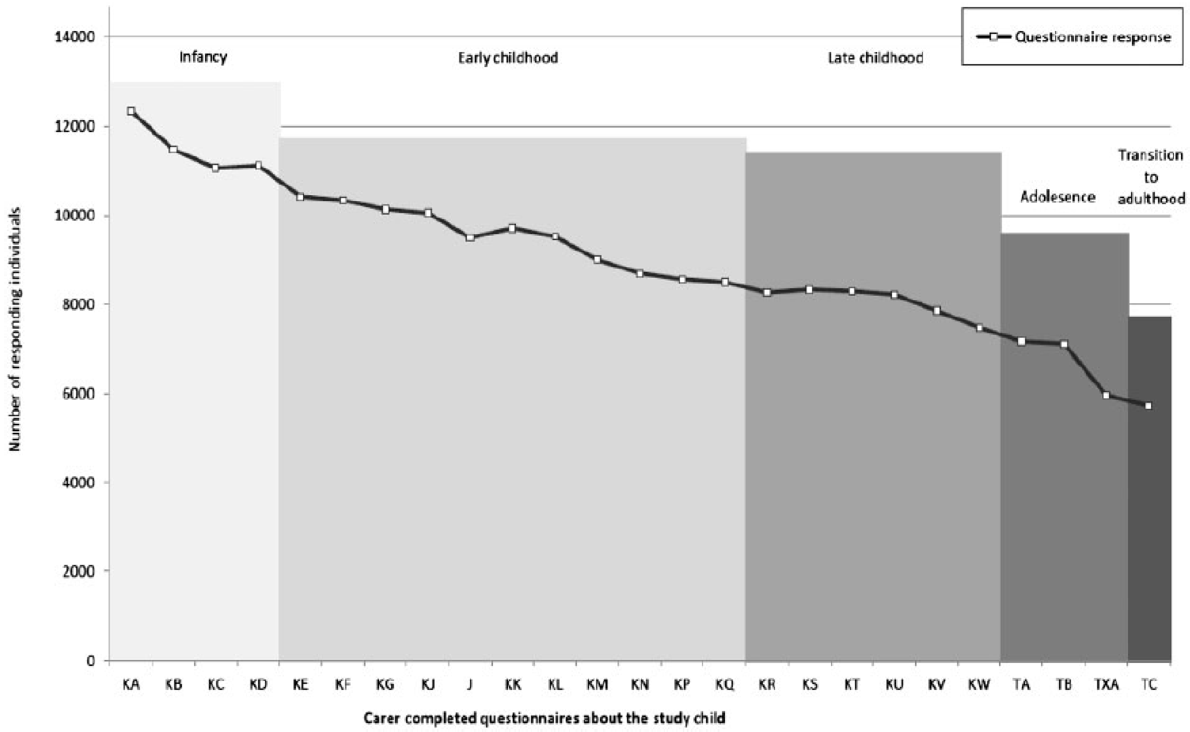

Figure 4: Mother completed data collection rates from Boyd et al. (2013)

3.6.5.2 Retention

The ALSPAC team attempted to reduce attrition or non-participation by using shorter or web-based questionnaires. Also, they used media coverage, newsletters, booklets and birthday cards to encourage participation (Golding et al. 2001). Alongside retention behaviours, ALSPAC argues that the attrition is somewhat exaggerated as 11,264 (82%) mothers are still engaged with the study; they explain participants often answer every other questionnaire or not complete one for several occasions and then respond (Fraser et al. 2013). They conclude that "we can often include a large proportion of participants in analyses using repeat (change) in questionnaires characteristics and can also combine data from questionnaires close together to increase numbers with a specific outcome" (Fraser et al. 2013, p.100).

3.6.5.3 Representation

While the area of Bristol shares some similarities with GB, the original sample was biased as a greater proportion were White and had more ownerships of cars and houses compared to the national population (Fraser et al. 2013). Boyd et al. (2013) explains that the participating sample is an over-representation of more affluent groups which may influence external validity of some study findings. Moreover, the data were collected in the 1990s, and society has changed considerably over the last 30 years. This includes greater health awareness, e.g., alcohol guidelines, and greater rights for vulnerable groups, e.g., Equality Act (2010). As a result, the biases limit the generalisability and reliability of the research. Nevertheless, its sample size, breadth, frequency of data collection, availability of repeat measures and commitment from the study families are still of value, particularly when methods for accounting for missing data can be employed (Boyd et al. 2013).

3.7 The Millennium Cohort Study

The study is conducted by the Centre for Longitudinal Studies and is funded by the ESRC. It was founded in 1999 as the British government wanted to mark the coming millennium with a new birth cohort study (Hansen 2012). It was developed as a way of capturing "large-scale information about the New Century's children, and the families who are bringing them up, for the four countries of the United Kingdom" (Hansen 2012, p.8). It aimed to chart the social, economic and health advantages and disadvantages facing new children in the new century (Hansen 2012). The sample includes babies that were born from September 2000 to September 2001, who are still followed to this date.

3.7.1 Sampling and recruitment

The sampling strategy was employed to collect data on marginalised populations. The sample is "clustered geographically and is disproportionately stratified to over-represent areas with high proportions of ethnic minorities in England, areas of child poverty and the three smaller countries of the UK" (Hansen 2012, p.10). The sampling frame used was the electoral wards, (e.g., there are 35 wards in Bristol). Child Benefit records provided by the Department of Social Security (now HM Revenue and Customs) were used to identify children (Hansen 2012).

The sample was clustered as fieldwork costs were restricted to £1.7m (Plewis 2007). The disadvantage with clustering is that "the estimates are less precise than those obtained from simple random samples of the same size… and this loss of precision increases as cluster sizes increase" (Plewis 2007, p.12). This is further increased by the use of larger wards combined with no ability to sub-sample by the Child Poverty Index (CPI) or ethnic minority status (Plewis

2007); however, large wards were avoided. These clusters were stratified by ethnic minority status, disadvantaged, or advantaged status. The ethnic minority stratum was children living in wards where at least 30% of their total population was 'Black' or 'Asian' (taken from the 1991 census) (Plewis 2007). The disadvantaged stratum were children living in the poorest 25% of the ward-based CPI for England and Wales (Plewis 2007); defined as households receiving either Income Support, Jobseekers Allowance, Family Credit and Disability Working Allowance. The advantaged stratum were those not in the top quartile of the CPI (Plewis 2007). Outside of England, only the disadvantaged and advantaged strata applied.

MCS aimed for a sample of 15,000 children (Plewis 2007), which avoided small samples in Wales, Scotland, and Northern Ireland; 1,500 was the target sample size for countries other than England. In England, half of the population were sampled from the advantaged strata, a quarter from the disadvantaged strata, and another quarter from the ethnic minority strata. In countries outside of England, populations were selected equally across advantaged and disadvantaged strata. The final target sample was 20,646 with 13,146 being in England, 3,000 in Wales, 2,500 in Scotland and 2,000 in Northern Ireland (Plewis 2007, p.13). The information on ward response is displayed in Figure 5, taken from Plewis (2007).

The sample was selected systematically within each stratum and country; the "sampling interval being determined by the ratio of the number of wards in the populations to the number of wards required in the samples" (Plewis 2007, p.15). This method of selection, when combined with the order, is more efficient than just sampling randomly as it produces gains in precision as well as controlling the sample size (Plewis 2007). Alongside the first sampling attempt, the survey attempted to "make contact with another 1,389 'New Families' in England who appeared to have been living in sample wards at the time of MCS1, but whose addresses reached DWP records too late to be included in the first survey" (Hansen 2012, p.13). Of the 1,389 New Families, 692 families were productive in the second sweep of the study (MCS2); others were ineligible, or refused the survey, or were unproductive (Hansen 2012).

	Number of sample wards	Expected births per ward (SD)	Expected response rate (%)	Expected sample size before ward selection
ENGLAND: Advantaged	110	68 (43)	75	5610
ENGLAND: Disadvantaged	71	108 (63)	70	5368
ENGLAND: Ethnic	19	197 (117)	65	2433
WALES: Advantaged	23	48 (27)	75	828
WALES: Disadvantaged	50	62 (40)	70	2170
SCOTLAND: Advantaged	32	52 (18)	75	1248
SCOTLAND: Disadvantaged	30	61 (22)	70	1281
N.IRELAND: Advantaged	23	46 (20)	75	794
N.IRELAND: Disadvantaged	40	48 (27)	70	1344

Figure 5: Required number of sample wards by stratum and country by Plewis (2007)

In terms of eligibility, all children born between the 1st of September 2000 and 31 August 2001 for England and Wales, and between the 24th November 2000 and 11th January 2002 for Scotland and Northern Ireland, who were alive in the UK at nine months old and eligible to receive Child Benefit were included (Plewis 2007). This means that the sample includes children living in non-household situations, i.e. hostels, prisons, women's refuges at age nine months and children who were not born in the UK but established residency in the UK at age nine months (Plewis 2007). The decision to collect information from children later in the year in Scotland and Northern Ireland was to avoid an overlap with an infant feeding survey being conducted in September and October (Hansen 2012, p.10). In addition, some families would become eligible for the study, so health visitors were contacted to find out if "families moving into survey wards were willing to be recruited" (Hansen 2012, p.11).

However, as child benefit is only available to families whose residency is not temporary members of foreign armed forces, or asylum seekers are ineligible (Plewis 2007). In addition, some families were ineligible if they did not claim for Child Benefit, or if their address could not be matched to a ward via a postcode (Plewis 2007). Outside of ineligibility, some families opted-out of the study or refused to participate. Furthermore, some cases were classified as sensitive and subsequently excluded, for instance, homes where a child had died in the last five years, or homes where the child was taken into care (Plewis 2007; Hansen 2012).

3.7.2 Participants

In total, 24,180 families were issued to the field, as some families were excluded, or opted out or moved-out from the original field of 27,201 (Plewis 2007). Of those issued, 1.7% were ineligible, 6.3% had uncertain eligibility, 15.2% were unproductive. This resulted in 18,552 families in total, and 1,938 of these were partial households, where only some questionnaires were filled in (Plewis 2007). The advantaged strata had higher inclusion rates than expected; Wales' advantaged strata are particularly over-represented (113%). The disadvantaged strata had lower inclusion, as around 87% - 98% of the original target size was recruited. The ethnic minority strata had around 92% inclusion of the original target size, which was considered as a significant gain. The 18,552 families resulted in 18,818 children, with 62% in England, 15% in Wales, 13% in Scotland and 10% in Northern Ireland (Hansen 2012). The majority of these children were nine months at the time of interview (Plewis 2007); however, a small percentage were slightly older than this, but not older than 12 months. The final sample size was very close to the original target size (n=20,646), and decreasing fertility is used as an explanation (Plewis 2007).

The participants are the children, their household members, teachers, and siblings. In the first sweep of sampling, the natural mothers of the children were the most likely to participate in the main household interview, and the fathers or partners were more likely to answer the partner interview (Centre for Longitudinal Studies 2004). However, the study did capture less nuclear settings, e.g. single-parents of both genders, foster parents, adoptive parents (Centre for Longitudinal Studies 2004). However, nuclear settings were common as 84.3% of MCS families had two resident parents in the first sweep, like ALSPAC, and most households with no partner were single-parent households. In later sweeps, the siblings and teachers of the children were interviewed; older siblings were interviewed in sweeps two and three (age 3 and 5 years of the cohort child respectively), and teachers filled out a questionnaire at sweep 3 and 4 (when the cohort child was aged 5 and 11 years).

3.7.3 Data collection method

Data collection was scheduled for when the babies were nine months and 15 days of age; the window was up to 11 months of the baby's age, and up to 12 months for the partner interview (Hansen 2012); 75% of the sample met this. When this time arrived, a fieldworker would interview the main household respondent, which was assisted by computer software – termed as Computer-Assisted Personal Interviews (CAPI). The topics would include aspects such as household composition, information on family and relatives, pregnancy, childcare, and parental health (Hansen 2012). A self-completed questionnaire followed the interview, which featured questions on more sensitive topics such as their relationship, or mental health (Hansen 2012). Alongside the main household response, MCS asked the partner to complete an interview and questionnaire; it was answered using the same method (Hansen 2012).

In the first sweep, only data from the main respondent and their partner was collected; this was collected at every sweep. In the second sweep, older siblings completed a self-completion questionnaire, and the cohort child underwent various assessments, such as measurements of height and weight. Sweep three was similar, but teachers in Wales, Scotland and Northern Ireland completed a self-completion questionnaire about the cohort children. At sweep four, the cohort child filled out a questionnaire on hobbies, friends and family, feelings, school, and the teachers in England completed a self-completion questionnaire on the cohort child.

The method of face-to-face interviewing, along with the computer-assisted questionnaire has some advantages. Employing an interviewer allows for the early identification of problems in the data collection process. For instance, where the respondent is illiterate, or when their first language is not English. Interviewers can not only provide supportive aids, but encourage respondents to process the survey items whilst reducing task difficulty by offering further explanations of what the question is asking (Hope et al. 2014). Hence, the use of an interviewer may reduce nonresponse, response bias, and boredom (Streiner et al. 2015).

However, interviewers are expensive and pose certain biases. The employment, training, and briefing of interviewers is expensive, along with accommodating for their travel and subsidy expenses. Also, interviewers often work around the respondent's availability which can vary and is often not cost-efficient. Alongside this, the presence of an interviewer can cause respondents to consider the social norms around the topic being asked (Lavrakas 2008). Moreover, the characteristics of the interviewer can influence responses such as age, gender, or ethnicity (Lavrakas 2008); for instance, People of Colour may be less likely to disclose an incident of racism to White people. Furthermore, the interviewer may also record the information from the respondent incorrectly; these problems are exacerbated if they are systematic.

Due to interviewer bias, MCS has attempted to use computer-assisted self-completion questionnaires (CASI) to reduce the interviewer effects. For instance, asking sensitive questions on the self-competition questionnaire was hoped to reduce social desirability bias; however, self-completed questionnaires pose problems, e.g. nonresponse and item-response (Bowling 2005). However, these self-reported questionnaires do not have the same problems as postal or internet-link questionnaires in terms of coverage and response rate (Bowling 2005) as the interviewer conducts a face-to-face interview first. Alongside primary methods of data collection, this study also links to data from other resources. The linked dataset that will be accessed in conjunction with MCS is the National Pupil Database (NPD); this is the same as ALSPAC, where the disadvantages and advantages have already been discussed.

3.7.4 Ethical considerations of MCS

Ethical approval of this research was approved by the School of Social Sciences Research Ethics Committee of Cardiff University on the 21st December 2018 (see confirmation letter in Appendix B). This section will consider the ethical implications of using MCS data in terms of consent, anonymity, and harm.

MCS have explicitly outlined their consent procedures for the survey and data linkage in their technical report (Shaw and Calderwood 2004). Before a fieldworker arrived at the household, participants received a letter about the study, and then were sent an information leaflet – this was the first chance that parents had to opt-out of the study via writing or telephone (Shaw and Calderwood 2004). The leaflet included information about the study, how the research could be used, confidentiality and funding. If the household did not opt-out, the fieldworkers would prepare a visit. When fieldworkers were in an area, they had to declare their presence and activity to the local police (Shaw and Calderwood 2004). Once interviewers arrived at the household "all potential respondents were properly informed about this study before they agreed to take part" (Shaw and Calderwood 2004, p.27). If the interview was completed, participants were asked for their consent for data linkage; sweep one asked about health data and sweep three asked for educational data. These forms were translated into many different languages, and provisions were made for people who had impairments.

Harm is more likely to occur in the primary data collection phase, as interviewers may ask questions which may make participants uncomfortable. For instance, the interview discusses the relationship with the partner, which may have been distressing for the mother. However, more sensitive questions have been put in a self-completed questionnaire to allow for privacy. Nevertheless, due to this being a secondary analysis, the implications of these questions cannot be addressed here, they are rather acknowledged.

The largest risk of harm is from data not being anonymised. The data is available from the UK Data Archive (UKDA) on an end-user license; however, as this research uses linked educational data, access to the UKDA's Secure Lab was required. This is a highly secure method of accessing the data, as it is remote workstation access using a server. To access this, the Secure Access User Agreement was completed, and attendance of the course 'Safe User of Research data and Environments' was completed in London on the 20th March 2019; an examination was passed by Graham Moore, Simon Moore and I. Access to data via the Secure Lab could only occur via the computer in the office; although, this changed due to COVID-19, where remote access was permitted. Statistical disclosure control standards were applied with this dataset and all outputs were checked by the Secure Lab team.

3.7.5 *Key methodological limitations with MCS*

This section will discuss the attrition, retention, and representativeness of MCS.

3.7.5.1 *Attrition*

Only sweeps one, two, three, and four are discussed as those were used in the analysis. At sweep one, before the New Families had been accounted for, the study managed to achieve 18,553 productive families (91%). After the new families, the MCS had a response rate of 78% at sweep two (Plewis 2007, p.9). The refusal rates were lower outside of England and were concentrated among the New Families. The refusal rates were, however, higher for the disadvantaged groups (10%) and ethnic minority groups (13%) in comparison to the advantaged groups (8%) in England; Wales and Scotland were equal, and Northern Ireland less so (Plewis 2007, p.10). At sweep three, the response rate was 79.2% (Hansen 2012), with similar patterning in advantaged, disadvantaged and ethnic minority productivity (Ketende 2010). Finally, the fourth sweep had a response rate of 72% (of the total cohort sample); no discussion was made in terms of strata responses. This sweep features linkage to the National Pupil Database, whereby 88.5% (n=7,476) consented to their children's data being linked (University College London 2019). Therefore, although MCS has experienced greater nonresponse in the disadvantaged and ethnic minority strata, the over-sampling of these area's is likely to counter the small differences in these sweeps (Connelly and Platt 2014).

3.7.5.2 *Retention*

Like ALSPAC, MCS make continual efforts to publicise the findings of research that has used the data. As MCS use interviewers to collect data, they have retained participants by tracking them if they move house, providing this move is communicated to Department of Work and Pensions (Hansen 2014). If it was not, participants were traced by fieldworkers, until this had been exhausted. However, MCS is unlike ALSPAC who had methods for retention, MCS do not mention any methods; this may be due do that 72% of the initial sample was still participating at sweep four.

3.7.5.3 Representation

Representation of the UK population has been the target of this cohort. However, the sampling frame may have had problems. Plewis (2007) explains that the child benefit records are not always up to date for various reasons; Hansen (2012) also discusses the problems with this. While this has problems, the cohort capitalises on some of the most robust methods of collecting data within its confines, and despite attrition it continues to remain nationally representative (Connelly and Platt 2014). The next sections will consider analytical approaches to the datasets discussed in terms of weighting, comparing cohorts, and analytical considerations.

3.8 Weighting

No weighting is available that can adjust for temporal analysis, i.e., exposure at time one, a mediator at time two and outcome at time three. As a result, it would be a choice of which weighting creates the least amount of bias, which remains unclear. Moreover, Solon et al. (2015) explain that weighting can cause further problems as they should only be applied for a particular reason, i.e. correcting for heteroskedasticity. Furthermore, as the results from ALSPAC do not have weights available for temporal exposure, it would be erroneous to compare results from weighted data to unweighted data. Therefore, as the dataset is still considered robust in terms of systematic attrition, and population estimates are not the target of this research, weights were not applied. The next section considers both ALPSAC and MCS and their similarities and differences for a cross-cohort approach.

3.9 Cross-cohort analysis approach

Cross-cohort approaches are the comparison of results across two, or more, cohort studies. They allow researchers to understand the external validity and generalisability of their findings. Some researchers believe them to improve causal inference through the comparison of associations across populations with different confounding structures (Gage et al. 2016; Sellers et al. 2020). However, as the data used in this research is unable to make causal statements, this assumption is problematic. Moreover, as the studies used in this research are more similar than not, the evidence is weaker compared to studies that have used cross-cultural data (Gage et al. 2016). The methodological similarities and differences are discussed in the next section in terms of the political climate and confounding structure, sampling, participants, data collection, attrition, and linkage rate.

3.9.1 Political climate of each cohort

The methods in which to collect the data were considerably different between ALSPAC and MCS. Firstly, the data was collected in 1991 for ALSPAC, and late 2000 for MCS. Although parental substance use and parenting has remained somewhat consistent over that time there has been changes in government, and in education. ALSPAC was developed during a long-reigning conservative government, just after Thatcher, and during Major. Thatcher came into power with the ambition to change the states' role in the public sector, stating in first Cabinet meeting to start the 'painful but necessary' process of shrinking the public sector (Burton 2013). After numerous 'reforms to the public sector' argued as an ideological term for austerity, privatisation, and policies promoting individualism, e.g., the right to buy, the public sector and overall state was completely restructured.

From this, ALSPAC developed in a political climate whereby individuals had less government support, particularly those in poverty. Moreover, in the years of Thatcher, those who had non-nuclear family settings were heavily criticised; right-wing organisations consistently referenced single mothers as the 'underclass' and discussed the problem with absent fathers (Pascall 1997) - with the direction of the blame often implicitly being women. Numerous acts, such as The Child Support Act (1993) and 1996 Housing Act were instilled to further push the responsibility of children on the family and away from the state (Pascall 1997). Hence, the Thatcher and Major governments made clear efforts to dismantle the states responsibility to the family, which undoubtedly had negative impacts on children and worsened the impacts of inequality.

Come 1997, the public voted for Blair of the Labour party. His focus was largely on the improvement of Britain's public services, with more progressive policies including reducing child poverty, and improving education. However, the family rhetoric with Blair was not largely unchanged to Thatcher and Major, with consistent references to the 'underclass' of lone mothers and unemployed young men (Carling et al. 2005). However, policies were more progressive in the sense they aimed to support employment for those in poverty, such as encouraging businesses to have more family-friendly environments (Carling et al. 2005) rather than instating acts which put responsibility on the individual. Blair's policies aimed to balance getting mothers into employment and offering children good educational foundations, e.g., Sure Start, with the hope to reduce child poverty. However, this community focused solution still bordered on victim-blaming (Carling et al. 2005), and has been argued to further support working, middle-class mothers more whilst simultaneously alienating mothers at greatest need (Reay 2008). Nevertheless, in the 2000's when MCS began the political climate for families was more supportive, with reducing child poverty and inequality being a focus of the government. As a result, these confounding structures are different in terms of their political climate but are similar in what confounds each samples.

3.9.2 Sampling

ALSPAC's sampling method was considerably less robust compared to MCS due to its opportunistic nature. While this is a problem, ALSPAC have attempted to amend this by using methods to contact families who were eligible in 1991 but not contacted; not many have been identified suggesting high coverage (Boyd et al. 2013). However, the sample in Bristol was affluent before being collected, with most being White, and more owning their own home compared to the average in the UK (Boyd et al. 2013). Therefore, the ALSPAC study is likely to be a community-based sample, which is representative of Bristol in the 1990's, with the potential of being generalisable to other cities who possessed similar characteristics. In contrast, MCS has employed numerous strategies to contact marginalised groups with stratified, clustered sampling of the four countries in the UK, using a very accurate sampling frame. Whilst some marginalised groups may have been missed, e.g., traveller communities, homes not claiming child benefit, this will be considerably less biased than ALSPAC.

3.9.3 Participants

For the participants, they were largely the same people, but the methods differed. ALSPAC used the more traditional method of the mother being the main respondent, whereas MCS let the household choose, giving more representation to same-sex couples, or non-traditional settings. The data collection differed, with ALSPAC using postal questionnaires only, and MCS using an interviewer for the main respondent, but a postal questionnaire for sensitive questions. Both cohorts have viable uses, but postal questionnaires do often have a lower response rate which may explain the ~10% difference in response rate shown.

3.9.4 Response rates and attrition

The response rate for both datasets when the measures in this research were used were around ~70% for the mothers of ALSPAC and ~80% for the main respondents in MCS. Whilst the partner response is lower, that is anticipated as some respondents would not have partners, and they would be more difficult to contact as they might not live in the household. Both studies have attrition, but ALSPAC more so. With a sample that is already more affluent than the general population, it has been noted that less affluent groups are more likely to refuse the study, or be unproductive (Boyd et al. 2013). This differs to MCS, which has shown less socioeconomic patterning in the attrition due to their sampling technique. The education linkage was higher in ALSPAC than MCS, as MCS took their linkage consent later in the study when attrition had already begun. Therefore, this section has highlighted the similarities and differences across the cohorts in terms of methodology.

The next section will discuss the analytical approach for both MCS and ALSPAC.

3.10 Analytical approach

For both cohort studies, the data management was conducted on Stata 15 (StataCorp 2017). This included recoding, renaming, reshaping, merging, and converting the datasets; it also was used for conducting descriptive statistics and correlation analysis. Mplus 8 (Muthén and Muthén 2017) was used for regression analysis, factor analysis and structural equation modelling (SEM) which included latent variable modelling, measurement invariance, latent class analysis, and mediation analysis. Statistical significance was set at 95% (p<0.05).

3.10.1 Missing data

The handling of missing data in research is vital, and the method of handling depends on the distribution of missingness (Graham 2009).

3.10.1.1 Missing at Random (MAR)

It is plausible that both datasets are Missing at Random (MAR), which is classified as 'ignorable nonresponse', whereby the missingness may depend on the observed data, but not on unobserved data (Schafer and Graham 2002). Spratt et al. (2010) has tested the plausibility of ALSPAC being MAR using multiple imputation; they found that complete-case analysis underestimated the prevalence of wheeze at 81 months, but the differences in odds ratios were not substantial. For MCS, the relatively equal attrition and nonresponse suggest that the dataset is still representative (Connelly and Platt 2014), and has been considered to meet the conditions for MAR (Girard et al. 2017; Santos et al. 2020).

3.10.1.2 Techniques to handle MAR

Methods to handle MAR data include pairwise deletion, mean substitution, group mean substitution, imputation by regression, expectation maximisation, and Full Information Maximum Likelihood (FIML) and multiple imputation (Olinsky et al. 2003). However, these are criticised for their limitations and production of invalid standard errors (Olinsky et al. 2003; Graham 2009). Multiple Imputation is a technique used in epidemiological research to handle MAR data. It is defined as a "technique that replaces each missing or deficient value with two or more acceptable values representing a distribution of possibilities" (Rubin 2004, p.2). However, if not correctly applied it can introduce more bias (White and Carlin 2010), and it can be computationally demanding, and complex. The technique that overcomes this complexity which is commonly used in SEM is FIML. It is considered equal to multiple imputation, and is recommended particularly for SEM research (Arbuckle 1996; Enders and Bandalos 2001; Graham 2009).

3.10.1.3 FIML

FIML maximises the use of the data by using all available data, compared to listwise deletion, which needs all data per observation. It does this by minimising the "determinant of the covariance matrix associated with the residuals of the reduced form of the equation system" (Olinsky et al. 2003, p.59). The key advantages are that it is straightforward and time-efficient as there is no requirement for the researcher to create complex imputed datasets for evaluation and comparison. Olinsky et al. (2003) conducted a study which compared techniques and found that FIML was the best for estimating parameters, at all sample sizes. However, large sample sizes are required for FIML to work in a similar manner to other techniques (Olinsky et al. 2003), and the standard error estimation is better using multiple imputation. FIML has been used in peer-reviewed papers which consider ALSPAC and MCS data (Spratt et al. 2010; Girard et al. 2017; Mahedy et al. 2017; Santos et al. 2020). As a final consideration, the exposures, mediators, and data linkage capitalised on earlier measures where less systematic bias was prevalent.

3.10.2 Statistical analysis

This section will detail each statistical technique that will be used.

3.10.2.1 Regression procedures

Logistic regression analysis will answer research questions one and two as the educational outcome variables were binary. They were built on a theoretical basis, so any non-significant covariates remained in the model. To avoid the violation of assumptions regarding non-normal data, the robust maximum likelihood estimator option in Mplus was used as recommended (Muthén and Muthén 2017). Furthermore, the variables were checked for potential multi-collinearity as multiple independent variables that co-vary together can provide incorrect model estimates. (Linneman 2018)

3.10.2.2 Structural Equation Modelling (SEM)

SEM is described as a two-part model - measurement and structural, and analysis must be performed in this order. The measurement derives from the latent variable use; these capture the covariance between different indicators, which are then connected in the model using regression coefficients (Geiser 2013). Latent variables in this research are constructed in Mplus using Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). These are considered of better quality compared to sum-scores as they allow for measurement error in the analysis (Geiser 2013). As a result, the relationships between variables in the structural model can be better estimated compared to conventional correlation, regression, or path analyses at the level of manifest levels (Geiser 2013, p.26). The structural part of SEM is the regression coefficients. Logistic and linear coefficients are preferred, but in some analyses, only probit can be estimated by Mplus.

Similarly to Geiser (2013) the models will not be depicted using mathematical equations, rather diagrams were used. For explanation, regressions coefficients are symbolised through single head arrows (→); all variables which receive an arrow are considered endogenous – known as outcome variables. Variables which only omit paths are exogenous – predictor variables (Geiser 2013). Arrows which are double-headed represent non-directional relationships, such as covariance or correlations (Geiser 2013). Furthermore, latent variables are characterised by ovals, with the manifest variables represented as rectangles.

3.10.2.2.1 Model fit

SEM models are tested for goodness of fit using several tests. The most common tests include Chi-square (χ^2); Comparative Fit Index (CFI); Tucker-Lewis Index (TLI); Root Mean Square Error of Approximation (RMSEA); Standardised Root Mean Square Residual (SRMR); Information Criteria (AIC, BIC or Adjusted BIC); Residuals and Model Modification Indices (Geiser 2013). For formulaic summaries of the model fit tests see Chen (2007). For adequate model fit, the χ^2 should show a non-significant result (p>0.05). The CFI and TLI should be >0.90 for acceptable fit and >0.95 for good fit. For acceptable fit, the RMSEA should be <0.08, and <0.05 for good fit; the SRMR should be <0.08. The model modification indices show large values for model misspecification and are calculated using χ^2; values under five tend to be rejected for misspecification, but the theoretical judgement is critical in this decision. The next sections discuss factor analysis, latent class analysis, and SEM mediation.

3.10.2.2.2 Factor analysis – EFA and CFA

Factor analysis permits the researcher to use multiple variables of which represent a single, or multiple, underlying construct(s) (Fabrigar and Wegener 2012), e.g., happiness is a construct that is likely to be represented by multiple variables. Rather than just inspecting correlation between variables, factor analysis is used to "determine the number of distinct constructs assessed by a set of measures" (Fabrigar and Wegener 2012, p.3). However, this estimation also results in unique factors; this is defined as the "portion of the score on a measured variable that is not explained by the common factors" (Fabrigar and Wegener 2012, p.6). This uniqueness is then the variance that is not shared between the manifest variables, as each manifest variable will have a proportion of uniqueness. As a result, each latent variable will represent the shared, observed variance between the manifest variables, and the residual variance is the measurement error.

3.10.2.2.2.1 EFA

EFA is used when "the researcher has no clear expectations or relatively incomplete expectations about the underlying structure of correlations" (Fabrigar and Wegener 2012, p.4); it discovers structure rather than confirms structure (Child 2006). It has been used to determine if the observed variables are linked to their underlying factors (Byrne 2012); for some variables, it has also been for data reduction purposes. The main justification for using EFA before CFA was that all mediator variables were not part of a validated scale, and EFA can test new assessment measures (Byrne 2005). However, it was followed by CFA as EFA tends to be less conservative in terms of model fit (Bollen 1989).

Before estimation, the variables must be checked for correlations first. It is suggested that variables which correlate above 0.70 are not used in the same model (Brown 2015). To estimate the EFA, the maximum likelihood estimator is recommended for continuous data (Fabrigar et al. 1999), but the Weighted Least Square Mean and Variance Adjusted (WLSMV) estimator for categorical data (Barendse et al. 2015; Muthén and Muthén 2017). They argue that maximum likelihood "methods lack theoretical justification for use with discrete data… [and] the MLR [Maximum Likelihood Robust] method has the problem that the chi-square difference test of yields negative results" (Barendse et al. 2015, p.99). Moreover, model fit indices are not given for maximum likelihood robust estimation, and these are fundamental for evaluation. It also is computationally demanding due to the integration required for categorical variables (Fitzmaurice et al. 2008). However, WLSMV does not use FIML; instead, it uses pairwise correlations. This warrants concern for the effects of missing data, but the sample size was checked with maximum likelihood which uses FIML to ensure samples did not differ due to missing data.

For the rotation, the oblique rotation was used, as recommended by Worthington and Whittaker (2006, p.833) as other methods are often criticised in the context of psychological research (Fabrigar et al. 1999). For model fit, the regular 'goodness of fit' indices were used (see section 3.5.2.2.1). Factor models were rejected if most indices did not meet the required values; however, the χ^2 was ignored due to sensitivity with large samples. It is advised by Mplus that variables which have negative residual variance are removed, as it likely they are Heywood cases (Muthén and Muthén 2017). Alongside model fit, only eigenvalues of 1.00 and above should be considered for factor models. Factor loadings had to be above 0.40 or -0.40 in order to meet the factor inclusion requirement (Brown 2015); this level of acceptance is disputed by researchers, for large sample sizes 0.30 or -0.30 are also accepted (Costello and Osborne 2005). In essence, when deciding the model fit, the researcher must "balance the need for parsimony… against the need for plausibility" (Fabrigar et al. 1999, p.277). Once a suitable model was identified, it would then be replicated in a CFA.

3.10.2.2.2.2 CFA

The purpose of CFA was to test that the EFA forms a valid, theoretical construct (Brown 2015). The key difference between EFA and CFA is that it does not explore the number of factors, the research assumes that all variables will load on one-factor, formulating a single construct; it also does not have eigenvalues. Aside from that, all other fit criteria are the same in terms of model fit, factor loadings (0.40 and -0.40) and the estimator used (WLSMV).

3.10.2.2.3 Measurement Invariance

Measurement invariance, or equivalence, is concerned with whether "components of the measurement model and the structural model are invariant (i.e., equivalent) across particular groups of interest" (Byrne 2012, p.193). This is because a construct that is measured may different a different meaning for various groups, or at different times (Bornstein 1995). A useful example is depression for men and women in Putnick and Bornstein (2016). Measurement invariance is tested using three steps: configural; metric and scalar; for categorical variables, only configural and scalar tests are performed (Brown 2015). For SEM models to be generalisable, the latent variables must show partial invariance (Byrne 2005; Oberski et al. 2015), i.e. some variables on the latent factor do not differ across groups or times. The discussion will only concern categorical variables, as that is what the measurement invariance was performed on.

The first step entails conducting the configural model – also known as the equal form model. For categorical variables, the factor loadings and thresholds are freely estimated in all groups, but the factor means, and scale factors are fixed to zero in all groups (Brown 2015). Once achieved, the scalar model is conducted, and this tests for equivalence across thresholds in categorical variables (Brown 2015). To test these, the χ^2 difference testing function in Mplus is used, where significance ($p<0.05$) denotes variance. If variance is found, partial invariance must be explored; to identify variables that are contributing to the variance, the modification indices are used. Modification indices reflect "an approximation of how much the overall χ^2 will decrease if the fixed or constrained parameter is freely estimator" (Brown 2015, p.99). To test for partial invariance, the equality constraints for thresholds and factor loadings for a given indicator are relaxed (Brown 2015, p.372). Once full or partial invariance has been achieved, this is then implemented in structural models which use the latent constructs.

Whilst this process is acceptable, measurement invariance using categorical variables requires more research. For instance, the type of parameterisation is disputed among scholars in terms of delta and theta (Muthén and Asparouhov 2002; Brown 2015). Moreover, the χ^2 difference testing is very sensitive to large samples, meaning that the incidence of invariance is very low when using these data (Sass et al. 2014). While in continuous data that uses maximum likelihood (robust), changes in the model fit are usually considered (Chen 2007), this is not suggested for models which use WLSMV (Sass et al. 2014). Due to the underdevelopment in this area, it is encouraged that researchers, specifically reviewers and editors, to view measurement invariance tests as dynamic and informative aspects of the functioning of a construct across groups rather than a gateway test (Putnick and Bornstein 2016, p.19).

3.10.2.2.4 Latent Class Analysis

Latent class analysis (LCA) is defined as "a statistical procedure that can be used to classify individuals into homogeneous subgroups" (Geiser 2013, p.233). It is argued that LCA is a form of data reduction, similarly to EFA, and to some extent, this is true. However, I view it as more of a confirmatory technique, specifically one which allows us “to test theories about typological differences between individuals” (Geiser 2013, p.233). These typologies would have considerable importance for the parental substance use literature, and previous research has explored substance use groups in this way (Evans-Polce et al. 2016; Jääskeläinen et al. 2016). LCA offers a method which can model how mothers and their partners use both alcohol and drugs, going beyond unidimensional explanations. The classes, or groups, which are developed from this technique, can be used then to predict outcomes.

The LCA was set-up in accordance with Geiser (2013) and Muthén and Muthén (2017). All models used maximum likelihood robust estimators; thus, FIML was employed, and non-normal data could be adjusted for. Start values were 500 iterations of 50 random starts and 50 iterations, with the convergence criterion left as the default; these were only increased if necessary. The log-likelihood replicability has been checked for in all models, with avoidance of the error message, which indicates where the best log-likelihood value was not replicated. After these criteria were met, the model fit statistics were considered.

The main fit statistics include absolute model fit χ^2; Akaike Information Criterion (AIC); Bayesian Information Criterion (BIC); entropy; average latent class probabilities for most likely latent class membership; bootstrap likelihood ratio difference test (BLRT); Vuong-Lo-Mendell-Rubin test (VLMR) and Lo-Mendell-Rubin (LRT) adjusted likelihood ratio test. First, the Pearson χ^2 and likelihood ratio statistic is referring to whether the model perfectly reproduces the observed data (Geiser 2013). However, it is suggested that these statistics are considered with caution, as a large sample size with small discrepancies can show significance, (Geiser 2013). Second, the AIC and BIC are descriptive indices for model comparisons which take into account both the goodness of fit of a model, and model parsimony (Geiser 2013). It is suggested that these indices are interpreted as the smaller the estimate, the better the fit (Geiser 2013).

Third, the entropy is considered which is a “summary measure for the quality of the classification in an LCA model. Values close to 1.00 indicate good classification accuracy, whereas values close to 0 indicate lack of accuracy” (Geiser 2013, p.269). There are no golden rules when it comes to entropy; however, it has been suggested that values should not be lower than 0.70 (Wang et al. 2017). Fourth, the average latent class probabilities for most likely latent class membership should be above 0.80 (Rost 2006; Geiser 2013). Finally, the three likelihood ratio tests are considered, the BLRT, VLRT, and LRT. A significant value (p<0.05) in any of these tests suggests that "the estimated model fits significantly better than the model with one class less" (Geiser 2013, p.266). The BLRT, although a gold-standard model fit criteria, is computationally demanding and requires extra modelling to converge often; therefore, guidance from Asparouhov and Muthén (2012) was followed. Once all the criteria were met, the LCA would be examined according to "the model that best-balanced interpretability and fit" (Melendez-Torres et al. 2018, p.160).

3.10.2.2.5 SEM, mediation, and indirect effects

SEM is used to explore whether parenting and the family environment are mediators in the relationship between parental substance use and children's educational outcomes. There are debates around what constitutes mediation, partial mediation, and indirect effects. While the aim of this thesis is not to discuss that at length, it has devised a clear strategy in interpreting the results of each model, and whether it constitutes mediation, partial mediation, or indirect effects.

Mediation tests whether X has a relationship with Y, but through the intervening mechanism of M; this is termed a causal chain of X → M → Y (Mathieu and Taylor 2006). The original approach, largely influenced by Baron and Kenny (1986), identifies a mediator as a variable which "accounts for the relation between the predictor and the criterion" (p. 1176). They do this via a path diagram in their article, where they explain the following:

> *(a) variations in levels of the independent variable significantly account for variations in the presumed mediator (path a), (b) variations in the mediator significantly account for variations in the dependent variable (path b), and (c) when paths a and b are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of the mediation occurring when path c is zero.* (Baron and Kenny 1986, p.1176)

Following this, they conclude that the independent variable must affect the mediator in the first equation; the independent variable must affect the dependent variable in the second equation, and finally, the mediator must affect the dependent variable in the third equation (Baron and Kenny 1986). Perfect mediation is held when the independent variable has no effect when the mediator is controlled for.

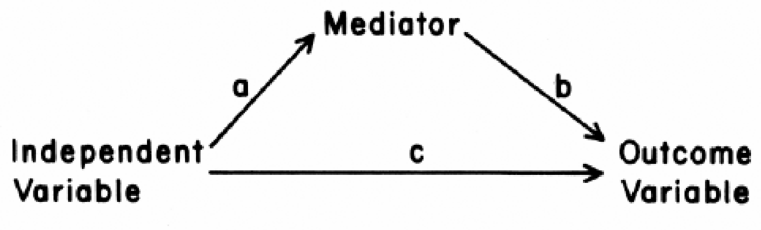

Figure 6: Mediation model pathways by Baron and Kenny (1986)

However, mediation has expanded to considerations of the preconditions of mediators, the use of multiple mediators, partial mediation, and indirect effects. Mathieu and Taylor (2006) argue that other variables may confound relationships when evaluating the mediation model. Second, they argue that temporal precedence is important, so X must occurs before M, and M much must occur before Y (Mathieu and Taylor 2006). If this is present, it is possible to have more confidence that the chain of relationships is not compromised. Third, they argue that the only basis for advancing a particular causal order in non-experimental studies is with simultaneous measurement of the antecedent, mediator and criterion (Mathieu and Taylor 2006, p.1035); which can be strengthened by longitudinal design. Fourth, they argue that latent variables provide stronger mediators which are more reliable.

However, what constitutes as mediation is also disputed. Some argue that "the antecedent must exhibit a significant 'total' relationship with a criterion", whereas some "have relaxed this precondition, and argued that mediation inferences are justified if the indirect effect carried by the X → M and M → Y paths are significant" (Mathieu and Taylor 2006, p.1037). This is the key distinction between mediation and indirect effects. The possibility for an indirect effect is defended well by Preacher and Hayes (2004, p.719): "It is quite possible to find that an indirect effect is significant even when there is no evidence for a significant total effect. Whether or not the effect also represents mediation should be judged through examination of the total effect.".

One being that confounding, suppression, and interactive effects could attenuate overall X → Y effects (MacKinnon et al. 2000). The example used in MacKinnon et al. (2000) to demonstrate the suppression effect is useful here:

> *Suppose that a researcher is interested in the interrelationships among workers' intelligence (X), level of boredom (M), and the number of errors made on an assembly line task (Y). It can be plausibly argued that, all else being equal, the more intelligent workers would make fewer errors, the more intelligent workers would exhibit higher levels of boredom, and boredom would be positively associated with number of errors. Thus the direct effect of intelligence on errors would be negative, and the indirect effect of intelligence on errors mediated by boredom would be positive. Combined, these two hypothetical effects may cancel each other out, resulting in a total effect of intelligence on errors equal to zero.*
> (MacKinnon et al. 2000, p.3)

As a result, it is plausible to see how both mediation and indirect effects can operate. Within the debate of mediation, there also is partial mediation which is where only some of the relationship between X and Y is accounted for by M. A diagrammatic example taken from Mathieu and Taylor (2006) of the three types of mediation covered in this thesis is given for illustration purposes, see Figure 7.

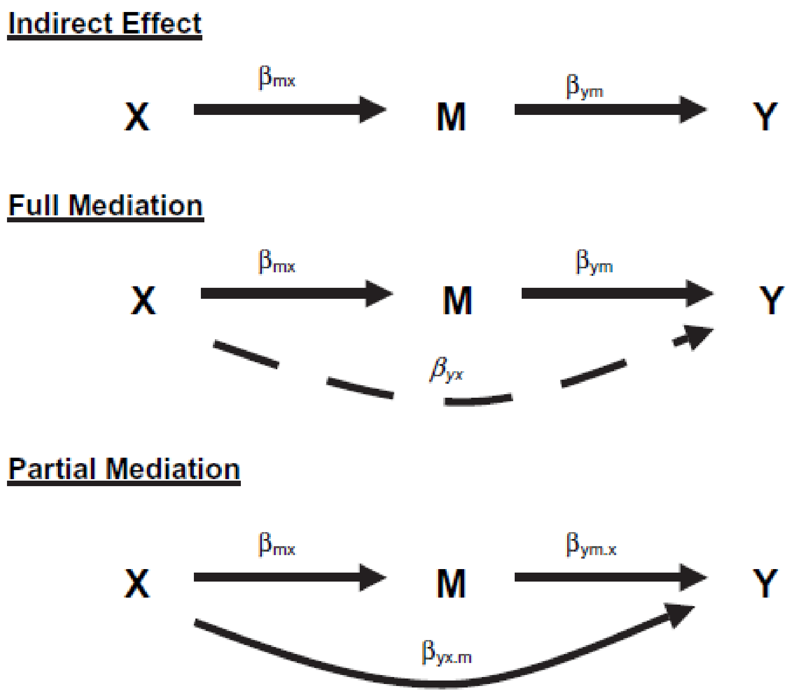

Figure 7: Mediation and indirect effects from Mathieu and Taylor (2006)

3.10.2.2.6 A distinction between mediators and mechanisms

The terms mediators and mechanisms are often used interchangeably, but they are different (Tryon 2018). In Chapter 1, mechanisms were discussed as variables which may explain the relationship between parental substance use and children's educational outcomes; Chapter 2 theorised that these could be parenting and the family environment. The distinction lies in the method and interpretation. The analysis discussed poses mediation as a method in determining if parenting and the family environment mediate the relationship between parental substance use and children's educational outcomes. These are then interpreted as potential mechanisms, but as explained by Tryon (2018, p.626) this is "what correlation is to cause". While mediation may be useful, it alone is not sufficient to establish mechanism status, even when using multiple indicators of latent constructs (Tryon 2018); mediation analysis is the first step, but experimental evidence and explanations of causal processes must follow to establish mechanism status. Therefore, this research conducts mediation analysis as the first step in determining if parenting and the family environment are potential mechanisms in the relationship between parental substance use and children's educational outcomes.

3.11 Preparation for analysis

Both datasets were managed to form a wide dataset, whereby each line constituted a child, and there were multiple variables over-time. In both datasets, the child had a household ID and a person ID which uniquely identified multiple births. Both datasets were managed in the sense that the main household respondent was the mother, and the partners could be male or female in ALSPAC, but in MCS, same-sex couples were excluded due to disclosure. All responses that were not answered, even partially, by the person in question were excluded from the analysis where possible. Responses were checked to ensure that the temporal ordering would hold, i.e., mediators would have to occur before the education tests would be taken. The data was managed on Stata 15 and was converted to Mplus 8 using the 'stata2mplus' user-written command for analysis (How can I convert a Stata data file to a Mplus data file? | Stata FAQ. [no date]). All SEM findings present unstandardised coefficients except latent variables which are standardised for interpretation.

3.12 Summary

This chapter has discussed the main considerations of using secondary data for quantitative research. This included longitudinal design, an evaluation of using secondary data, ethical considerations, and framing the research in a CR ontology and epistemology. From this, using secondary data was deemed beneficial, and the datasets of ALSPAC and MCS are used in this thesis. Both datasets were discussed and compared; they differ in their sampling strategies but are similar in terms of data-collection methods and have both shown study attrition. Their representation differed, with ALSPAC being more of a community sample which represents White affluent groups and MCS being more nationally representative of the UK. Following the discussion of the datasets, the analytical approach was outlined. The approach involves using regression analysis to answer research question one and two for both datasets. Moreover, SEM will be used to answer research questions three and four for both datasets; this includes LCA, EFA, CFA, measurement invariance, and SEM mediation models. The findings from each cohort will be used to answer research question five. Therefore, the next chapters will compromise of the findings for ALSPAC, MCS, and the cross-cohort analysis.

Chapter 4 presents the measures used and findings from the ALSPAC data using the analytical approach.

Chapter 4 The Avon Longitudinal Study of Parents and Children: Results

This chapter will follow the analytical approach outlined in Chapter 3 to answer the following three research questions:

1. What is the relationship between parental substance use and children's educational attainment?
2. What is the relationship between parental substance use and children's educational attainment once adjusted for environmental and demographic factors?
3. Do parenting and the family environment mediate the relationship between parental substance use and children's educational attainment?

4.1 Outline

Section 4.2 will outline the measures used in this research. Following this, the demographics of the sample are shown for mothers, their partners, and children in section 4.3. Following this, the measurement of the SEM models is conducted, sections 4.4. and 4.5. show the results for the EFA and CFA. Once the latent variables are developed, they were checked for invariance across socioeconomic status in section 4.6. Section 4.7. shows the results of the LCA of parental substance use. This method was used to explore types of substance use among both parents, and both substances, this is published and under a creative commons license can be reused with acknowledgements (Lowthian et al. 2020). Following this, the class with the highest consumption was converted into a predicted probability to use as an exposure for the research. Section 4.8, 4.9. and 4.10. feature regression models and SEM mediation models. Throughout this research, partner-based variables include largely male partners, but also some female partners, whereas mothers are natural, female mothers in this cohort.

4.2 Measures

Below are the measures, note that responses of 'refusal', 'don't know', or 'do not want to answer' were recoded to missing.

4.2.1 Exposures

All exposure variables are used in the LCA, section 4.7.

4.2.1.1 Alcohol use

Both maternal and paternal alcohol consumption are measured when the child was aged 3 years and 11 months; this age was chosen because it is before the child begins school and occurs before most parenting variables are collected.

4.2.1.1.1 Maternal alcohol consumption

Maternal drinking has been measured using a self-reported daily diary of alcohol consumption for one week; one glass was a unit of alcohol – 8g, and this was communicated to respondents in the questionnaire. This data is categorised as count data whereby each day forms a variable of total number of units for Monday, Tuesday, Wednesday and so forth. If any days of the week were missing, then the variable was coded as missing. Each daily number of units' variable was used to form a latent variable.

4.2.1.1.2 Partner alcohol consumption

Partner alcohol use has been measured using the mother's report of partner drinking as there was a lower number of observations for self-reported partner use; correlation analysis was used to check for consistency and the correlation was strong and statistically significant (R^2=0.74, p<0.05). The mother reported on how often the partner had consumed alcohol in terms of >4 units in a drinking episode over the course of the month. Responses included 'None', '1 - 2 days', '3 - 4 days, '5 - 10 days', '>10 days' and 'Everyday'.

4.2.1.2 Drug use

This question is used for mothers only, as there were too few partner's responses, and no mother report was available. The question asks, "In the past year how often have you taken the following?", followed by tick boxes of various illicit substances including cannabis/marijuana, tranquillisers, amphetamines or other stimulants, heroin, methadone, crack, and cocaine. The next question asks how often the individual has used the illicit drug and the responses are 'every day', 'often', 'sometimes', and 'not at all'. A binary measure of parental drug use was employed as more nuanced understandings would have caused boundary errors in estimation; this has been done in other research (Macleod et al. 2008).

4.2.2 Mediators

This section covers the parenting and the family environment mediators; some variables form latent variables which feature in sections 4.4, and 4.5 for EFA and CFA respectively.

4.2.2.1 Parenting

The variables outlined in this section include the mother-child interaction, school involvement, help with homework, and cruelty. For parenting variables, the mother, and to a lesser extent their partner, was the respondent. In a small number of cases, respondents were others, e.g., grandparents or nannies, if this occurred then the variable was coded to show that mother or their partner had no interaction.

4.2.2.2 Mother and Partner-child interaction

Mother-child interactions have been studied using ALSPAC data in numerous studies to define positive interaction (Gutman and Feinstein 2010; Kiernan and Mensah 2013; Davis et al. 2016). Similar measures are used in this research to explore the mother/partner-child interaction as a latent variable. As there are many variables, EFA will be used to explore the relationships between variables. The variables used in analysis are shown in Table 3. Variables were coded where the higher the number, the greater occurrence of the activity. The partner's interactions were the same.

Question	Response
Mum/female makes things with child	*Not at all,* *Less often,* *Once or twice a month,* *Once or twice a week,* *Several times a week,* *Everyday*
Mum/female sings to child	"
Mum/female reads to child	"
Mum/female plays with toys with child	"
Mum/female does active play with child	"
Mum/female takes child to park/playground	"
Mum/female takes child swimming	"
Mum/female draws/paints with child	"
Mum/female takes child to classes	"
Mum/female takes child shopping	"
Mum/female takes child to watch sports	"
Mum/female has conversations with child	"

Table 3: Questions forming the parental interaction measure in ALSPAC

4.2.2.3 Parental school involvement

Table 4 shows all variables which measure parental school involvement, for both parents if applicable. The questions regarding homework and preparing for school are measured in the response of 'Nearly every day', '2-5 times a week', 'Once a week', 'Less than once a week', and 'Never'. These were coded as the higher the occurrence, the higher the score. For the school interest variable, the question regarding interest has the responses of 'Yes, very', 'Yes, mostly', and 'No, not really', a higher score equals *less* interest.

Question	Response
Mum/female does homework with child	*Not at all,* *Less often,* *Once or twice a month,* *Once or twice a week,* *Several times a week,* *Everyday*

Mum/female helps child prepare for school	"
Mother is interested in what child does at school	*Yes, very,* *Yes, mostly,* *No*
Dad/male does homework with child	"
Dad/male helps child prepare for school	"

Table 4: Questions forming the parental school involvement measure in ALSPAC

4.2.2.4 Cruelty towards children

Questions regarding cruelty are asked and displayed in Table 5, they follow on from the overarching question "Have any of these occurred since the study child was 2 and a half years old? If so please assess how much effect it had on you". This measure is taken on the child's 5th birthday. This variable is coded as binary to depict any physical or emotional cruelty vs. no cruelty. Both the mother and her reports of the partner's behaviour were used.

Question	**Response**
You were physically cruel to your children?	*Yes, and it affected me a lot,* *Yes, moderately affected,* *Yes, mildly affected,* *Yes, but it did not affect me at all* *No, did not happen*
You were emotionally cruel to your children?	"
Your husband/partner was physically cruel to your children?	"
Your husband/partner was emotionally cruel to your children?	"

Table 5: Questions forming the physical and emotional cruelty measure in ALSPAC

4.2.2.5 Child routine

The question 'Child has a regular sleeping routine' was used, with the responses being 'Yes' and 'No', as used in other studies (Kiernan and Mensah 2013; Davis et al. 2016). No other questions regarding routine were available, such as regular meals.

4.2.2.6 Interparental conflict

Table 6 shows questions used to develop a construct of interparental conflict. These variables were reported by the mother and are explored in an EFA and CFA, whereby higher scores described more conflict.

Question	**Response**
Frequency that mother has been irritable with husband/partner recently	*Not at all,* *Less than once a week,* *1-2 times a week,* *3-6 times a week*
Frequency that husband/partner has been irritable with mother recently	*Not at all,* *Less than once a week,* *1-2 times a week,* *3-6 times a week*
Number of arguments or disagreements between mother and husband/partner in the past 3 months	*None,* *1 – 3,* *4 – 7,* *8 – 13,* *14 or more*
Mother/husband/partner were not speaking for more than half an hour, in the past 3 months	*Yes, I did this,* *Yes, he did this,* *Yes, we both did this,* *No, not at all*
Mother/husband/partner walked out of the house in the past 3 months	"
Mother/husband/partner shouted or called one another names in the past 3 months	"
Mother/husband/partner hit or slapped one another in the past 3 months	"
Mother/husband/partner threw or broke things in the past 3 months	"

Table 6: Questions forming the interparental conflict measure in ALSPAC

4.2.2.7 Child breakfast frequency

Breakfast consumption was measured by the question which asks ‘Frequency child eats something before school’ with the following responses ‘Never’, ‘Once in 2 weeks’, ‘Once a week’, ‘2 - 4 times a week’, and ‘5 times a week’. A higher score indicated greater frequency.

4.2.3 Outcomes

The attainment outcomes will be linked with the data from the NPD; the outcomes are Key Stage 1, 2, 4 outcomes (KS1 - 4). Key stage 3 outcomes are omitted as they cannot be harmonised with MCS, and the analysis has low linkage rates compared to others; for models of KS3 see Appendix D and E. For KS1 and 2, age 7 – 8 years and 10 – 11 years respectively, children had to reach the expected level of attainment in both English and Maths tests to be coded as ‘attained’; this is Level 2 in KS1, and Level 3 in KS2. For KS4, aged 15 – 16 years, the variable ‘achieved 5 or more GCSE and equivalents at grades A - C including GCSE English and Maths (including functional English and maths)’ was used. All variables are binary coded, with 1 = attained, and 0 = not attained.

4.2.4 Demographics

Sex, age, and ethnicity are taken from the mother, their partner, and child. Socioeconomic status will be derived from: family income per week (banded) and the mother’s highest qualification (the partners was very low in observations). Income has five categories, ‘<£100 per week’, ‘£100-199 per week’, ‘£200-299 per week’, ‘£300-399 per week’ and ‘>£400 per week’. Qualifications are in six-categories, ‘None’, ‘CSE’, ‘Vocational/Apprenticeship/C&G Intermediate’, ‘O-level’, ‘A-level/Register Nurse/C&G Final’ and ‘Degree level’.

4.2.4.1 Prenatal exposures

4.2.4.1.1 Tobacco smoking

Tobacco smoking is taken prenatally at 18 weeks gestation; the only available measure. The question asks, ‘Have you smoked tobacco in the last 2 weeks?’; the responses are ‘No’, ‘Yes cigarettes’, ‘Yes cigars’ and ‘Yes other’. If they said ‘Yes’, then a frequency was taken which included ‘None’, ‘1-4’, ‘5-9’, ‘10-14’, ‘15-19’, ‘20-24’, ‘25-29’, and ‘30+’.

4.2.4.1.2 Alcohol use

Prenatal alcohol is measured at 18 weeks gestation, following Sayal et al. (2014). This is measured as 'Never', 'Less than one glass a week', '1 or more glasses per week', '1-2 glasses per day', '3-9 glasses per day', and '10+ glasses a day'.

4.2.4.1.3 Drug use

Illicit drug use is captured at 18 weeks gestation. Drugs include ecstasy, methadone, heroin, cocaine, crack, barbiturates, amphetamine, and cannabis. The question asks what drug has been used during pregnancy and for each drug the responses are 'Nearly every day', 'Once per week', 'Less than once per month' and 'Not at all'. A binary measure was form on whether the mother had used illicit drugs in pregnancy or not (Yes/No).

4.2.4.2 Parental mental health

The Crown-Crisp Experiential Index (CCEI) is a validated measure for identifying poorer mental health symptoms for the mother; it was taken when the child was 2 years and 9 months. It asks questions on the frequency of feelings of regret, difficulty to sleep, crying, and life being an effort. The answers were summed to form a continuous variable. Any questions which were missing set the scale total to missing. A higher score equals better mental wellbeing, or less depressive symptoms. This measure correlates highly with the Edinburgh's post-natal depression scale (Evans et al. 2001) and the General Health Questionnaire (Joukamaa 1992).

4.3 Demographics

Descriptive statistics are given below for mother's demographics, partner demographics and child demographics; variables are taken at different time points and the time point is stated under the variable. For statistical disclosure, if cells were less than five then '<' and '>' is given to top-code estimates, and '~' is given to show that these are masked estimates. The average age of the mother at birth was 28 years old, and 33 years for their partners. Around a quarter of the sample was earning >£400 a week by the time the child was age 3 years and 11 months. Most mothers and their partners were qualified to O-level, or above. A large majority of the sample were white (97.4% and 97.8%). Few mothers used alcohol or drugs in pregnancy on a regular basis; 80.3% of mothers did not smoke in the last 2 weeks of the questionnaire.

	Mothers demographics				Partners demographics			
	Valid N (%)	**Missing %**	**Mean**	**SD**	**Valid N (%)**	**Missing %**	**Mean**	**SD**
Age *(at delivery)*	14076	8.9%	28.00	4.96	7877	49.0%	33.00	5.74
Wellbeing (*Ch-age 2)*	9503	38.5%	25.90	3.63	5282	65.8%	27.30	3.03
Weekly income *(Ch-age 3)*	8589	44.4%			4752	69.2%		
< £100	665 (7.7%)				88 (1.9%)			
£100 - £199	1350 (15.7%)				456 (9.6%)			
£200 - £299	2252 (26.2%)				1197 (25.2%)			
£300 - £399	1901 (22.1%)				1229 (25.9%)			
> £400	2421 (28.2%)				1782 (37.5%)			
Qualifications *(Ch-age 2)*	11687	24.4%			9232	40.3%		
None	551 (4.7%)				655 (7.1%)			
CSE	1235 (10.6%)				949 (10.3%)			
Vocational	1164 (10.0%)				682 (7.4%)			
O Level	4327 (37.0%)				2231 (24.2%)			
A level	2801 (24.0%)				2777 (30.1%)			
Degree	1609 (13.7%)				1938 (12.6%)			
Ethnicity *(Ch-age 2)*	12401	19.7%			4037	73.9%		

White	12075 (97.4%)			3950 (97.8%)
Ethnic Minorities	326 (2.6%)			87 (2.2%)
Prenatal Alcohol use *(18 weeks gest)*	12943	16.2%		
Never	6567 (50.7%)			
<1 glass per week	4457 (34.4%)			
1+ glasses per week	1734 (13.4%)			
1-2 glasses per day	161 (1.2%)			
3-9 glasses per day	13 (0.1%)			
10+ glasses per day	11 (0.1%)			
Prenatal cigarette use *(18 weeks gest)*	13303	13.9%		
None	10687 (80.3%)			
1-4	529 (4.0%)			
5-9	636 (4.12%)			
10-14	633 (4.1%)			
15-19	418 (2.7%)			
20-24	289 (1.9%)			
25-29	77 (0.5%)			
30+	34 (0.2%)			

Prenatal drug use *(18 weeks gest)*	12567	18.6%
No	12295 (97.8%)	
Yes	272 (2.2%)	

Table 7: Mothers and their partner's demographics for ALSPAC

The demographics of the child are shown in Table 8. A higher percentage of children (5.1%) are ethnic minorities compared to mothers and their partners, this may be due to the child's ethnicity being taken early in the study. Gender was equally split (51.4% vs. 48.6%).

Child demographics and confounders

	Valid N (%)	% Missing
Ethnicity *(32 weeks gest)*	12150	21.3%
White	11537 (95.0%)	
Ethnic Minorities	613 (5.1%)	
Gender	14854	3.8%
Male	7635 (51.4%)	
Female	7219 (48.6%)	

Table 8: Demographics of children in ALSPAC

The next sections will present the results of the EFA and CFA.

4.4 Exploratory factor analysis (EFA)

EFA permits the measurement of the latent variables. It has been conducted for interparental conflict, mother-child interaction, partner-child interaction, and school involvement. For adequate model fit, the χ^2 should not be significant, but it can be due to the large sample size; the RMSEA and SRMR must be <0.08 and CFI, TLI >0.90. For good fit, the RMSEA must be <0.05 and CFI, TLI >0.95.

4.4.1 *Interparental conflict*

This analysis included 7,919 pairwise observations. The correlation matrix (see Appendix C) showed moderate correlations between variables; there was a strong positive correlation (0.73, $p<0.05$) between the mother being irritated with her partner, and the partner being irritated with the mother. As a result, the partner variable was omitted as these variables were likely to be capturing the same construct, and were greater than 0.70, which is not recommended (Brown 2015). Other correlations were sufficient for analysis, despite being weaker. Following this, the EFA used six measures and three factors; this was the maximum given the parameters. The χ^2 for each of the three EFA models was significant ($p<0.05$). The one factor solution was the only solution that had an acceptable eigenvalue (>1.00); see Appendix C for models.

The model fit showed that the 1-factor model was an acceptable fit (χ^2 = 601.99, df = 14, p <0.05, RMSEA = 0.07, CFI = 0.97, TLI = 0.96, SRMR = 0.09); however, the SRMR was slightly below adequate. The factor loadings suggested a strong construct; the argument variables loaded the highest (0.88) and not talking loaded the lowest (0.59). The 2-factor model was considered as it was a better fit (χ^2 = 87.89 df = 8, p <0.05, RMSEA = 0.04, CFI = 1.00, TLI = 0.99, SRMR = 0.04) however, the factor loadings showed negative residual variances which suggested problems with model fit. The 3-factor model also was a better fit (χ^2 = 13.71, df = 3, p <0.05, RMSEA = 0.02, CFI = 1.00, TLI = 1.00, SRMR = 0.01), but was theoretically non-sensical. Therefore, the 1-factor solution was accepted for CFA; see Appendix C for models.

Rotated factor loadings for 1-factor solution	
Mother irritated with partner	**0.73**
Arguments	**0.88**
Not talking	**0.59**
Walked out	**0.67**
Shouted at partner	**0.74**
Slapped or hit	**0.72**
Thrown or break things	**0.70**

Table 9: Factor loadings for 1-factor solution of interparental conflict EFA (accepted factor loadings in bold)

4.4.2 Mother-child interaction

This analysis included 8,500 pairwise observations. All correlations were statistically significant (p<0.05) with average correlations being 0.31; see Appendix C for all tables. As this was a data reduction technique, the EFA was explored with 6-factor solutions on all items despite some high correlations (0.71, 0.75 and 0.85); the first model showed that the conversation variable had negative residual variance, so it was removed, this previously had high correlations in the matrix so was a likely source of error. The variables of cuddling the child and preparing food were correlated at 0.71 but were kept as they marginally exceeded the recommended guide (0.70) and were deemed key variables.

The analysis was re-conducted. For the 15-item model, the eigenvalues were acceptable for all models. The 1-factor model showed poor fit and was rejected (χ^2 = 7705.93, df = 90, p<0.05, RMSEA = 0.10, CFI =0.91, TLI = 0.90, SRMR = 0.08) as the RMSEA and SRMR were too high. The 2-factor model had a better fit (χ^2 = 601.99, df = 14, p<0.05, RMSEA = 0.06, CFI = 0.97, TLI = 0.96, SRMR = 0.04). Two constructs emerged, see Table 10. One being 'creative play' as creative variables loaded on this factor, e.g., making things, playing with toys. Second being 'warmth' as bathing and cuddling loaded well. The other models were inspected but were rejected based on parsimony. Warmth was tested in the CFA due to its theoretical relevance.

Rotated factor loadings - 2-factor solution

	Creative play	**Warmth**
Bathes the child	0.11	**0.52**
Makes things with the child	**0.77**	0.00
Sings to the child	**0.52**	0.18
Read to child	0.30	**0.50**
Plays with toys with the child	**0.82**	0.00
Cuddles the child	0.25	**0.74**
Active play with the child	**0.76**	0.00
Takes child to the playground	**0.54**	0.11
Puts the child to bed	-0.02	**0.78**
Takes the child swimming	0.18	0.31
Draws and paints with the child	**0.79**	-0.04
Prepares food for the child	-0.01	**0.79**
Takes the child to classes	0.09	0.34

Goes shopping with the child	0.35	0.17
Takes the child to watch sport	0.28	0.10

Table 10: Factor loadings for mother-child 2-factor solution EFA (accepted factor loadings in bold)

4.4.3 Partner-child interaction

This analysis included 8,485 pairwise observations. Correlation analysis of the 16-item partner-child interaction variables were explored, see Appendix C for the matrix. All correlations were statistically significant (p<0.05), conversations and cuddling had a correlation of 0.85 which is above the recommended limit. However, as this was for data reduction purposes the variables were tested in the EFA first, and then it was removed to compare. The EFA would converge up to 8-factor solutions, see Appendix B for factor solutions and eigenvalues.

When including conversations, the 1-factor model had poor fit (χ^2 = 11660.13, df = 104, p<0.05, RMSEA = 0.11, CFI = 0.94, TLI = 0.93, SRMR = 0.07); the 2-factor model also had poor, but improved, model fit (χ^2 = 6603.19, df = 89, p<0.05, RMSEA = 0.09, CFI = 0.96, TLI = 0.95, SRMR = 0.05). The 3-factor had adequate fit (χ^2 = 4430.55, df = 75, p<0.05, RMSEA = 0.08, CFI = 0.98, TLI = 0.96, SRMR = 0.04). The 3-factor solution suggested three underlying constructs of: creative play, warmth, and practical activities (Table 11). When conversations were removed the 3-factor model was still the best (χ^2 = 3284.89, df = 63, p<0.05, RMSEA = 0.08, CFI = 0.98, TLI = 0.96, SRMR = 0.04), and the same variables all loaded above 0.40 on the warmth construct, with the addition of Food 0.41. As a result, two CFA's are conducted. First, the warmth construct with the conversation variable included, and second with the conversation variable removed and the food variable included due to cross-loadings.

Rotated factor loadings – 3-factor solution

	With conversations included			With conversations removed		
	Creative play	**Warmth**	**Practical activities**	**Creative play**	**Warmth**	**Practical activities**
Bathes the child	0.01	**0.66**	0.10	0.03	**0.68**	0.10
Makes things with the child	**0.80**	0.09	-0.02	**0.92**	-0.12	-0.01
Sings to the child	**0.41**	0.20	0.12	**0.57**	0.07	0.04
Read to child	0.29	**0.64**	-0.02	**0.43**	**0.51**	-0.07

Plays with toys with the child	**0.67**	0.24	0.01	**0.88**	0.02	-0.08
Cuddles the child	0.01	**0.68**	0.32	0.37	**0.48**	0.07
Active play with the child	**0.42**	0.19	0.26	**0.65**	0.05	0.11
Takes child to the playground	**0.42**	-0.02	0.37	**0.49**	-0.01	0.31
Puts the child to bed	-0.01	**0.82**	0.03	-0.01	**0.89**	0.00
Takes the child swimming	0.19	0.02	**0.48**	0.24	0.11	**0.40**
Draws and paints with the child	**0.82**	-0.02	0.00	**0.92**	-0.21	0.01
Prepares food for the child	-0.01	0.29	**0.47**	0.00	**0.41**	**0.42**
Takes the child to classes	-0.04	0.12	**0.57**	-0.02	0.27	**0.50**
Goes shopping with the child	0.10	0.03	**0.52**	0.11	0.15	**0.47**
Takes the child to watch sport	0.18	-0.17	**0.54**	0.21	-0.05	**0.45**
Has conversations with the child	0.00	**0.71**	**0.41**	-	-	-

Table 11: Factor loadings for partner-child 3-factor solution EFA (accepted factor loadings in bold)

4.4.4 School involvement

This analysis included 9,129 pairwise observations. Correlation analysis of five school involvement items was explored (mother and partner homework help, mother and partner school preparation and mother's school interest); see Appendix C for the matrix, factor-model estimates and eigenvalues. All correlations were statistically significant (*p*<0.05), but some were weaker (<0.15).

Two models were selected however, the 2-factor did not converge, and the 1-factor model had poor model fit (χ^2 = 1475.23, df = 5, *p*<0.05, RMSEA = 0.18, CFI = 0.84, TLI = 0.68, SRMR = 0.14). Inspection of the variables suggested that the mother's interest variable was likely to be causing poor fit due to a low factor loading (-0.23). The EFA was then conducted without the mother's interest variable (n=8,496), however this model had poorer fit (χ^2 = 1364.97, df =

2, p <0.05, RMSEA = 0.28, CFI = 0.84, TLI = 0.53, SRMR = 0.17). Therefore, it was accepted that the variables of homework help, and school interest would be used in the SEM model as individual variables due to their lack of shared variance; no CFA was conducted following this. The next section is the CFA of the accepted EFA models.

4.5 Confirmatory factor analysis (CFA)

The accepted EFA models are interparental conflict, mother-child interaction, and partner-child interactions. For adequate model fit, the χ^2 should not be significant, however when large sample sizes are used it is possible that a significant value can reach significance with only small problems with model fit; the RMSEA and SRMR must be <0.08 and CFI, TLI >0.90. For good fit, the RMSEA must be <0.05 and CFI, TLI >0.95.

4.5.1 Interparental conflict

The model showed adequate model fit (χ^2 = 601.99, df = 14, p<0.05, RMSEA = 0.07, CFI = 0.97, TLI = 0.96, SRMR = 0.07); this was improved fit compared to the EFA. Each variable loaded above 0.40 on the factor, see Figure 8 for factor loadings. The argument variable loaded the highest (0.88), whereas the not talking variable loaded the least (0.59). Therefore, this CFA model will be implemented in the mediation models.

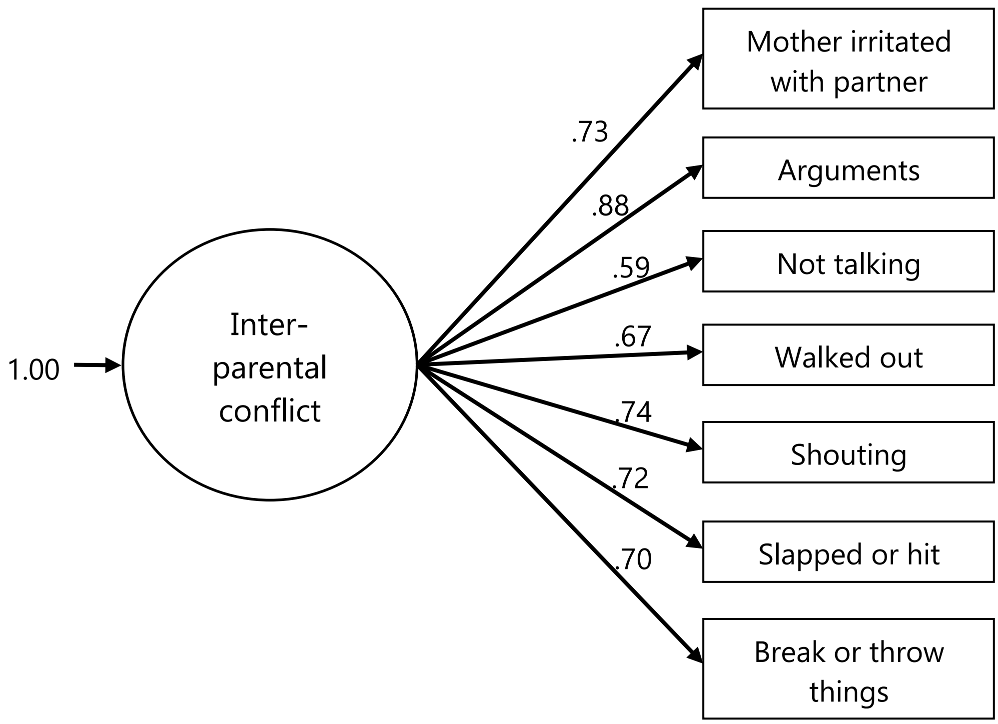

Figure 8: Interparental conflict CFA in ALSPAC

4.5.2 *Mother-child interaction: construct of warmth*

The model showed adequate fit (χ^2 = 215.35, df = 5, p<0.05, RMSEA = 0.07, CFI = 0.99, TLI = 0.98, SRMR = 0.02). Each variable loaded well on the factor, see Figure 9 for factor loadings. The cuddle variable loaded the highest on the factor (0.90) whereas the bathing variable loaded the least (0.60). Therefore, this CFA model will be implemented in mediation models.

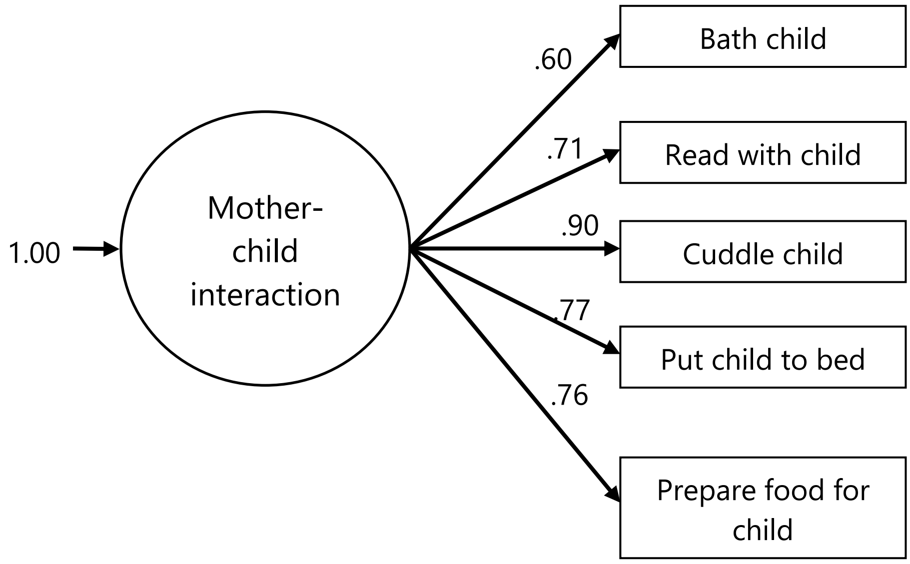

Figure 9: Mother-child interaction CFA in ALSPAC

4.5.3 *Partner-child interaction: construct of warmth*

The model with conversations showed poor fit regarding the RMSEA (χ^2 = 1215.06, df = 5, p<0.05, RMSEA = 0.17, CFI = 0.99, TLI = 0.98, SRMR = 0.04). Likewise, the model without conversations showed inadequate fit for the RMSEA in a CFA (χ^2 = 361.34, df = 5, p<0.05, RMSEA = 0.09, CFI = 0.99, TLI = 0.99, SRMR = 0.02); the 90% CI was explored to see if borderline fit could be justified, but the value was 0.08 - 0.10 which is not acceptable. Therefore, neither CFA model will be implemented in the mediation models. The next section will explore if the accepted CFA's are invariant across socioeconomic status.

4.6 *Measurement invariance*

Both the latent constructs of interparental conflict and mother-child interaction were tested to ensure that they are invariant, or equivalent across groups. Without testing invariance, it is not clear whether the SEM mediation models can be generalised across the groups of interest. As mentioned in Chapter 3, Brown's (2015) guidance is used for conducting measurement invariance with categorical variables; note that the methodology is increasingly developing in this area and currently may overestimate variance in large samples. The variable of income has been used, with the three highest categories constituting high income (n=6,606), and the two lowest constituting low income (n=2,034). While this could have been conducted for many variables, income is a widely used measure of socioeconomic status which is likely to be a confounder for these variables.

4.6.1 Interparental conflict

First, the model for a single-group CFA is inspected, this is the same model in the CFA results section for interparental conflict. This model is compared with an equal form model – known as configural invariance. The equal form model showed good model fit (χ^2 = 500.50, df = 28, p <0.05, RMSEA = 0.07, CFI = 0.97, TLI = 0.96, SRMR = 0.07); therefore, configural equivalence is achieved (Brown 2015). Secondly, for scalar invariance the measurement invariance model is conducted. The results from the model suggested that the restriction of equal loadings and thresholds caused an increase in the model χ^2; however, the model fit still suggested good fit (χ^2 = 527.13, df = 39, p <0.05, RMSEA = 0.06, CFI = 0.97, TLI = 0.97, SRMR = 0.07). Nevertheless, the model does not suggest scalar equivalence in income groups due to the χ2 difference test being statistically significant (p <0.05).

To achieve partial invariance, freeing the thresholds of the variable walking out the house (χ^2=54.62), irritated by partner (χ^2=21.69), not talking (χ^2=18.65), arguing with the partner (χ^2=9.614) and shouting (χ^2=5.05) would decrease the χ^2. The variable with the largest modification indices was freed first, and this was enduring until the variable reached partial invariance signified by a non-significant χ^2 test. From this, walking out, being irritated by partner, not talking to their partner, and arguing with their partner were freed to produce a non-significant χ^2 difference test (χ^2= 0.00, df = 1, p =0.97) reaching partial invariance. The model fit was still acceptable using the partial invariance model (χ^2= 488.06, df = 29, p <0.05, RMSEA = 0.07, CFI = 0.97, TLI = 0.96, SRMR = 0.07). Therefore, the interparental conflict variable has partial equivalence when considering high- and low-income groups.

4.6.2 Mother-child interaction

The model for a single-group CFA compared with an equal form model showed good model fit (χ^2 = 185.76, df = 10, p <0.05, RMSEA = 0.07, CFI = 0.99, TLI = 0.98, SRMR = 0.02); therefore, configural equivalence is achieved (Brown 2015). Secondly, for scalar invariance the measurement invariance model is conducted. The results from the model suggested that the restriction of equal loadings and thresholds caused an increase in the model χ2; however, the model fit still suggested good fit (χ^2 = 377.21, df = 28, p <0.05, RMSEA = 0.06, CFI = 0.98, TLI = 0.98, SRMR = 0.03). Nevertheless, the model does not suggest scalar equivalence in income groups due to the χ^2 difference test being statistically significant (p<0.05).

The modification indices showed that freeing the variables of putting the child to bed (χ^2=217.25), bathing the child (χ^2 =38.36), reading to the child (χ^2 =21.51), and preparing food for the child (χ^2=12.90) could decrease the χ^2. From this, putting the child to bed, bathing the child, reading with the child, and preparing food were freed to show a non-significant result (χ^2= 0.243, df = 2, p =0.89). The model fit was also still acceptable using the partial invariance model (χ^2= 202.94, df = 12, p<0.05, RMSEA = 0.07, CFI = 0.99, TLI = 0.98, SRMR = 0.02). Therefore, the mother-child interaction variable has partial equivalence when testing for high- and low-income groups.

This completes the latent variable modelling analysis for ALSPAC. The next section will consist of LCA, where parental substance use variables are used to identify classes of substance use.

4.7 Latent class analysis (LCA)

This section documents the LCA which was discussed in Chapter 3 as "a statistical procedure that can be used to classify individuals into homogeneous subgroups… [which can] test theories about typological differences between individuals" (Geiser 2013, p.233). This technique has been used to create classes of parental substance use using the mother and partner's alcohol and drug use variables. This section includes descriptive statistics of the measures used and the findings.

4.7.1 Descriptive statistics

The LCA conducted in ALSPAC used nine variables. The weekly diary of mother's alcohol was used as a latent variable to adjust for correlation in alcohol over the week; the measurement model is shown later in this section. This variable was estimated using negative binomial regression; this was chosen as a zero-inflated model was not theoretically plausible given that there were not excess zeroes. Moreover, research suggests that negative binomial regression is mathematically a stronger estimator, but equivalent to zero-inflated binomial regression when analysing alcohol use (Horton et al. 2007); other research has used the same estimator when measuring alcohol use by day (Neal and Simons 2007; Lewis et al. 2009; Iwamoto et al. 2011). The CFA showed good fit (χ^2=45494.7, *df* =77826, *p* =1.00); no other model fit estimates were given for a CFA using count variables. The factor loadings were adequate, with Saturday being the lowest (0.54) which is expected given that Saturday alcohol use is most likely higher compared to other days. The variance was 3.11, and this is unusual due to the standardisation of estimates not being as interpretable when using count variables estimated by zero-inflated binomial regression. Following this, the CFA model was then used in the LCA model, following guidance from the developers (Muthén and Muthén 2017); see Figure 10 for the CFA model. Alongside the latent variable, the mother's report of the partners frequency of consuming >4 units a month, and a binary variable of mother's drug use was used.

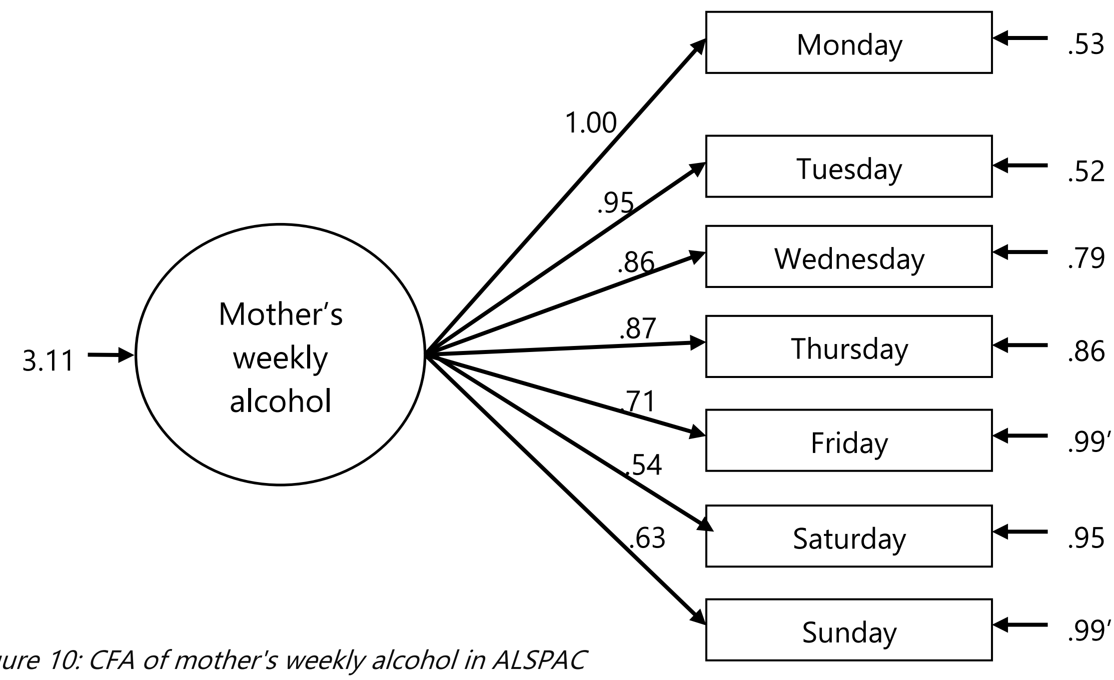

Figure 10: CFA of mother's weekly alcohol in ALSPAC

	Valid N (%)	Missing (%)	Mean	Median	SD	Variance	Skewness/ Kurtosis
Monday	9557	38.1%	0.43	0.00	1.15	1.33	6.34/76.78
Tuesday	9557	38.1%	0.44	0.00	1.07	1.14	4.15/33.35
Wednesday	9556	38.1%	0.50	0.00	1.18	1.40	4.56/42.76
Thursday	9557	38.1%	0.51	0.00	1.19	1.41	4.24/37.81
Friday	9557	38.1%	0.88	0.00	1.63	2.64	2.86/16.05
Saturday	9556	38.1%	1.29	0.00	2.06	4.23	3.58/34.69
Sunday	9557	38.1%	0.74	0.00	1.48	2.18	5.21/76.87

Table 12: Mother's daily alcohol use variables in ALSPAC

The mother's weekly diary of alcohol shows a range of units per day, and variables show a shift in units over the week, with Monday being the lowest average day of units and Saturday being the highest (see Table 12). In addition, the skew and kurtosis of these variables are quite substantial, so a maximum likelihood robust estimator was used to adjust for this. For partner's binge drinking, most of the participants had '5 - 10 days' a month drinking more than 4 units or above; see Table 13. For mother's drug use, a large majority of the participants had not used any of the illicit drugs asked about in the survey - cannabis, opioids, cocaine, amphetamine, and tranquilisers; see Table 13.

Frequency of partner consuming >4 units in a drinking episode over a month	N – Valid cases (%)	Missing (%)
None	1346 (16.6%)	47.5%
1-2 days	1466 (18.1%)	
3-4 days	1632 (20.1%)	
5-10 days	1985 (24.5%)	
>10 days	1224 (15.1%)	
Everyday	457 (5.6%)	
Mothers drug use		
No	9004 (94.6%)	38.3%
Yes	519 (5.5%)	

Table 13: Partner's alcohol use and mother's drug use in ALSPAC

4.7.2 Results

The LCA was performed with three variables: the latent variable of mother's weekly alcohol use, partner's frequency of >4 units, and mother's drug use. The first LCA estimated 2 classes, and this continued until the statistical criteria was no longer improving, or the models could no longer converge. The statistical criteria that were used are the AIC and BIC, where the lower the value equals improved fit. Likewise, classification accuracy was used, which is a value between 0.00 and 1.00, and closer to one represents better accuracy of the model fitting the data for each class; above 0.80 is recommended. Entropy is similar, where scores are between 0.00 and 1.00, with values closer to 1.00 representing better fit; scores above 0.70 are recommended. The Likelihood Ratio tests of the LMR LRT, VLMR LRT, and the Bootstrap LRT are shown. If these tests are significant (p<0.05), they represent that the number of classes do not fit better than one less (k-1). As mentioned, the LCA was judged on an array of statistics balancing mathematical requirements and theory (Melendez-Torres et al. 2018). The model that was decided on was the 4-class solution as it showed the best model fit statistics overall. Table 14 shows the statistical solutions for each class for 9,559 observations.

	2-class	**3-class**	**4-class**	**5-class**
AIC	164704.97	161985.65	161304.85	161243.84
BIC	164948.59	162286.59	161663.11	161659.42
Adjusted BIC	164840.54	162153.12	161504.22	161475.11
Proportions	52% (n=4934)	21% (n=2011)	38% (n=3623)	27% (n=2582)
	48% (n=4625)	29% (n=2758)	27% (n=2623)	32% (n=3106)
		50% (n=4791)	5% (n=426)	11% (n=1096)
			30% (n=2886)	2% (n=184)
				27% (n=2591)
Entropy	0.78	0.77	0.74	0.68
Probability of most likely latent class membership	94%	88%	86%	71%
	93%	92%	89%	80%
		91%	85%	72%
			84%	82%
				88%
VLMR LRT	p<0.05	p<0.05	p<0.05	p=0.30

LMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.30$
Bootstrap LRT	$p<0.05$	-	-	-

Table 14: Latent class analysis statistical criteria for ALSPAC total sample

The 4-class solution was chosen as although the 5-class solution showed the lowest AIC, BIC, and adjusted BIC the difference from the 4-class solution was minimal. The entropy was high in the 4-class solution (0.74) and was not a considerable change from the others (0.78 - 0.77) unlike the 5-class solution (0.68). In addition, the 4-class solution showed good probability of being in the latent class group, with all groups being above 80% as recommended by Geiser (2013). The LRT ratio tests also suggested that the 4-class solution was the best (where $p<0.05$ means k-1 is a significantly worse fit), with the 5-class solution LRT tests being non-significant. Note that the bootstrap LRT was not completed for the 3rd, 4th, and 5th solution due to computational demand despite using the OPTSEED and LRTSTARTS function Mplus offer (Asparouhov and Muthén 2012); the other LRT tests were checked and showed similarity which confirmed robust results. Therefore the 4-class solution was selected.

The four distinct classes were identified of 'very low users' (27%), 'low users' (38%), 'moderate users' (40%), and 'heavy users' (5%). For mothers' alcohol use, all mothers used less alcohol on weekdays (Monday – Thursday) compared to the weekends, apart from the very low users, who were abstainers (blue line on Figure 12). The main distinction between the moderate class (pink line on Figure 12) and low class (red line in Figure 12) is that the moderate class uses alcohol in the week, alongside drinking more on the weekend. The low class had near no consumption of alcohol in the week, but consumed alcohol on the weekend, particularly Saturday. The heavy class consumed at least three units or glasses a day of alcohol on average, with this peaking to almost four (3.80) on Saturday. These are shown in Table 15 and graphed in Figure 11.

	Very low users	Low users	Moderate users	Heavy users
Monday	0.00	0.11	0.82	3.15
Tuesday	0.00	0.12	0.88	3.00
Wednesday	0.00	0.19	1.00	2.92
Thursday	0.00	0.19	1.02	2.89
Friday	0.00	0.66	1.59	3.44
Saturday	0.00	1.30	2.08	3.80
Sunday	0.00	0.59	1.28	2.91

Table 15: Means of mother's alcohol use by latent classes

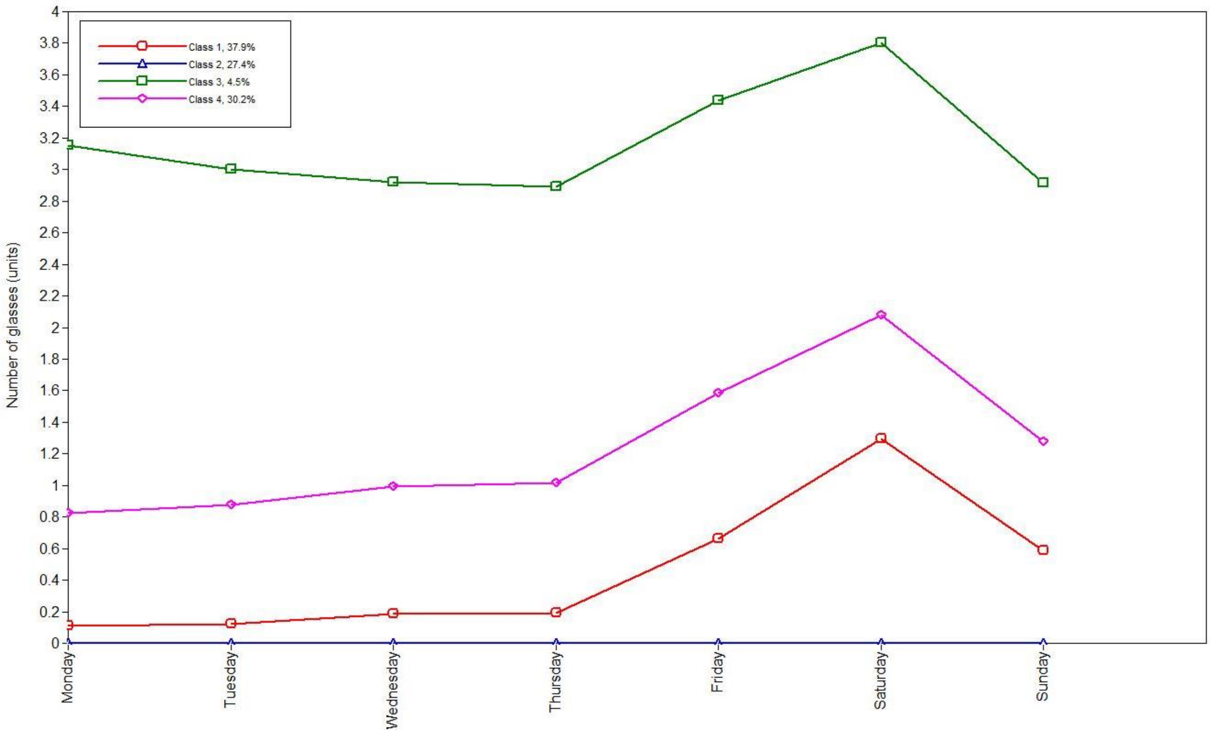

Figure 11: Graph of mother's alcohol use by the latent classes of heavy (green), moderate (pink), low (red), and very low (blue, on x-axis as fixed to 0.00)

The partner's alcohol use pattern is somewhat similar (see Table 16 and Figure 13). However, there was less abstaining from alcohol in partners, who were mostly men, compared to mothers. There are differences however, in the measurement of alcohol as the partner's use is the frequency of>4 units over a month. The proportion of abstaining for the very low users class was the highest among the classes (the blue line in Figure 13), with 30% of this class being in the 'None' category, compared to 16% of the low user's class, 7% of the moderate, and 6% for the heavy class. The most common use in the low class was '3 – 4 days' (25%) and

'5 – 10 days' (25%) (the red line in Figure 13); this was '5 – 10 days' and '> 10 days' in the moderate class (the pink line in Figure 13). Notably, the heavy users class (green line in Figure 13) were the most likely to use >4 units 'Every day' (32%), whereas the other classes had a low proportion of this (4%, 3% and 6% respectively). There is a clear patterning as classes shift to heavier use a greater proportion of partner's use consume >4 units more often over a month; see Table 16 and Figure 12 for more detail.

		Very low users	**Low users**	**Moderate users**	**Heavy users**
Frequency of partner consuming >4 units in a drinking episode over a month	None	31%	16%	7%	6%
	1 - 2 days	23%	21%	12%	2%
	3 - 4 days	17%	25%	18%	10%
	5 - 10 days	15%	25%	37%	12%
	> 10 days	9%	10%	23%	33%
	Everyday	4%	3%	6%	37%
Mothers drug use	Yes	4%	3%	8%	19%
	No	96%	97%	92%	81%

Table 16: Partners frequency of >4 units a month, and mothers drug use proportions by latent classes

For the mother's drug use, the heavy class had the highest proportion of mothers who used drugs (19%). This was followed by the moderate class (8%), very low class (4%), and low class (3%); this is shown in Table 16. Overall, the latent class shows a potential mirroring, or projection (given the mother answered for their partner), particularly for the heavy users class, along with some evidence for poly-use. Mothers who use alcohol at the highest levels often reported that their partners are more likely to consume >4 units for '>10 days' a month. Similarly, mothers who abstain from alcohol are more likely to report that their partners do not consume >4 units a month or have lower consumption. Therefore, the latent class analysis shows that familial substance use clusters together, whereby mothers and their partner's drinking tend to happen concurrently, with greater likelihood for poly-use.

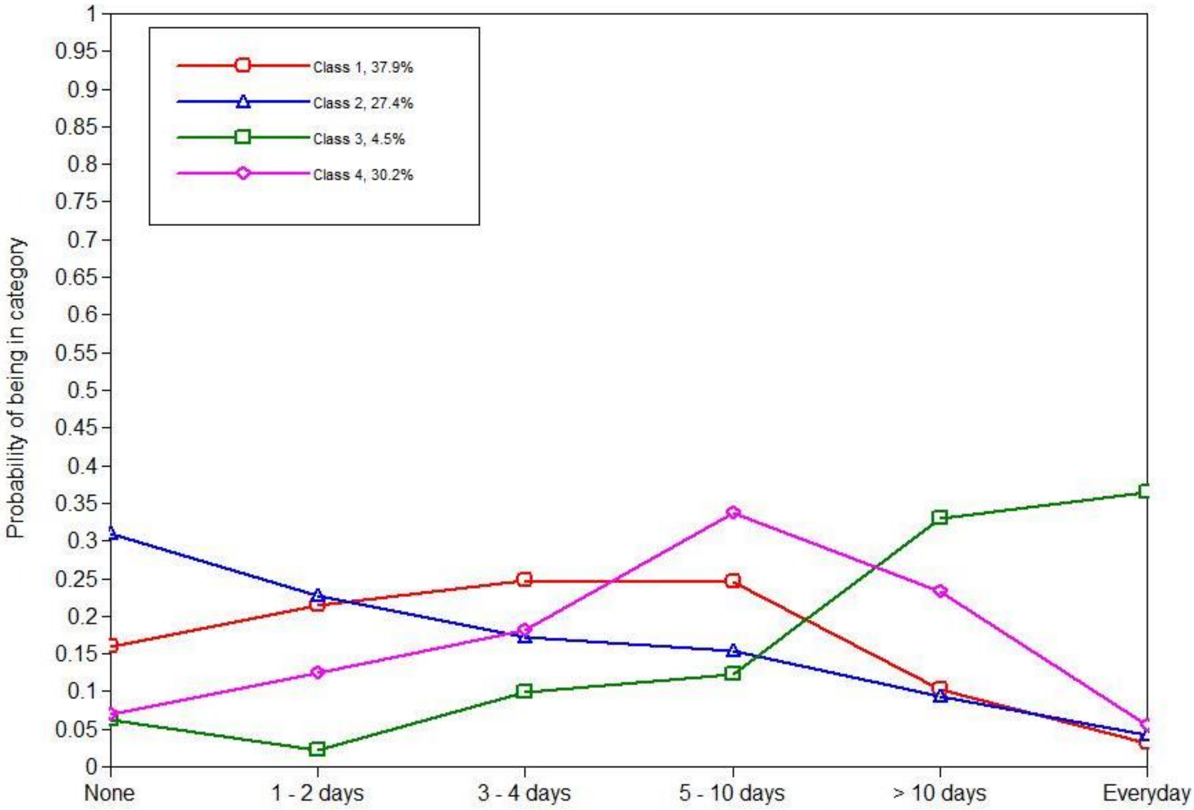

Figure 12: Graph of proportions of each class in each category for partner's alcohol use by the latent classes of heavy (green), moderate (pink), low (red), and very low (blue)

Following this, the predicted probabilities (0.00 – 1.00) of being in each class of the 4-class solution will be used as the predictor of substance use for regression (research questions one and two) and SEM mediation models (research question three).

4.8 *What is the relationship between parental substance use and children's educational attainment?*

The regressions were conducted with the latent class predicted probabilities shown and are the measures of substance use. For instance, the predicted probability of being in the heavy users class will range from 0.00 to 1.00. In the first instance, a regression model was tested to explore if the predicted probabilities of each class could be used in one model as predictors, but this could not converge due to multi-collinearity. Following this, the predicted probability of each class (very low, low, moderate, and heavy) was separately conducted to predict KS1, 2 and 4 outcomes. The dependent variables were estimated together, adjusting for correlations between them. This was conducted using FIML, and the maximum likelihood robust estimator.

Table 17 shows the unadjusted associations to KS1, KS2 and KS4 (KS3 is in Appendix D) for a total of 8,034 observations. The bold estimates are statistically significant, and the Confidence Intervals (CI) represent the upper and lower 2.5%. As the outcomes are binary, Odds Ratios (OR) have been used. The model shows that being in the very low class reduces KS1, 2 and 4 outcomes (OR 0.58, 0.55, 0.57, $p<0.05$). The low class predicted KS1-4 outcomes whereby there is an increase in attainment (OR 1.35, 1.21, 1.29, $p<0.05$). Likewise, being in the moderate group was associated with an increase in KS1 - 4 outcomes (OR 1.50, 1.70, 1.56, $p<0.05$). However, the heavy class did not significantly predict KS1- 4 outcomes (OR 1.25 $p=0.38$, OR 1.63 $p=0.06$, OR 1.21 $p=0.26$).

	KS1		**KS2**		**KS4**	
	n = 8034		n = 8034		n = 8034	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Very Low	**0.58**	0.50 - 0.68	**0.55**	0.48 - 0.63	**0.57**	0.51 - 0.64
Low	**1.35**	1.07 - 1.60	**1.21**	1.04 - 1.41	**1.29**	1.14 - 1.46
Moderate	**1.50**	1.24 - 1.82	**1.70**	1.44 - 2.00	**1.56**	1.36 - 1.78
Heavy	1.25	0.80 - 1.94	1.63	0.95 - 2.46	1.21	0.90 - 1.64

Table 17: Binary logistic regression of the direct effects of the predicted probability of being in a class on KS1-4 outcomes in ALSPAC

4.9 *What is the relationship between parental substance use and children's educational attainment once environmental and demographic factors are adjusted for?*

The models presented are conducted separately by each class in this chapter, with the adjustment of confounders. The confounders include prenatal use, mother's demographics, and wellbeing, and child demographics.

4.9.1 *Very low users class predicting attainment, adjusted for confounders*

The probability of being in the very low class decreased the chances of achieving KS1-4 outcomes (OR 0.78, 0.77, 0.84, $p<0.05$); see Table 18. In addition, increased prenatal smoking was related to a decrease in KS1 and 4 outcomes (OR 0.90, 0.91, $p<0.05$); but this was not observed at KS2 (OR 0.95, $p=0.12$). Mother's age was statistically significant for KS2 and 4 (OR 1.03, 1.03, $p<0.05$); however, this was not observed for KS1 (OR 1.01, $p=0.23$). Females had a higher chance of meeting the expected level at every key stage outcome (OR 2.22, 1.39, 1.56 $p<0.05$). Income and qualifications were statistically significant, where higher income (OR 1.30, 1.26, 1.25, $p<0.05$) and qualifications (OR 1.40, 1.49, 1.47, $p<0.05$) increased the probability for meeting KS1-4 outcomes. Mothers wellbeing was statistically significant for KS1 (OR 1.03, $p<0.05$), meaning an increase in wellbeing resulted in higher attainment.

	KS1		**KS2**		**KS4**	
	n = 5670		n = 5670		n = 5670	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Very low class	**0.78**	0.64 - 0.97	**0.77**	0.64 - 0.92	**0.84**	0.72 - 0.97
Prenatal smoking	**0.90**	0.84 - 0.96	0.95	0.89 - 1.01	**0.91**	0.86 - 0.96
Prenatal alcohol use	1.07	0.94 - 1.21	1.07	0.96 - 1.19	1.01	0.93 - 1.10
Prenatal drug use	0.64	0.36 - 1.14	1.04	0.54 - 2.02	1.07	0.67 - 1.70
Mothers age at delivery	1.01	0.99 - 1.03	**1.03**	1.01 - 1.04	**1.03**	1.02 - 1.05
Child sex	**2.22**	1.86 - 2.66	**1.39**	1.20 - 1.61	**1.56**	1.38 - 1.76
Child ethnicity	0.71	0.46 - 1.12	0.79	0.53 - 1.18	0.83	0.57 - 1.20
Family income	**1.30**	1.20 - 1.42	**1.26**	1.17 - 1.34	**1.25**	1.18 - 1.32
Mother's qualification	**1.40**	1.23 - 1.50	**1.49**	1.41 - 1.59	**1.47**	1.39 - 1.56
Mother's wellbeing	**1.03**	1.01 - 1.05	1.01	0.99 - 1.03	1.01	1.00 - 1.03

Table 18: Binary logistic regression of KS1-4 outcomes with the very low class predicted probability class - adjusted for confounders

4.9.2 Low users class predicting attainment, adjusted for confounders

The probability of being in the low class has no association with achieving KS1 - 4 outcomes (OR 1.16, p=0.24, OR 1.01, p=0.90, and OR 1.13, p=0.15) (Table 19). However, increased prenatal smoking was related to a decrease in KS1 and 4 outcomes (OR 0.90, 0.91, p<0.05); but this was not observed at KS2 (OR 0.95, p=0.09), but the estimate was in the same direction and p<0.10. Mother's age was statistically significant for KS2 and 4 (OR 1.03, 1.04, p<0.05); this was in the same direction for KS1 (OR 1.01, p=0.21). Females had a higher chance of attaining each key stage outcome (OR 2.23, 1.40, 1.56, p<0.05). Income and qualifications were statistically significant, where higher income (OR 1.31, 1.26, 1.25, p<0.05) and qualifications (OR 1.41, 1.51, 1.48, p<0.05) increased the probability of reaching the expected level for KS1-4. Mothers wellbeing was statistically significant for KS1 (OR 1.03, p<0.05) only, but KS2 and KS4 were in the same direction; see Table 19.

	KS1		**KS2**		**KS4**	
	n = 5670		n = 5670		n = 5670	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Low class	1.16	0.92 - 1.47	1.01	0.84 - 1.23	1.13	0.97 - 1.33
Prenatal smoking	**0.90**	0.84 - 0.96	0.95	0.89 - 1.01	**0.91**	0.86 - 0.96
Prenatal alcohol use	1.11	0.98 - 1.25	1.04	1.00 - 1.22	1.04	0.95 - 1.13
Prenatal drug use	0.66	0.37 - 1.17	1.06	0.55 - 2.05	1.09	0.68 - 1.74
Mothers age at delivery	1.01	0.99 - 1.04	**1.03**	1.00 - 1.04	**1.04**	1.02 - 1.05
Child sex	**2.23**	1.86 - 2.67	**1.40**	1.21 - 1.61	**1.56**	1.38 - 1.76
Child ethnicity	0.70	0.44 - 1.11	0.77	0.52 - 1.16	0.82	0.59 - 1.19
Family income	**1.31**	1.20 - 1.42	**1.26**	1.18 - 1.35	**1.25**	1.18 - 1.33
Mother's qualification	**1.41**	1.31 - 1.51	**1.51**	1.42 - 1.60	**1.48**	1.40 - 1.56
Mother's wellbeing	**1.03**	1.01 - 1.05	1.01	0.99 - 1.03	1.01	1.00 - 1.03

Table 19: Binary logistic regression of KS1-4 outcomes with the low class predicted probability class - adjusted for confounders

4.9.3 Moderate users class predicting attainment, adjusted for confounders

The probability of being in the moderate class had a significant association with the chances of achieving the expected level for KS2 (OR 1.28, p<0.05); associations with KS1 (OR 1.12, p=0.43) and KS4 (OR 1.08, p=0.42) were in the same direction. Increased prenatal smoking was related to a decrease in KS1 and 4 outcomes (OR 0.89, 0.91, p <0.05); KS2 (OR 0.95, p=0.09) was in the same direction, but not significant. Moreover, prenatal drug use had a negative association with KS1 outcomes (OR 0.65, $p<0.05$). Mother's age was statistically significant for KS2, and 4 (OR 1.03, 1.03, $p<0.05$); KS1 (OR 1.01, $p=0.21$) showed the same direction but was not statistically significant. Females had a higher chance of meeting the expected level at every key stage outcome (OR 2.23, 1.39, 1.56, $p<0.05$). There were no statistically significant differences between white and ethnic minority children. Income and qualifications were statistically significant, where higher income (OR 1.31, 1.26, 1.25, $p<0.05$) and qualifications (OR 1.40, 1.50, 1.48, $p<0.05$) increased the probability of being at the expected level for KS1-4. Mothers wellbeing was statistically significant for KS1 only (OR 1.03, $p<0.05$), KS2 and KS4 were in the same direction but not statistically significant; see Table 20.

	KS1		**KS2**		**KS4**	
	n = 5670		n = 5670		n = 5670	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Moderate class	1.12	0.86 - 1.45	**1.28**	1.03 - 1.60	1.08	0.90 - 1.29
Prenatal smoking	**0.89**	0.84 - 0.95	0.95	0.89 - 1.01	**0.91**	0.86 - 0.96
Prenatal alcohol use	1.09	0.96 - 1.24	1.07	0.96 - 1.20	1.03	0.94 - 1.12
Prenatal drug use	**0.65**	0.36 - 1.15	1.05	0.55 - 2.03	1.07	0.67 - 1.72
Mothers age at delivery	1.01	0.99 - 1.04	**1.03**	1.01 - 1.04	**1.04**	1.02 - 1.05
Child sex	**2.23**	1.86 - 2.67	**1.39**	1.20 - 1.61	**1.56**	1.38 - 1.76
Child ethnicity	0.69	0.44 - 1.09	0.78	0.52 - 1.16	0.82	0.57 - 1.19
Family income	**1.31**	1.20 - 1.42	**1.26**	1.18 - 1.35	**1.25**	1.18 - 1.32
Mother's qualification	**1.40**	1.31 - 1.51	**1.50**	1.41 - 1.59	**1.48**	1.40 - 1.56
Mother's wellbeing	**1.03**	1.01 - 1.05	1.01	0.99 - 1.03	1.01	1.00 - 1.03

Table 20: Binary logistic regression of KS1-4 outcomes with the moderate class predicted probability class - adjusted for confounders

4.9.4 Heavy users class predicting attainment, adjusted for confounders

The heavy class did not predict KS1-4 outcomes significantly (OR 1.39, $p=0.38$, OR 1.83, $p=0.10$, OR 1.04, $p=0.86$). While KS2 had 95% CI's that intersected the null, the p value was not statistically significant. Increased prenatal smoking was related to a decrease in KS1 and 4 outcomes (OR 0.89, 0.91, $p<0.05$); this was near significant for KS2 (OR 0.95, $p=0.08$), and in the same direction. Mother's age was statistically significant for KS2, and 4 (OR 1.03, 1.04, 1.04, *p*<0.05); however, not for KS1 (OR 1.01, *p*=0.21) but in the same direction. Females had a higher chance of KS1-4 (OR 1.31, 1.26, 1.25, *p*<0.05). The ethnicity of the child was also statistically significantly associated with KS1 scores (OR 0.68, *p*<0.05), and in the same direction for KS2 and KS4 but not statistically significant. Income and qualifications were statistically significant, where higher income (OR 1.31, 1.26, 1.25, *p*<0.05) and qualifications (OR 1.41, 1.51, 1.48, *p*<0.05) increased the probability of being at the expected level for KS1-4. Mothers wellbeing was statistically significant for KS1 (OR 1.03, *p*<0.05), but not for KS2 or KS4 despite being in the same direction; see Table 21.

	KS1		**KS2**		**KS4**	
	n = 5670		n = 5670		n = 5670	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Heavy class	1.39	0.75 – 2.56	1.83	1.06 – 3.14	1.04	0.69 – 1.56
Prenatal smoking	**0.89**	0.84 – 0.95	0.95	0.89 – 1.01	**0.91**	0.86 - 0.96
Prenatal alcohol use	1.09	0.96 - 1.24	1.08	0.98 - 1.20	1.03	0.95 - 1.13
Prenatal drug use	0.64	0.36 - 1.14	1.00	0.52 - 1.96	1.07	0.67 - 1.72
Mothers age at delivery	1.01	0.99 - 1.04	**1.03**	1.01 - 1.04	**1.04**	1.02 - 1.05
Child sex	**2.23**	1.86 - 2.67	**1.40**	1.21 - 1.61	**1.56**	1.38 - 1.76
Child ethnicity	**0.68**	0.42 - 1.08	0.77	0.51 - 1.15	0.82	0.56 - 1.18
Family income	**1.31**	1.21 - 1.42	**1.26**	1.18 - 1.35	**1.25**	1.18 - 1.33
Mother's qualification	**1.41**	1.31 - 1.52	**1.51**	1.42 - 1.61	**1.48**	1.40 - 1.56
Mother's wellbeing	**1.03**	1.01 - 1.06	1.01	0.99 - 1.03	1.01	1.00 - 1.03

Table 21: Binary logistic regression of KS1-4 outcomes with the heavy class predicted probability indicators - adjusted for confounders

4.9.4.1 Heavy users class predicting attainment, adjusted for parenting and confounders

To conduct the SEM mediation analysis, the parenting and demographic variables have been explored in a regression model. First, the parenting variables were used in an unadjusted model without the exposure, and then the model was adjusted for with demographic variables and the predicted probability of being in the heavy users class.

	KS1		KS2		KS4	
	n=7002		n=7002		n=7002	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Interparental conflict	1.09	0.89 – 1.35	1.01	0.84 – 1.21	1.02	0.86 – 1.18
Mother-child interaction	1.21	1.01 – 1.46	1.19	1.01 – 1.39	1.11	0.96 – 1.28
Lack of school interest	**0.54**	0.41 – 0.70	**0.64**	0.50 – 0.81	**0.64**	0.52 – 0.79
Emotion or Physical cruelty	0.80	0.56 – 1.16	0.88	0.64 – 1.21	0.92	0.70 – 1.21
Breakfast	**1.27**	1.13 – 1.44	**1.32**	1.19 – 1.47	**1.27**	1.15 – 1.41
Sleep routine	**1.58**	1.37 – 1.83	**1.32**	1.15 – 1.52	**1.48**	1.30 - 1.67

Table 22: Binary logistic regression of KS1-4 outcomes with the parenting variables as predictors

For the parenting and family environment model, interparental conflict, mother-child interaction and emotional and physical cruelty were not statistically significant. However, the mother-child interaction was in the expected direction for KS1 and KS2 which intersected the null, which suggests it is a key predictor of attainment. Mother's school interest (OR 0.54 – 0.64), breakfast (OR 1.27, 1.32, and 1.27) and sleep routine (OR 1.58, 1.32 and 1.48) were statistically significant. Note, that an increase in mother's school interest variable represents a decreased interest in the child's schooling; see Table 22.

	KS1		KS2		KS4	
	n=5189		n=5189		n=5189	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Heavy class	1.67	0.74 – 3.74	1.51	0.81 – 2.83	0.99	0.62 – 1.60
Prenatal smoking	**0.91**	0.84 – 0.99	0.95	0.88 – 1.02	**0.89**	0.84 – 0.95
Prenatal alcohol use	1.12	0.97 – 1.30	1.12	0.99 – 1.27	1.06	0.96 – 1.17
Prenatal drug use	0.88	0.40 – 1.93	0.94	0.41 – 2.12	1.10	0.60 – 2.02
Mothers age at delivery	1.01	0.98 – 1.03	**1.03**	1.01 – 1.05	**1.03**	1.02 -1.05
Child sex	**2.13**	1.72 – 2.64	**1.37**	1.16 – 1.63	**1.52**	1.32 – 1.75
Child ethnicity	**0.60**	0.35 – 1.03	0.85	0.53 – 1.38	0.88	0.57 – 1.35
Family income	**1.24**	1.13 – 1.37	**1.17**	1.08 – 1.27	**1.22**	1.14 – 1.30
Mother's qualification	**1.36**	1.24 – 1.49	**1.49**	1.39 – 1.61	**1.44**	1.35 – 1.54
Mother's wellbeing	1.03	1.00 – 1.06	1.00	0.97 – 1.02	1.00	0.98 – 1.03

Interparental conflict	1.13	0.86 – 1.48	1.02	0.90 – 1.51	0.99	0.82 – 1.29
Mother-child interaction	1.17	0.90 – 1.51	1.02	0.80 – 1.51	1.01	0.84 – 1.23
Lack of school interest	**0.62**	0.44 – 0.88	**0.65**	0.48 – 0.88	**0.70**	0.54 – 0.91
Emotional/physical cruelty	0.68	0.43 – 1.08	0.71	0.49 – 1.04	0.74	0.53 – 1.03
Breakfast	1.12	0.95 – 1.33	**1.20**	1.05 – 1.38	**1.19**	1.04 – 1.35
Sleep routine	**1.48**	1.23 – 1.79	1.20	1.00 – 1.45	**1.30**	1.10 – 1.52

Table 23: Binary logistic regression of KS1-4 outcomes adjusted for the probability of being in the heavy class, parenting variables, and sociodemographic variables

Table 23 shows the adjusted model with demographics and parental substance use exposure. Prenatal smoking had a negative association with KS1 and KS4 attainment (OR 0.91 and 0.89, p<0.05), KS2 was in the same direction, but not statistically significant. Females were more likely to attain KS1, KS2 and KS4 (OR 2.13, 1.37, 1.52, p<0.05) whereas ethnic minorities in KS1 were less likely (0.60, p<0.05). Mother's age had a positive relationship with attainment at KS2 and 4 (OR 1.03, p<0.05), as did income (OR 1.24, 1.17, 1.22 p<0.05) and qualifications (1.36, 1.49, 1.44, p<0.05) for all outcomes. Once adjusted, parenting, and family environment model, interparental conflict, mother-child interaction and emotional and physical cruelty were not statistically significant. The variables mother's school interest (OR 0.62, 0.65, 0.70, p<0.05), breakfast (OR 1.20, 1.19, p<0.05) and sleep routine (OR 1.48, 1.30, p<0.05) had a statistically significant association with educational attainment. In short, when adjusted the same variables remained statistically significant, but the effect size reduced.

The next section compromises of the SEM mediation models for KS1, KS2 and KS4.

4.10 Do parenting and the family environment mediate the relationship between parental substance use and children's educational attainment?

The models in this section include the SEM mediation models. As the relationship with the heavy class and educational attainment was non-significant, these models will test for indirect effects. This means that these models can identify if an increase in the predicted probability of being in the heavy users class is associated with parenting and family environment variables, and whether these variables are in turn associated with attainment.

While the analytical approach aimed to use FIML for missing data, this posed numerous errors in models as they did not converge and the indirect effect could not be calculated (Muthén and Muthén 2017). As a result, the models were conducted using Weighted Least Squares Means and Variance (WLSMV) estimators, which are recommended for dependent variables which are binary (Muthén and Muthén 2017). Despite that FIML was not used, WLSMV uses a pairwise approach to missing data. When compared, the number of observations across maximum likelihood and WLSMV did not differ so missing data bias was unlikely to be a problem. Some variables required collapsing for analysis as Mplus models would not converge; this included child sleep routine and mothers school interest. The collapsing aimed to not change the meanings of the variables substantially. The limitations of this are acknowledged but was required for model computation.

Each SEM mediation model fit was judged before interpretation. For adequate model fit, the χ^2 should not be significant, but it can be due to the large sample size; the RMSEA and SRMR must be <0.08 and CFI, TLI >0.90. For good fit, the RMSEA must be <0.05 and CFI, TLI >0.95 – the same as the EFA and CFA. The circular variables represent latent variables, and rectangular variables represent manifest, or single, variables. The curved arrows represent correlation. The direct effect is the association between the predicted probability of the heavy class on KS1 – 4, the indirect effect is the mediator associations. As OR was not available, the coefficients are probit estimates. The next sections are KS1 – 4 models, with KS3 in Appendix E.

4.10.1 KS1 outcomes

The model had good fit (n=9,414, χ^2 = 2036.60, df = 159, p<0.05, RMSEA = 0.04, CFI = 0.96, TLI = 0.95, SRMR = <0.08). This fit improved as correlations were added for mothers help with homework and mother-child interaction (R^2 = 0.53), and mothers help with homework and partners help with homework were correlated (R^2 = 0.41).

The mediation model (Figure 13) shows the predicted probability of being in the heavy class increased KS1 outcomes (0.28, p<0.05). However, there was a negative indirect effect. The heavy class increased the chances of the mother being less interested in the child's schooling (0.56, p<0.05). This was then followed by a decrease in KS1 outcomes (-0.18, p<0.05), this path was a statistically significant negative indirect effect (β=-0.10, p<0.05). The heavy class was negatively associated with mother's homework help (-0.26, p<0.05), which was also negatively associated with KS1 outcomes (-0.15, p<0.05); it had a positive indirect effect (β=0.04, p<0.05). Likewise, the heavy class had a negative association with the partners homework help, however this variable increased KS1 outcomes; this had a negative indirect effect (β=-0.02, p<0.05).

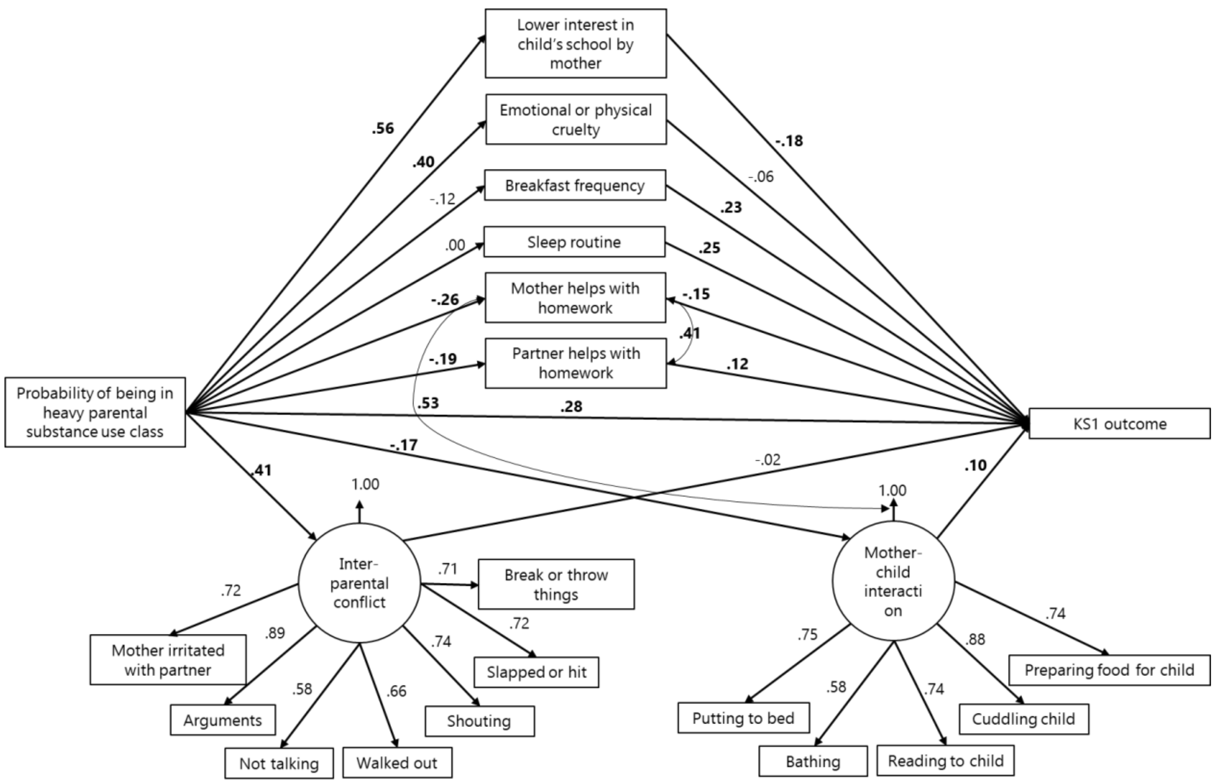

Figure 13: SEM mediation model for the heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

The other relationships were in the expected directions but were not statistically significant indirect effects. For instance, the increased probability of being in the heavy class increased the chances of parental emotional and physical cruelty (0.40, p<0.05). Moreover, it decreased the frequency of breakfast (-0.12, p=0.34), mother-child interactions (-0.17, p<0.05) and increased interparental conflict (0.41, p<0.05); no association was found for sleep routine (0.00, p=0.97). The mediator variables were in expected directions for their association with KS1 outcomes. The presence of cruelty decreased KS1 outcomes (-0.06, p=0.16), and the presence of interparental conflict decreased outcomes (-0.02, p=0.42). Whereas sleep routine (0.25, p<0.05), breakfast (0.23, p<0.05) and mother-child interaction (0.10, p<0.05) all increased the chances of KS1 outcomes. Note, mother-child interactions were not a statistically significant indirect effect but did suggest a small negative indirect effect (β=-0.02, p=0.08). In terms of total effects, the total effect was β=0.12 (p=0.29), whereas the total indirect effect was β=-0.16 (p<0.05), showing a negative indirect via parenting and the family environment.

4.10.2 KS2 outcomes

The model had good fit (n=9,431, χ^2 = 2028.60, df = 159, p<0.05, RMSEA = 0.04, CFI = 0.96, TLI = 0.95, SRMR = <0.08). This fit improved as correlations were added for mothers help with homework and mother-child interaction (R^2 = 0.53), and mothers help with homework and partners help with homework were correlated (R^2 = 0.41).

The mediation model (Figure 14) shows the predicted probability of being in the heavy class increased KS2 outcomes (0.40, p<0.05). However, the model does suggest an indirect effect. Firstly, the heavy class increased the chances of the mother being less interested in the child's schooling (0.56, p<0.05). This was then followed by a decrease in KS2 outcomes (-0.15, p<0.05). This effect was a statistically significant indirect effect (β=-0.08, p<0.05). Similarly, the heavy class was negatively associated with the mother's homework help (-0.26, p<0.05), this variable also decreased KS2 outcomes (-0.13, p<0.05); this variable had a positive indirect effect (β=0.04, p<0.05). Likewise, the heavy class was negatively associated with the partner's homework help (-0.20, p<0.05), this variable increased KS2 outcomes (0.09, p<0.05); this variable had a negative indirect effect (β=-0.02, p<0.05).

Other variables showed relationships that were in the theorised directions. For instance, the increased probability of being in the heavy class increased the chances of parental emotional and physical cruelty (0.40, $p<0.05$). Moreover, it decreased the frequency of breakfast (-0.12, $p=0.35$), mother-child interactions (-0.17, $p<0.05$) and increased interparental conflict (0.41, $p<0.05$); no effect was found for sleep routine (0.00, $p=0.99$). In addition, the mediator variables were in expected directions for their impact on KS2 outcomes. The presence of cruelty decreased KS2 outcomes (-0.02, $p=0.55$), as did interparental conflict (-0.03, $p=0.24$). Whereas sleep routine (0.19, $p<0.05$), breakfast (0.20, $p<0.05$) and mother-child interaction (0.12, $p<0.05$) all increased the chances of KS2 outcomes. Note, that the model did not suggest that the mother-child interaction was a significant indirect effect (β=-0.02, $p=0.06$), but both paths to and from the independent and dependent variable were significant ($p<0.05$). In terms of total effects, the total effect was β=0.27 ($p<0.05$), whereas the total indirect effect was β=-0.13 ($p<0.05$), showing an indirect pathway via parenting and the family environment.

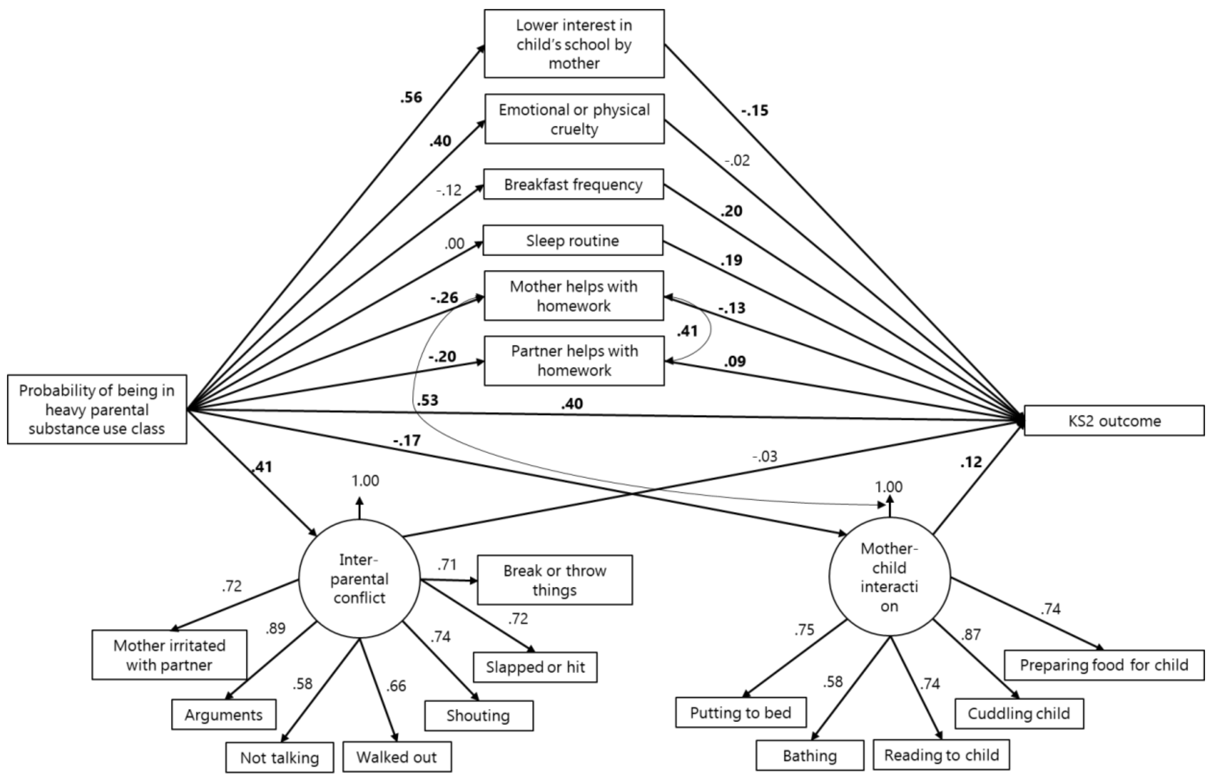

Figure 14: SEM mediation model for the heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

4.10.3 KS4

The model had good fit (n=9,431, χ^2 = 2044.80, df = 159, $p<0.05$, RMSEA = 0.04, CFI = 0.96, TLI = 0.95, SRMR = <0.08). This fit improved as correlations were added for mothers help with homework and mother-child interaction (R^2 = 0.53), and mothers help with homework and partners help with homework were correlated (R^2 = 0.41); see Figure 15.

The mediation model shows a statistically significant positive increase in KS4 outcomes when the probability of being in the heavy class increased (0.24, $p<0.05$). However, the model does suggest an indirect effect. Firstly, the heavy class increased the chances of the mother being less interested in the child's schooling (0.56, $p<0.05$). This was then followed by a decrease in KS4 outcomes (-0.13, $p<0.05$). This effect was a significant negative indirect effect, and it was statistically significant (β=-0.07, $p<0.05$). Similarly, the heavy class was negatively associated with the mother's homework help (-0.26, $p<0.05$) and this variable also decreased KS4 outcomes (-0.08, $p<0.05$); this variable had a positive indirect effect (β=0.02, $p<0.05$). Likewise, the heavy class also reduced the partner's homework help (-0.20, $p<0.05$), however unlike mother's help, this variable increased KS4 outcomes (0.08, $p<0.05$); this variable had a negative indirect effect (β=-0.02, $p<0.05$).

However, the other variables showed relationships that were in the theorised directions. For instance, the heavy class increased the chances of parental emotional and physical cruelty (0.40, $p<0.05$). Moreover, it decreased the frequency of breakfast (-0.12, p=0.35), mother-child interactions (-0.17, $p<0.05$) and increased interparental conflict (0.41, $p<0.05$); no effect was found for sleep routine (0.00, p=0.98). In addition, the mediator variables were in expected directions for their association with KS4 outcomes. The presence of cruelty decreased KS4 outcomes (-0.02, p=0.55), and the presence of interparental conflict decreased outcomes (-0.03, p=0.12). Whereas sleep routine (0.25, $p<0.05$), breakfast (0.20, $p<0.05$) and mother-child interaction (0.06, $p<0.05$) all increased the chances of KS4 outcomes. Note, that the model did not suggest mother-child interaction was a significant indirect effect (β=-0.01, p=0.13), but both paths to and from the independent and dependent variable were significant ($p<0.05$). The total effect was β=0.12 (p=0.20), whereas the total indirect effect was β=-0.12 ($p<0.05$), suggesting a negative indirect path via parenting and the family environment.

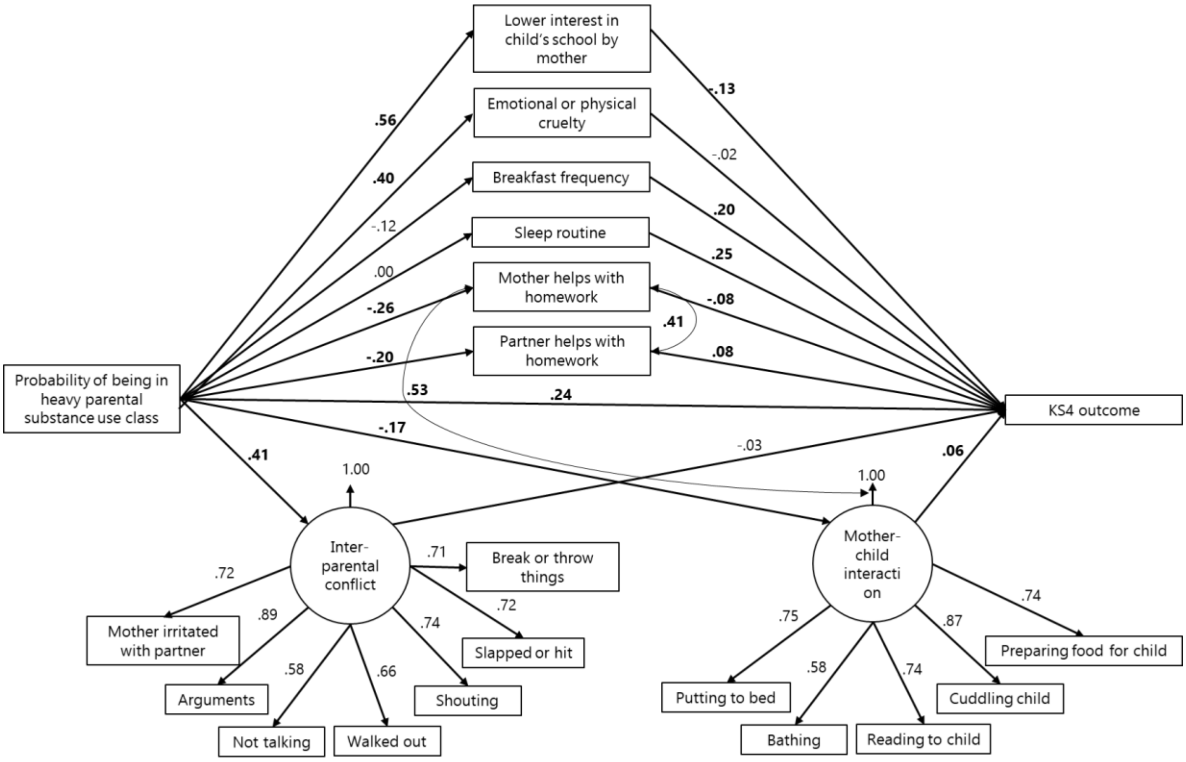

Figure 15: SEM mediation model for the heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

4.11 Summary of findings for ALPSAC

This chapter has answered three research questions regarding the relationship between parental substance use. The latent class analysis showed four distinct classes of parental substance use - very low users, low users, moderate users, and heavy users. The probability of being a low or moderate user had a positive association with educational attainment, whereas the very low class had a negative association. The probability of being in the heavy users class had no statistically significant association with educational attainment, but a positive direction. Once adjusted for demographic and environmental aspects, the effects of substance use classes were largely annulled, and the confidence intervals widened. From this, indirect effects were explored using both manifest and latent variables for parenting and the family environment. EFA was used to explore the constructs, and it suggested that a 1-factor model of interparental conflict was acceptable; this was confirmed with CFA. Likewise, the mother-child interaction was explored using EFA, and 2-factors emerged, with the construct of warmth being tested in a CFA; this suggested a good fit in CFA also. However, the partner-child interaction had poor fit, as did school involvement so were not used as latent variables.

Following this, the SEM mediation models were conducted with the latent variables. These models showed that there was some evidence of parenting and the family environment being mediators through heavy substance use and attainment. The mother's interest in the child's schooling, the mother-child interaction, and homework help from both parents were key mediators. However, the direct pathway from parental substance use to attainment consistently showed a positive association which was unexpected given the indirect pathways. This unexpected finding warranted further analysis which is conducted and discussed in Chapter 6.

The next chapter (Chapter 5) uses the MCS data to perform the same analysis conducted in this chapter.

Chapter 5 The Millennium Cohort Study: Results

This chapter will follow the analytical approach outlined in Chapter 3 to answer the following three research questions:

1. What is the relationship between parental substance use and children's educational attainment?
2. What is the relationship between parental substance use and children's educational attainment once adjusted for environmental and demographic factors?
3. Do parenting and the family environment mediate the relationship between parental substance use and children's educational attainment?

5.1 Outline

This aim of this Chapter is to replicate the analysis shown in Chapter 4 for the ALSPAC dataset. Following this, the estimates will be compared in a cross-cohort analysis in Chapter 6. In this Chapter, section 5.2. outlines the measures used in this research. Following this, the demographics of the sample are shown for mothers, their partners, and children in section 5.3. Then, sections 5.4. and 5.5. show the results for the exploratory and confirmatory factor analysis. Once the latent variables are developed, section 5.7. shows the results of the latent class analysis of parental substance use. Following this, the class with the highest consumption has been converted into a predicted probability to use as an exposure for the research. Section 5.8, 5.9. and 5.10. answer research questions one, two and three and include regression analysis and SEM mediation models. Throughout this research, partner-based variables only include males, and mothers are females; same-sex couples had to be excluded due to disclosure risks.

5.2 Measures

Below are the measures, note that responses which included 'refusal' 'don't know', or 'do not want to answer' were recoded to missing.

5.2.1 Exposures

All exposure variables are used in the latent class analysis in section 5.7.

5.2.1.1 Alcohol

Mothers and their partner's alcohol use has been measured using the CAGE questionnaire. The CAGE questionnaire is made up of four questions which focus on the Cutting down, Annoyance, Guilt and Eye-opener drinks of alcohol use. The first question is "Have you ever felt like you should cut down on your drinking?". The second question is "Have people annoyed you by criticising your drinking?". The third question is "Have you ever felt bad/guilty about your drinking?". The final question (eye-opener) asks "Have you ever had a drink first thing in the morning?". These four questions have the binary responses of 'Yes' or 'No'; in clinical settings any response of 'Yes' could indicate problem drinking.

Another question was asked to participants about how they usually use alcohol – "How often do you usually drink alcohol?". The responses were 'Every day', '5-6 times per week', '3-4 times per week', '1-2 times per week', '1-2 times per month', 'Less than once a month' and 'Never'. In MCS, only the frequency measure is available for mothers and their partners. Nevertheless, the CAGE has been used multiple times, and is a validated tool for identifying problematic alcohol use (Malet et al. 2005). Higher coded responses indicated greater frequency.

5.2.1.2 Drugs

Both mothers and their partner's drug use has been measured using the question 'Have you used recreational drugs like cannabis, cocaine or ecstasy?'. The responses included 'Never', 'Occasionally', and 'Regularly'. Due to the latent class estimation, these variables were recoded as binary variables whereby occasionally and regularly was recoded to 'Yes', and never was recoded to 'No'; this harmonises with ALSPAC's measures.

5.2.2 Mediators

5.2.2.1 Mother and partner and child interactions

MCS ask several questions which surround mother and partners interactions with their children. However, the questions are less detailed and are more activity based compared to

ALSPAC. Table 24 shows the questions which are asked to both the main respondent and their partner. All variables were coded as the higher the score, the more frequent the interaction.

Question	**Response**
How often do you read to the child?	*Not at all,* *Less often,* *Once or twice a month,* *Once or twice a week,* *Several times a week,* *Everyday*
How often do you tell stories to the child?	"
How often do you do musical activities with the child?	"
How often do you draw/paint with the child?	"
How often do you play physically active games with the child?	"
How often do you play games/toys indoors with the child?	"
How often do you take the child to the park/playground?	"

Table 24: Mother and partner-child Interactions measure for MCS

5.2.2.2 Closeness of Mother to child

Both the partner and mother were asked the question 'How close are you to the child?'. The responses include: 'Extremely close', 'Very close', 'Fairly close', and 'Not very close'. To avoid over-adjusting the model, only the mother's response was used. The variable was recoded to reflect the higher the score, the closer the relationship.

5.2.2.3 Parenting competency

The main respondent was asked to rate their parenting competency on a scale. The options were 'Not very good at being a parent', 'A person who has some trouble being a parent', 'An average parent', 'A better than average parent', and 'A very good parent'. The variable was recoded whereby a higher score represents a higher parenting competency.

5.2.2.4 School involvement

Four variables will be used to capture this. First, the variable which asked whether the parent, mother, or their partner, had attended the child's parents evening; if parents evening had not happened, these parents were recoded as missing, this accounted for around 7% of parents. Second, the variables which capture how often the main respondent (which could be the mother or their partner) helps with maths, writing and reading. It will be examined whether all four variables can form a single construct through EFA.

5.2.2.5 Family environment

5.2.2.5.1 Interparental conflict

To capture interparental conflict, the mother's report has been used. Eight items are available for use. These measures are less focused on conflict, and perhaps dissatisfaction in the relationship which is different to ALSPAC.

Question	**Response**
Partner is sensitive to and aware of respondents needs	*Strongly agree,* *Agree,* *Neither agree nor disagree,* *Disagree,* *Strongly disagree*
Partner doesn't listen to respondent	*"*
Respondent sometimes feels lonely even with partner	*"*
I suspect we may be on the brink of separation	*"*
How often respondent and partner disagree regarding child issues	*Never,* *Less than once a week,* *Once a week,* *Several times a week,* *Once a day,* *More than once a day*
How often respondent and partner go out without children	*Once a week or more,* *Once a month or more,* *Less often,* *Hardly ever/never*

How happy/unhappy are you in the current relationship?	*Scale of 1-7,* *7 = very unhappy 1 = very happy*
Has partner ever used force on respondent for any reason?	*No,* *Yes*

Table 25: Interparental conflict measures for MCS

5.2.2.5.2 Regular bedtime

The main respondent was asked if the child has a regular bedtime routine on term-time weekdays. The responses include: 'No', 'Never or almost never', 'Yes sometimes', 'Yes usually', 'Yes always'. The variable was recoded that the higher the score represented a more regular bedtime routine.

5.2.2.5.3 Breakfast frequency

The main respondent was asked how many days in the week the child has breakfast. The responses include: 'None', 'One', 'Two', 'Three', 'Four', 'Five', 'Six' and 'Seven'. The variable was recoded that the higher the score represented a greater frequency.

5.2.3 Educational outcomes

The outcomes are derived from the National Pupil Database (NPD). The outcomes are for KS1 (England and Wales), KS2 (England only) and KS4 (England only). For KS1, the child would be coded as 'attained' if they scored a Level 2 and above in English/Welsh, reading, writing, maths and science; otherwise, they were scored as 'not attained'. For KS2, the same coding applied. For KS4, the child had to attain 5 GCSE'S at A* - C level including English and maths to meet the expected standard. All educational attainment values were coded to be binary whereby 1 equalled attained, and 0 not attained.

5.2.4 Demographics

5.2.4.1 Prenatal smoking

MCS asked if the mother had smoked in their pregnancy; this measure was taken when the child was 9 months old. Numerous questions followed which discussed whether the mother had changed their behaviour, and the frequency of use. These questions were used to form a continuous variable which represented the number of cigarettes the mother smoked on average when pregnant.

5.2.4.2 Prenatal alcohol

When the child was aged 9 months old, the mother was asked how frequently she consumed alcohol when pregnant. The responses were 'Every day', '5-6 times per week', '3-4 times per week', '1-2 times per week', '1-2 times per month', 'Less than once a month' and 'Never'. The greater the score represented a greater use of alcohol during pregnancy.

5.2.4.3 Mother's age

Mother's age was a continuous variable, it was collected when the child was 9 months old.

5.2.4.4 Family Income

Multiple bands of income are given for the household in the survey, this was taken when the Child was aged 3 years old. The net family income was divided into six bands '£0 - £3300', '£3300.01-£11000', '£11000.01-£22000', '£2200.01-£33000', '£33000.01-£55000', '£55000+'; this strategy is recommended in the MCS technical documentation.

5.2.4.5 Mother's qualifications

The mother's qualifications were taken when the child was 9 months old. The variable was reverse coded so higher qualifications represented higher codes. The groups were as follows 'None', 'GCSE D-G, (N/S/GS)VQ level 1', 'GCSE A-C/Apprenticeship/(N/S/GS)VQ level 2', 'A-levels', '(N/S/GS)VQ level 3', 'First degree/Diplomas/pro quals/nursing', and 'Higher degree'.

5.2.4.5.1 Mothers Distress

The Kessler Psychological Distress scale was used; this included questions on the frequency of depression, hopelessness, restlessness, effort, worthlessness, and nervousness. The scores were summed to form a total, where a higher score represents more distress; this scale is significantly associated with anxiety and other mental disorders (Andrews and Slade 2001).

5.3 Demographics

For statistical disclosure control, if cells were less than ten, then ‘<’ and ‘>’ is given to top-code estimates, and ‘~’ is given to show that these are masked estimates. In some tables, raw numbers are not provided, and percentages are given.

Table 26 shows the demographics for the mother and their partner. The average age of the mother when the child was 9 months old was 29 years old, and 33 for their partner. The mean distress score was 9.31 for mothers’, and 8.85 for their partner’s, which suggests low prevalence of distress. Most families earned a net pay of £11000.01 - £22000.00 a year by the time the child was age 3 years (29.6%) but the categories above and below this also made up substantial proportions of the sample. Most mothers and their partners had GCSE’s (or equivalent) (29.9% and 28.1%) and over a quarter had a first degree (26.6% and 29.3%). Furthermore, most mothers did not use alcohol in pregnancy (71.3%), or smoke (mean of 2.02).

	Mothers’ demographics				**Partners’ demographics**			
	Valid N	**Missing**	**Mean**	**SD**	**Valid N**	**Missing**	**Mean**	**SD**
Age *(Ch-9 months)*	18,790	3.7%	29.66	5.97	15,500	20.6%	33.22	6.28
Distress *(Ch-age 3)*	12,384	36.5%	9.31	3.84	9,455	51.6%	8.85	3.14
Net income *(Ch-age 3)*	10,887	44.2%						
£0 - £3300	513 (3.9%)							
£3300.01- £11000	2,568 (19.3%)							
£11000.01- £22000	3,936 (29.6%)							
£2200.01- £33000	2,928 (22.1%)							
£33000.01- £55000	2,450 (18.5%)							
£55000+	886 (6.7%)							
Qualifications *(Ch-9 months)*	18,174	6.9%			12,931	50.9%		

None	3,072 (16.9%)				1,810 (14.0%)
GCSE D-G, (N/S/GS)VQ level 1	1,573 (8.7%)				914 (7.1%)
GCSE A-C/Apprenticeship/(N/S/GS)VQ level 2	5,436 (29.9%)				3,634 (28.1%)
A-levels, (N/S/GS)VQ level 3	2,635 (14.5%)				2,036 (15.8%)
First degree/Diplomas/pro quals/nursing	4,831 (26.6%)				3,785 (29.3%)
Higher degree	627 (3.5%)				752 (5.8%)
Prenatal Alcohol *(Ch-9 months)*	18,753	3.9%			
Never	13,371 (71.3%)				
Less than once a month	2,489 (13.3%)				
1-2 times per month	1,291 (6.9%)				
1-2 times per week	1,284 (6.9%)				
3-4 times per week	202 (1.1%)				
5-6 times per week	48 (0.3%)				
Everyday	68 (0.4%)				
Prenatal cigarette *(Ch-9 months)*	18,647	4.5%	2.02	5.14	

Table 26: Mothers and their partner's demographics of age, distress, income, qualifications, and prenatal substance use

Child demographics and confounders

		Valid N (%)	% Missing
Ethnicity	*(Ch-age 9 month)*	18,770	3.8%
	White	15,285 (81.4%)	
	Ethnic Minority	3,485 (18.6%)	
Gender		18,818	3.5%
	Male	9,648 (51.3%)	
	Female	9170 (48.7%)	

Table 27: Child's demographics of ethnicity and gender

Table 27 shows the demographics for the cohort children. Most were from a White background (81.4%). Gender was almost evenly split with slightly more males than females (51.3%). The next section will include the exploratory factor analysis to construct the latent variables.

5.4 Exploratory factor analysis (EFA)

The EFA forms part of the measurement of the latent variables to be used in the mediation models. It has been conducted for interparental conflict, mother-child interaction, partner-child interaction, and school involvement. For adequate model fit, the χ^2 should not be significant, but due to the large sample, small differences can lead to statistical significance; the RMSEA and SRMR must be <0.08 and CFI, TLI >0.90. For good fit, the RMSEA must be <0.05 and CFI, TLI >0.95.

5.4.1 Interparental conflict

The correlation between the variables were explored in preparation for factor analysis (n=11,554). Correlations above 0.70 are not recommended as it is likely that they would be representing the same construct (Brown 2015). There were positive correlations among all variables (R^2 0.59 – 0.06, p<0.05); the 'Go out together' variable had the lowest correlation, but variables were explored to evaluate a construct. The matrix and fit tables are in Appendix F.

The EFA was conducted with the maximum number of factors given the parameters (8 items); the WLSMV estimator was used. The first model showed that the variable 'Go out' did not load well (0.25). The 2-factor model was rejected based on poor eigenvalues and negative residual variance. On this basis, 'Go out' was removed and the EFA was re-estimated. Three models were conducted (n=11,551), with all χ^2 showing statistical significance, suggesting poor model fit. However, due to the sample size (n > 10,000), other model fit was explored. The eigenvalues for the 1-factor model were the highest (3.83) and the model showed acceptable fit (χ^2 = 923.36, df = 14, p<0.05, RMSEA=<0.08, CFI= 0.99, TLI = 0.98, SRMR = 0.03). Rotated factor loadings showed adequate loadings, ranging from 0.82 – 0.41, with lonely being the highest, and disagreement being the lowest; Table 28 shows the factor loadings.

Rotated factor loadings for 1-factor solution	
Sensitive to needs	**0.75**
Listens to partner	**0.80**
Feels lonely	**0.82**
Brink of separation	**0.79**
Frequency of disagreement	**0.41**
Scale of happiness	**0.70**
Partner ever used force	**0.50**

Table 28: Factor loadings for interparental conflict EFA

5.4.2 Mother-child interaction

Correlation analysis showed positive correlations among all variables, with some weaker than others (R^2 0.41 – 0.15, p<0.05). For analysis, the EFA was conducted with the maximum number of factors generated given the parameters (6 items); the WLSMV estimator was used. The first model showed that the variable 'takes child to playground' did not load well on the factor (0.37). The 2-factor model was rejected based on poor eigenvalues and lack of theoretical interpretation. On this basis, 'takes child to playground' was removed and the EFA was re-estimated. Two models were conducted, both χ^2 showing statistical significance. However, due to the sample size (n=15,207), it was expected significance would be observed so other model fit was explored. The 1-factor model was considered the best model as this had an eigenvalue of 2.27, and had good model fit (χ^2 =170.66, df = 5, p<0.05, RMSEA = 0.05, CFI = 0.99, TLI = 0.98, SRMR = 0.02). Rotated factor loadings were excellent, ranging from 0.67 – 0.49; see Table 29.

Rotated factor loadings for 1-factor solution	
Reads to child	**0.49**
Tells stories to child	**0.48**
Plays music to child	**0.53**

Draws or paints with child	**0.66**
Plays with toys with child	**0.67**

Table 29: Factor loadings for mother-child interaction EFA

5.4.3 Partner-child interaction

Correlation analysis showed positive correlations among all variables (R^2 0.40 – 0.18 p<0.05). For analysis, the EFA was conducted with the maximum number of factors generated given the parameters (6 items); the WLSMV estimator was used. Three models were conducted, with the 1, 2 and 3-factor χ^2 showing statistical significance (p<0.05). However, due to the sample size (n=10,679) it was expected so other model fit was explored. The 6-item EFA model showed an eigenvalue of 2.59, and good model fit values (χ^2 = 109.83, df = 9, p<0.05, RMSEA = 0.03, CFI = 0.99, TLI = 0.99, SRMR = 0.02). Rotated factor loadings were excellent, ranging from 0.67 – 0.43; see Table 30.

Rotated factor loadings for 1-factor solution	
Reads to child	**0.55**
Tells stories to child	**0.54**
Plays music to child	**0.54**
Draws or paints with child	**0.67**
Plays with toys with child	**0.64**
Takes child to the playground	**0.43**

Table 30: Factor loadings for partner-child interaction EFA

5.4.4 School involvement

Correlation analysis showed positive correlations among all variables, with some weaker than others (R^2 0.48 – 0.03, p<0.05); all variables were included for factor analysis (n=15,151). For analysis, the EFA was conducted with the maximum number of factors generated given the parameters (4 items); the WLSMV estimator was used. The model fit was good, with an eigenvalue of 2.01 (χ^2 =53.14, df = 2, p<0.05, RMSEA = 0.04, CFI = 1.00, TLI =1.00, SRMR = 0.02) but the parents evening variable did not load (0.08) so it was removed and EFA was re-ran. Due to latent variables requiring 4 items for model fit statistics, only the factor loadings can be considered, which were excellent, (0.60 – 0.87) and were accepted for use; see Table 31.

Rotated factor loadings for 1-factor solution	
Read	**0.60**
Writing	**0.87**
Maths	**0.74**

Table 31: Factor loadings for school involvement EFA

The models accepted in the EFA will be tested in a CFA in the next section.

5.5 Confirmatory factor analysis (CFA)

The accepted EFA models are interparental conflict, mother-child interaction, and partner-child interactions and school involvement. For adequate model fit, the χ^2 should not be significant but can be due small differences in a large sample size; the RMSEA must be <0.08 and CFI, TLI >0.90. For good fit, the RMSEA must be <0.05 and CFI, TLI >0.95. The WRMR fit is used for CFA, but this is not recommended as it can be unreliable (Muthén and Muthén 2017).

5.5.1 Interparental conflict

The model showed adequate fit (n=11,551, χ^2 = 923.36, *df* = 14, p<0.05, RMSEA = <0.08, CFI = 0.99, TLI = 0.98, WRMR = 3.03). Factor loadings were adequate (0.41 – 0.82); see Figure 16.

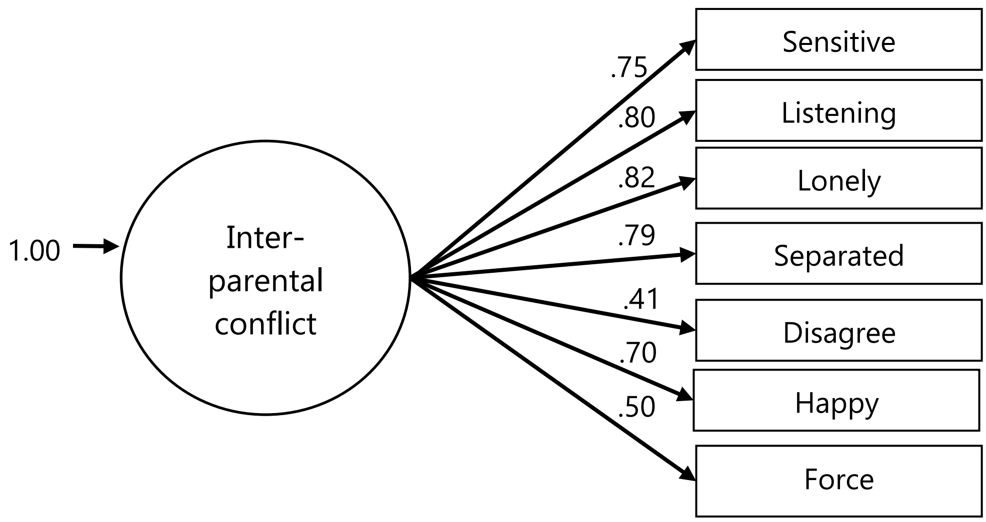

Figure 16: Interparental conflict CFA in MCS

5.5.2 *Mother-child interaction*

The model showed adequate model fit (n=15,207, χ^2 = 166.48, *df* = 5, *p*<0.05, RMSEA = 0.05, CFI = 0.99, TLI = 0.98, WRMR = 1.69). All factor loadings were adequate, ranging from 0.48 – 0.67 (Figure 17).

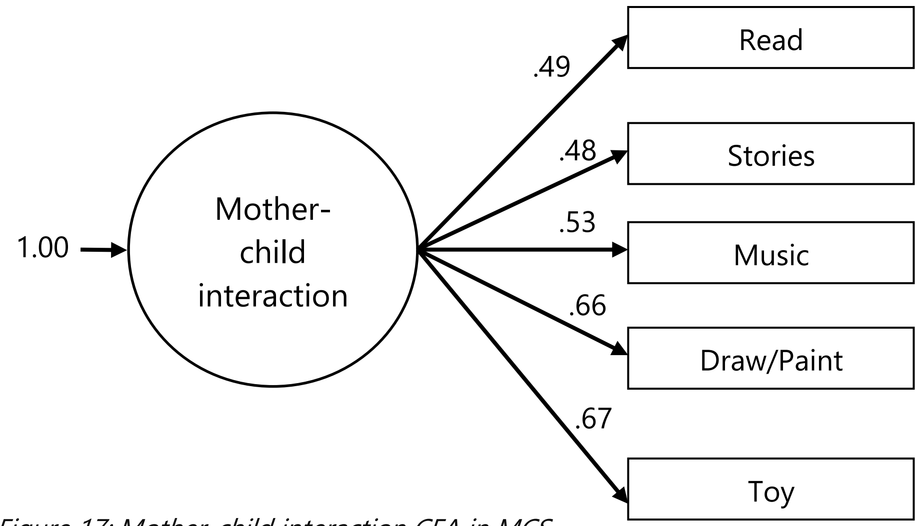

Figure 17: Mother-child interaction CFA in MCS

5.5.3 *Partner-child interaction*

The model showed good fit (n=10,679, χ^2 = 109.83, *df* = 9, *p*<0.05, RMSEA = 0.03, CFI = 0.99, TLI = 0.99, WRMR = 1.19). Factor loadings were adequate (0.43 – 0.67); see Figure 18.

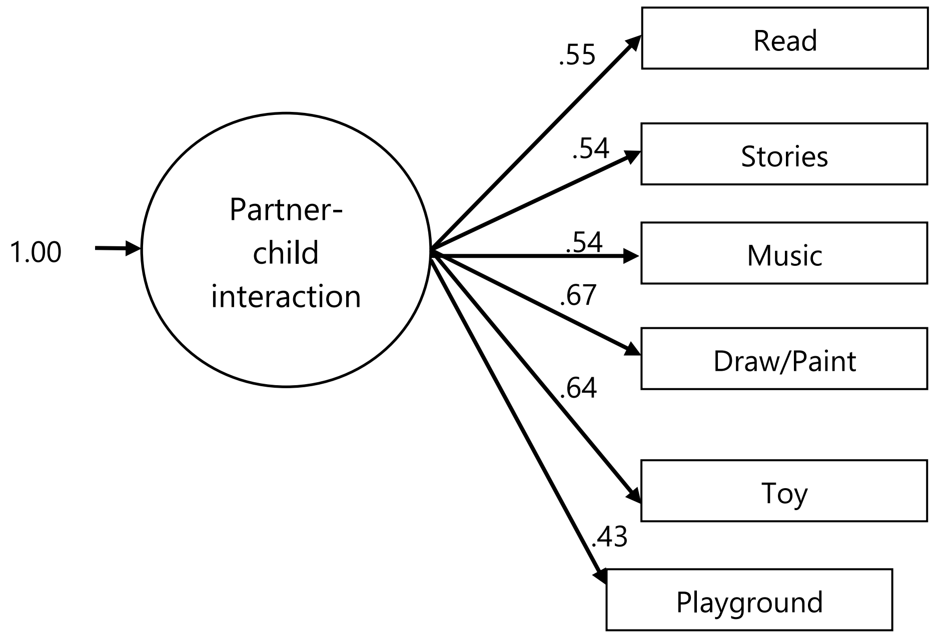

Figure 18: Partner-child interaction CFA in MCS

5.5.4 School Involvement

Although no model fit is available, the factor loadings were high ranging between 0.61 – 0.84 (Figure 19). This model was accepted for mediation analysis (n=15,149).

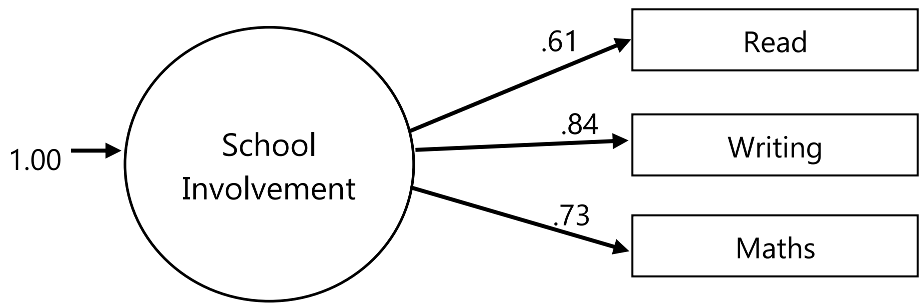

Figure 19: School involvement CFA in MCS

The next section will explore if the accepted CFA's can be generalised and are invariant.

5.6 Measurement invariance

Measurement invariance is conducted in three steps; or four if partial invariance is required. Parenting measures have been explored across high income (top three categories), and low-income groups (bottom three categories).

5.6.1 Interparental conflict

The first model for interparental conflict was a single CFA which showed good fit (χ^2= 923.36, *df* = 14, *p*<0.05, RMSEA = 0.08, CFI = 0.99, TLI= 0.98, WRMR = 3.03). When split by income, the observations dropped to 9,264. The equal form model showed good model fit (χ^2= 855.816, *df* = 28, *p*<0.05, RMSEA = 0.08, CFI = 0.98, TLI = 0.98, WRMR = 2.93); so configural invariance is achieved. The model that tests for scalar invariance showed good fit (χ^2= 639.42, *df*=54, *p*<0.05, RMSEA = 0.05, CFI = 0.99, TLI= 0.99, WRMR = 3.26); however, the χ^2 difference test suggested variance across income groups (χ^2= 99.73, *df*=26, *p*<0.05). Partial invariance was achieved by freeing the thresholds for the following variables: 'Force', 'Disagreement', 'Happy', 'Sensitive' and 'Listening'. The χ^2 difference test showed non significance at this level (χ^2=11.25, *df*=7, *p*=013) and the model fit was adequate (χ^2= 746.68, *df*=35, *p*<0.05, RMSEA

= 0.07, CFI = 0.99, TLI = 0.98, WRMR = 2.96). Due to five out of six items requiring free thresholds, this variable has weak scalar invariance.

5.6.2 *Mother-child interaction*

The first model for mother-child interaction was a single CFA which showed good fit (χ^2= 166.48, *df*=5, *p*<0.05, RMSEA = 0.05, CFI = 0.99, TLI = 0.98, WRMR = 1.69). When split by income, observations dropped to 11,739. The equal form model showed good model fit (χ^2=146.51, *df*=10, *p*<0.05, RMSEA = 0.05, CFI = 0.99, TLI = 0.98, WRMR = 1.60); so configural invariance is achieved. The model that tests for scalar invariance showed good fit (χ^2= 322.70, *df*=33, *p*<0.05, RMSEA = 0.04, CFI = 0.97, TLI = 0.98, WRMR = 2.74); however, the χ^2 difference test suggested variance across income groups (χ^2= 195.74, *df*=23, *p*<0.05). Partial invariance was achieved by freeing the thresholds for the following 'Read', 'Draw and Paint' and 'Music' (χ^2=13.78, *df*=8, *p*=0.09). Due to three out of five items requiring threshold fixing, this variable has weak scalar invariance (χ^2= 137.75, *df*=18, *p*<0.05, RMSEA = 0.03, CFI = 0.99, TLI = 0.99, WRMR = 1.69).

5.6.3 *Partner-child interaction*

The first model for partner-child interaction is a single CFA which showed good fit (χ^2= 109.83, *df*=9, *p*<0.05, RMSEA= 0.03, CFI = 0.99, TLI = 0.99, WRMR = 1.19). When split by income, observations dropped to 8,535. The equal form model showed good model fit (χ^2= 128.107, *df*=18, *p*<0.05, RMSEA = 0.04, CFI = 0.99, TLI = 0.99, WRMR = 1.30); so configural invariance is achieved. The model that tests for scalar invariance showed good fit (χ^2=516.11, *df*=46, *p*<0.05, RMSEA = 0.05, CFI = 0.96, TLI = 0.98, WRMR = 3.12); however, the χ^2 difference test suggested variance across income groups (χ^2= 370.22, *df*=28, *p*<0.05). Partial invariance was not achieved by freeing the thresholds for all variables. As a result, no scalar invariance was achieved.

This completes the latent variable modelling analysis for MCS. The next section will consist of the latent class analysis, where the parental substance use variables are used to produce classes of substance use.

5.7 *Latent class analysis*

This section documents the latent class analysis which was discussed in Chapter 3 as "a statistical procedure that can be used to classify individuals into homogeneous subgroups… [which can] test theories about typological differences between individuals" (Geiser 2013, p.233). This technique has been used to create classes of parental substance use using the mother and partner's alcohol and drug variables. This section includes the descriptive statistics of the measures used, and the findings of the latent class analysis (n=15,685).

The latent class model was conducted with eleven variables of the mothers and their partner's usual drinking habits, drug use and the CAGE alcohol tool. Table 32 shows the distribution of responses among the variables. For usual drinking, mothers tend to use alcohol less frequently compared to their partners, but both are most likely to use alcohol '1 – 2 times a week', with 2.5% of mothers and 6.7% of their partners consuming 'Every day'. Most mothers and their partners did not feel like they needed to cut down their drinking (90.5% and 77.0%). Near all mothers were not criticised about their drinking (97.6%) compared to their partners (92.9%). A moderate proportion of mothers and their partners felt guilty about their drinking (4.5% and 10.3%). A small proportion of mothers and their partners used alcohol first thing in the morning (0.7% and 3.0% respectively). Most mothers had not used drugs (4.1%), but the proportion for their partners use doubled (8.3%).

Models were conducted using the maximum likelihood robust estimator, to adjust for any data non-normality, this technique uses FIML. Some variables had to be fixed due to being binary, so are likely to have small numbers of observations in categories (Muthén and Muthén 2017). The model fit statistics are shown in Table 33. Four models were conducted, reaching up to five classes. The AIC, BIC and adjusted BIC decreased with every additional class, suggesting improved model fit. The best entropy observed was in the 3 and 4-class model; and both had good class classification (above 80%), the 5-class model showed inadequate levels. The VLMR, LMR and Bootstrapped LRT tests suggested that the 4-class model was the best, with the 5-class model being somewhat unstable. Hence, the 4-class model was chosen as it had low AIC and BIC values, acceptable entropy, good class classification values and a bootstrap LRT which was statistically significant; it also was shown to be the best for balancing theoretical interpretation and statistical criteria (Melendez-Torres et al. 2018). Table 34 shows the proportions of each variable for each class, and the following section discusses the findings, which are graphed in Figure 20.

Usual drinking (missing%)	**Mother (21%)**	**Partner (46%)**
Never	3,495 (22.5%)	1,458 (13.8%)
Less than once month	2,884 (18.6%)	1,106 (10.4%)
1 – 2 times a month	2,814 (18.1%)	1,490 (14.1%)
1 – 2 times per week	4,028 (25.9%)	3,376 (31.9%)
3 – 4 times a week	1,472 (9.5%)	1,819 (17.2%)
5 – 6 times a week	463 (3.0%)	644 (6.1%)
Everyday	394 (2.5%)	707 (6.7%)
Cut Down (missing%)	**Mother (25%)**	**Partner (47%)**
No	13,245 (90.5%)	8,002 (77.0%)
Yes	1,397 (9.5%)	2,397 (23.1%)
Criticise (missing%)	**Mother (25%)**	**Partner (47%)**
No	14,287 (97.6%)	9,656 (92.9%)
Yes	355 (2.4%)	743 (7.1%)
Guilty (missing%)	**Mother (25%)**	**Partner (47%)**
No	13,987 (95.5%)	9,329 (89.7%)
Yes	655 (4.5%)	1,070 (10.3%)
First Thing (missing%)	**Mother (25%)**	**Partner (47%)**
No	14,543 (99.3%)	10,088 (97.0%)
Yes	99 (0.7%)	311 (3.0%)
Drug use (missing%)	**Mother (31%)**	**Partner (49%)**
No	12,826 (95.9%)	9,060 (91.7%)
Yes	546 (4.1%)	824 (8.3%)

Table 32: Frequency of mother and partner alcohol and drug use variables in MCS

	2-class	3-class	4-class	5-class
AIC	137730.56	135092.74	132599.56	131561.81
BIC	138075.28	135613.65	133296.66	132435.10
Adjusted BIC	137932.27	135397.55	133007.47	132072.82
Proportions	66%	59%	50%	33%
	33%	30%	22%	28%
		11%	17%	18%
			11%	12%
				9%
Entropy	0.66	0.68	0.68	0.63
Probability of most likely latent class membership	90%	84%	81%	76%
	91%	85%	84%	70%
		92%	81%	81%
			91%	90%
				89%
VLMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.81$
LMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.81$
Bootstrap LRT	-	$p<0.05$	$p<0.05$	$p<0.05$

Table 33: Latent class analysis statistical criteria for total sample in MCS

Measure	Class 1 – Low (22%)		Class 2 – Partner-heavy (17%)		Class 3 – Moderate (50%)		Class 4 – Dual-heavy (11%)	
	Mother	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**
Usual drinking								
Never	71%	63%	15%	<5%	9%	<5%	<5%	<5%
Less than once month	21%	22%	17%	<5%	21%	10%	<5%	<5%
1 – 2 times a month	5%	10%	18%	<5%	27%	22%	<5%	<5%
1 – 2 times per week	<5%	<5%	33%	29%	34%	47%	28%	22%
3 – 4 times a week	<5%	<5%	12%	35%	8%	15%	33%	29%
5 – 6 times a week	<5%	<5%	<5%	13%	<5%	<5%	17%	20%
Everyday	<5%	<5%	<5%	17%	<5%	<5%	15%	19%
Cut down								
No	>95%	>95%	>95%	12%	>95%	95%	21%	53%
Yes	<5%	<5%	<5%	88%	<5%	5%	79%	47%
Criticise								
No	>95%	>95%	>95%	70%	>95%	>95%	81%	92%
Yes	<5%	<5%	<5%	30%	<5%	<5%	19%	8%
Guilty								
No	>95%	>95%	>95%	55%	>95%	>95%	62%	85%
Yes	<5%	<5%	<5%	48%	<5%	<5%	38%	16%
First thing								
No	>95%	>95%	>95%	90%	>95%	>95%	>95%	>95%
Yes	<5%	<5%	<5%	10%	<5%	<5%	<5%	<5%
Drug use								
No	>95%	95%	>95%	86%	>95%	94%	88%	85%
Yes	<5%	5%	<5%	14%	<5%	6%	13%	15%

Table 34: Proportions of substance use by each class in MCS

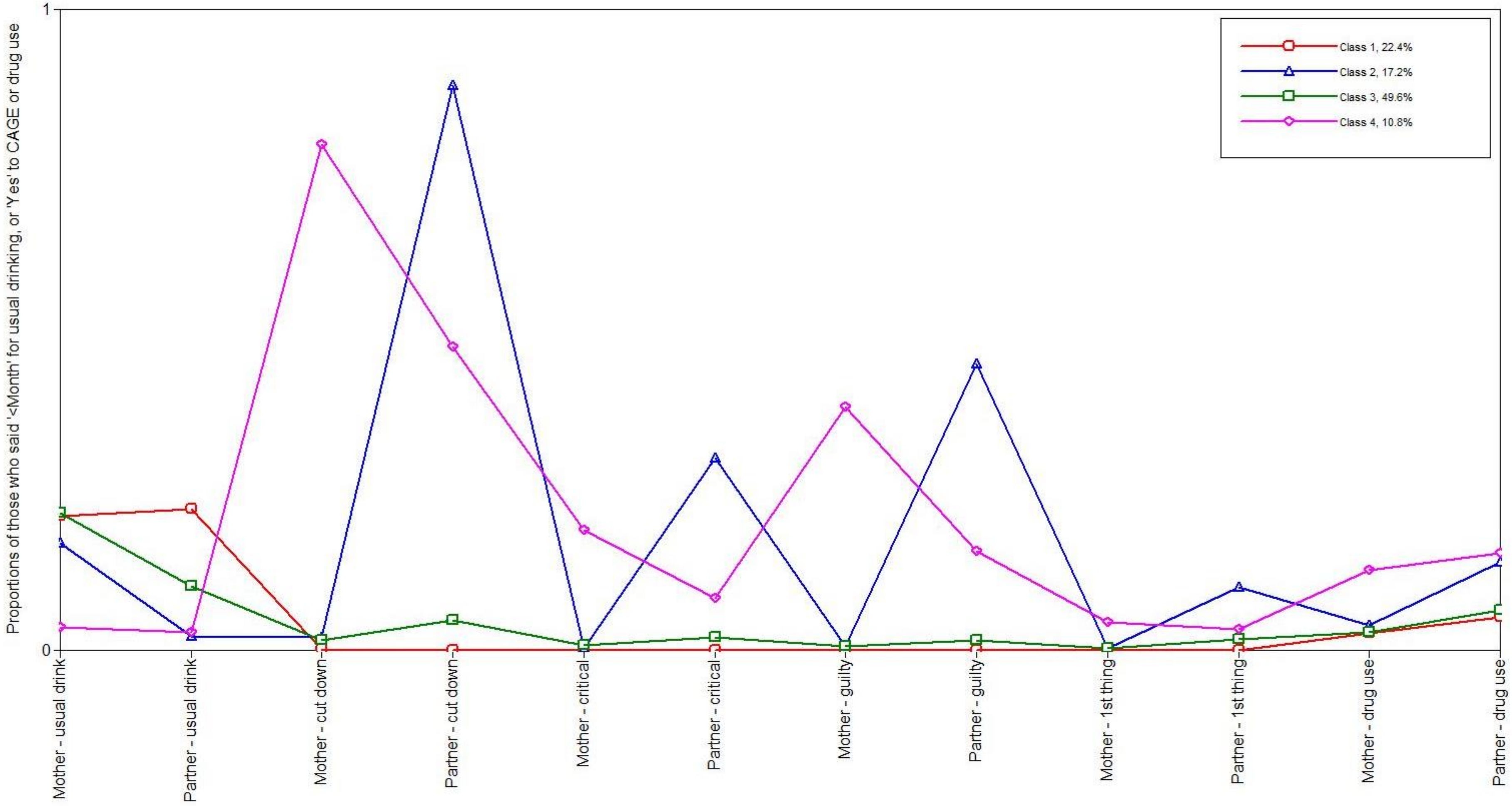

Figure 20: Graph of classes proportions who said 'Yes' to each CAGE question in MCS (Y-axis unavailable due to SDC)

5.7.1 Results of the 4-class model

The 4-class model showed distinct patterning of mothers and their partner's alcohol and drug use. These classes were defined as the low users (22%, red line), moderate users (50%, green line), partner-heavy (17%, blue line) and dual-parent heavy (11%, pink line). Figure 20 shows the classes proportion of those who used alcohol 'Less than once a month', or said 'Yes' to the CAGE alcohol screening tools or drug use; these are graphed for the proportions in Table 34.

The low users (22%) consisted of mothers and partners who did not use alcohol (71% and 63% respectively) or less than once a month (20% - 22% respectively); mothers used alcohol less frequently than their partners. The majority of mothers and their partners did not feel like they needed to cut down their drinking, or were criticised, felt guilty, or used alcohol first thing in the morning. For illicit drugs, near all mothers did not use drugs, but 5% of their partners had. The moderate users (50%) consisted of mothers and partners who used alcohol '1 – 2 times a week' (34% and 47% respectively) or '1 – 2 times a month' (27% - 22%); mothers used alcohol less frequently than their partners. The majority of mothers and their partners did not feel that they needed to cut down their drinking, or were criticised, felt guilty, or used alcohol first thing in the morning. For illicit drugs, a small proportion of mothers used drugs, but 6% of their partners had.

The partner-heavy class (17%) consisted of mothers who did not use alcohol often, 33% used it '1 – 2 times a week', and the latter used it less than this. Their partners used alcohol in the reverse pattern, with 29% using it '1 -2 times a week', 35% using it '3 – 4 times a week', 13% using it '5 – 6 times a week' and 17% using it 'Every day'. While mothers did not feel they needed to cut down their drinking, were criticised, felt guilty, or used alcohol first thing in the morning, larger proportions of their partners did. The majority of partners said they should cut down (88%), a third were criticised (30%), near half felt guilty (87%) and 10% used alcohol first thing. This was mirrored by the increase in drug use in partners (14%) compared to mothers (5%).

The final class was the dual-heavy class. This class consisted of mothers and partners who used alcohol in greater frequency. Near three-quarters of partners used alcohol more than '3 – 4 times a week', and this was the same for almost two-thirds of mothers. Both mothers and their partner's felt they should cut down (79% and 47% respectively). A moderate proportion were criticised for their drinking (19% and 8%) or felt guilty (38% and 16%). However, neither had high proportions of where they used alcohol first thing in the morning. Drug use was higher in this category, with 13% of mothers using drugs and 15% of their partners doing so.

The next section will use the predicted probabilities (0.00 – 1.00) of being in each class – low, moderate, partner-heavy and dual-heavy as the exposure variable in the regression analyses and SEM mediation models.

5.8 What is the relationship between parental substance use and children's educational attainment?

The predicted probability of being in each latent class will be used to predict on to KS1, KS2 and KS4 attainment. As with Chapter 4, the models were conducted simultaneously to account for the correlation between the outcomes using the maximum likelihood robust estimator. Each model is conducted using a different class as a predictor as models do not converge when all four classes are used in a model. Statistical significance is represented by bold estimates, and the upper 2.5% and lower 2.5% are given for confidence intervals (95% CI). Odd Ratios (OR) are used, with unstandardised results being used for statistical significance; OR statistical significance values were not available in this version of Mplus, so there may be slight differences and results which appear statistically significant (i.e., no intersect of the null).

Most values showed statistical significance. First, an increased probability of being in the low class reduced the chances of attainment at KS1 (OR 0.41, p<0.05), KS2 (OR 0.58, p<0.05), and KS4 (OR 0.70, p<0.05). In contrast, the increased probability of being in the moderate class increased chances of attainment at KS1 (OR 1.49, p<0.05), KS2 (OR 1.22, p<0.05), but not KS4. For the partner-heavy class, an increase in the predicted probability increased the chances of KS1 attainment (OR 1.43, p<0.05), likewise for KS2 (OR 1.30, p<0.05), and KS4 (OR 1.22, p<0.05). Furthermore, the dual-heavy class increased the chance of attainment at KS1 (OR 1.56, p<0.05), KS2 (OR 1.39, p<0.05), and KS4 (OR 1.30, p<0.05). See Table 35.

	KS1		KS2		KS4	
	n=9329		n=9329		n=9329	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Low	**0.41**	0.36 – 0.47	**0.58**	0.50 – 0.68	**0.70**	0.62 – 0.80
Moderate	**1.49**	1.31 – 1.70	**1.22**	1.05 – 1.42	1.06	0.94 – 1.19
Partner-Heavy	**1.43**	1.20 – 1.72	**1.30**	1.05 – 1.61	**1.22**	1.04 – 1.43
Dual-Heavy	**1.56**	1.27 – 1.86	**1.39**	1.09 – 1.69	**1.30**	1.10 – 1.50

Table 35: Binary logistic regression of the direct effects of the predicted probability of being in a class on KS1-4 outcomes in MCS

5.9 What is the relationship between parental substance use and children's educational attainment once environmental and demographic factors are adjusted for?

The predicted probability of being in each latent class will be used to predict KS1, KS2 and KS4 attainment. As with research question one, the models were conducted simultaneously to account for the correlation between the outcomes using the maximum likelihood robust estimator. Models were conducted separately for each class probability as models would not converge when all four classes were used in a single model. Statistical significance is represented by bold estimates and the upper 2.5% and lower 2.5% are given for confidence intervals (95% CI). Odd Ratios (OR) are used, with unstandardised results being used for statistical significance as OR statistical significance values were not available in the version of Mplus that the Secure Lab supplied. This means that statistical significance and 95% CI's may contradict and have been discussed in turn.

5.9.1 Low users class predicting educational attainment, adjusted for confounders

The regression model uses the predicted probability of being in the low user's class from the latent class analysis to estimate KS1, 2 and 4 outcomes, see Table 36. For KS1, 2 and 4, the increased probability of being in the low class reduced attainment (OR 0.60, 0.70, 0.77, $p<0.05$). Prenatal smoking had a negative association with KS1, 2 and 4 attainment (OR 0.98, 0.98, 0.96, $p<0.05$). An increase in the mother's age increased attainment significantly for KS4 (OR 1.04, $p<0.05$), but all education outcomes showed similar directions. Females were more likely to attain KS1, 2 and 4 (OR 1.91, 1.33 and 1.63, $p<0.05$). The child's ethnicity did not significantly predict attainment, with mixed-directions across KS1, 2 and 4. Family income predicted KS1, 2 and 4 attainment, with an increase in income resulting in higher chances of attainment (OR

1.21, 1.14, 1.07, *p*<0.05). The mother's qualification increased the chances of attainment for KS1, 2 and 4 (OR 1.35, 1.32, 1.26, *p*<0.05). The presence of mothers distress reduced chances of attainment for KS1, 2 and 4 (OR 0.96, 0.97, 0.98 *p*<0.05).

	KS1		KS2		KS4	
	n=6246		n=6246		n=6246	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Low users	**0.60**	0.47 – 0.76	**0.70**	0.53 – 0.93	**0.77**	0.62 – 0.96
Prenatal smoking	**0.98**	0.96 – 0.99	**0.98**	0.96 – 0.99	**0.96**	0.94 – 0.97
Prenatal alcohol use	1.03	0.96 – 1.11	1.04	0.95 – 1.13	0.98	0.93 – 1.04
Mothers age at delivery	1.00	0.99 – 1.02	1.02	1.00 – 1.03	**1.04**	1.02 – 1.05
Child sex	**1.91**	1.65 – 2.20	**1.33**	1.12 – 1.58	**1.63**	1.45 – 1.84
Child ethnicity	0.90	0.71 – 1.13	1.28	0.96 – 1.70	1.14	0.93 – 1.39
Family income	**1.21**	1.13 – 1.29	**1.14**	1.06 – 1.24	**1.07**	1.01 – 1.13
Mother's qualification	**1.35**	1.28 – 1.44	**1.32**	1.23 – 1.42	**1.26**	1.20 – 1.34
Mother's distress	**0.96**	0.95 – 0.98	**0.97**	0.95 – 0.99	**0.98**	0.96 – 0.99

Table 36: Logistic regression of the predicted probability of the low users class predicting attainment, adjusted for confounders

5.9.2 Moderate users predicting educational attainment, adjusted for confounders

The regression model uses the predicted probability of being in the moderate users class from The regression model uses the predicted probability of being in the moderate users class from the latent class analysis to estimate KS1, 2 and 4 outcomes, see Table 37. The increased probability of being in the moderate class increased the chances of attainment but this was not statistically significant. Prenatal smoking reduced the chances of KS1, 2 and 4 attainment (OR 0.97, 0.98, 0.96, *p*<0.05). Prenatal alcohol use was not significant for any outcomes. An increase in the mother's age increased attainment significantly for KS2 and KS4 (OR 1.02, 1.03, *p*<0.05), but all time-points showed similar directions. Females were more likely to attain KS1, 2 and 4 (OR 1.96, 1.42, 1.67, *p*<0.05). A child of an ethnic minority group had a reduced chance of attaining KS1 (OR 0.72, *p*<0.05), but KS2 and 4 were flipped and non-significant. Family income predicted KS1, 2 and 4 attainment, with an increase in income resulting in higher chances of attainment (OR 1.22, 1.19, 1.04, $p<0.05$). The mother's qualifications increased chances of attainment for all outcomes (OR 1.36, 1.30, 1.25, $p<0.05$). The presence of distress in mothers reduced the chances of attainment for KS1, 2 and 4 (OR 0.97, 0.97, 0.98, $p<0.05$).

	KS1		**KS2**		**KS4**	
	n=6246		n=6246		n=6246	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Moderate users	1.27	0.99 – 1.44	1.30	0.86 – 1.33	1.14	0.90 – 1.23
Prenatal smoking	**0.97**	0.96 – 0.99	**0.98**	0.96 – 0.99	**0.96**	0.94 – 0.97
Prenatal alcohol use	1.06	0.99 – 1.14	1.07	0.98 – 1.15	0.99	0.94 – 1.05
Mothers age at delivery	1.01	0.99 – 1.02	**1.02**	1.00 – 1.03	**1.03**	1.02 – 1.05
Child sex	**1.96**	1.65 – 2.20	**1.42**	1.13 – 1.58	**1.67**	1.45 – 1.84
Child ethnicity	**0.72**	0.63 – 0.98	1.16	0.88 – 1.50	1.02	0.87 – 1.28
Family income	**1.22**	1.14 – 1.31	**1.19**	1.07 – 1.25	**1.04**	1.02 – 1.14
Mother's qualification	**1.36**	1.29 – 1.45	**1.30**	1.24 – 1.43	**1.25**	1.20 – 1.33
Mother's distress	**0.97**	0.95 – 0.98	**0.97**	0.95 – 0.99	**0.98**	0.96 – 0.99

Table 37: Logistic regression of the predicted probability of the moderate users class predicting attainment, adjusted for confounders

5.9.3 Partner-heavy class predicting educational attainment, adjusted for confounders

The regression model uses the predicted probability of being in the partner-heavy class from the latent class analysis to estimate KS1, 2 and 4 outcomes, see Table 38. The increased probability of being in the partner-heavy class increased the chances of attainment but this was not statistically significant. Prenatal smoking reduced the chances of KS1, 2 and 4 attainment (OR 0.97, 0.98, 0.96, $p<0.05$). Prenatal alcohol use was not significant for any outcomes. An increase in mother's age increased attainment significantly for KS2 and KS4 (OR 1.02, 1.04, $p<0.05$), but all time-points showed similar directions. Females were more likely to attain KS1, 2 and 4 (OR 1.90, 1.33, 1.63, $p<0.05$). A child who was from an ethnic minority background had a reduced chance of attaining KS1 (OR 0.77, $p<0.05$), but KS2 and 4 were flipped and non-significant. Family income predicted KS1, 2, and 4 attainment, with an increase in income resulting in higher chances of attainment (OR 1.22, 1.15, 1.08, $p<0.05$). The mother's qualifications increased chances of attainment for all outcomes (OR 1.37, 1.33, 1.27, $p<0.05$). The presence of distress in mothers reduced the chances of attainment for KS1, 2 and 4 (OR 0.96, 0.97, 0.98, $p<0.05$).

	KS1		KS2		KS4	
	n=6246		n=6246		n=6246	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Partner-heavy	1.28	0.99 – 1.67	1.31	0.97 – 1.77	1.14	0.93 – 1.39
Prenatal smoking	**0.97**	0.96 – 0.99	**0.98**	0.96 – 0.99	**0.96**	0.94 – 0.97
Prenatal alcohol use	1.06	0.99 – 1.14	1.06	0.97 – 1.15	0.99	0.94 – 1.05
Mothers age at delivery	1.01	0.99 – 1.02	**1.02**	1.00 – 1.03	**1.04**	1.02 – 1.05
Child sex	**1.90**	1.64 – 2.20	**1.33**	1.12 – 1.57	**1.63**	1.45 – 1.84
Child ethnicity	**0.77**	0.62 – 0.96	1.15	0.89 – 1.49	1.05	0.88 – 1.27
Family income	**1.22**	1.14 – 1.31	**1.15**	1.07 – 1.25	**1.08**	1.02 – 1.14
Mother's qualification	**1.37**	1.29 – 1.45	**1.33**	1.24 – 1.43	**1.27**	1.20 – 1.33
Mother’s distress	**0.96**	0.95 – 0.98	**0.97**	0.95 – 0.99	**0.98**	0.96 – 0.99

Table 38: Logistic regression of the predicted probability of the partner-heavy class predicting attainment, adjusted for confounders

5.9.4 Dual-parent heavy class predicting educational attainment, adjusted for confounders

The regression model uses the predicted probability of being in the dual-heavy class from the latent class analysis to estimate KS1, 2 and 4 outcomes, see Table 39. The increased probability of being in the dual-heavy class was positively associated with KS1and 4, but this was very weak (OR 1.01); KS1 had an OR of 1.00, meaning no association was found. Prenatal smoking reduced the chances of KS1, 2 and 4 attainment (OR 0.97, 0.98, 0.96, $p<0.05$). Prenatal alcohol use was not significant for any outcomes. An increase in the mother’s age increased attainment significantly for KS4 (OR 1.04, $p<0.05$), but all time-points showed similar directions. Females were more likely to attain KS1, 2 and 4 (OR 1.90, 1.33, 1.63, $p<0.05$). A child of an ethnic minority background had a reduced chance of attaining KS1 (OR 0.76, $p<0.05$), but KS2 and 4 were flipped and non-significant. Family income had a positive association with KS1, 2 and 4 attainment (OR 1.23, 1.16, 1.08, $p<0.05$). The mother’s qualifications had a positive association with attainment for all outcomes (OR 1.37, 1.33, 1.27, p<0.05). The presence of distress in mothers reduced the chances of attainment for KS1, 2 and 4 (OR 0.96, 0.97, 0.97, p<0.05).

	KS1		**KS2**		**KS4**	
	n=6246		n=6246		n=6246	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Dual-heavy	1.01	0.77 – 1.31	1.00	0.73 – 1.37	1.01	0.81 – 1.25
Prenatal smoking	**0.97**	0.96 – 0.99	**0.98**	0.96 – 0.99	**0.96**	0.94 – 0.97
Prenatal alcohol use	1.06	0.98 – 1.14	1.06	0.97 – 1.16	0.99	0.94 – 1.05
Mothers age at delivery	1.01	0.99 – 1.02	1.02	1.00 – 1.03	**1.04**	1.02 – 1.05
Child sex	**1.90**	1.65 – 2.20	**1.33**	1.12 – 1.58	**1.63**	1.49 – 1.84
Child ethnicity	**0.76**	0.61 – 0.94	1.13	0.87 – 1.47	1.05	0.82 – 1.26
Family income	**1.23**	1.14 – 1.31	**1.16**	1.07 – 1.25	**1.08**	1.00 – 1.14
Mother's qualification	**1.37**	1.29 – 1.45	**1.33**	1.24 – 1.43	**1.27**	1.18 – 1.33
Mother's distress	**0.96**	0.95 – 0.98	**0.97**	0.95 – 0.99	**0.97**	0.95 – 0.99

Table 39: Logistic regression of the predicted probability of the dual-heavy class predicting attainment, adjusted for confounders

5.9.5 Parenting models

As in Chapter 4, regression models were conducted to evaluate the association of parenting and the family environment with attainment, both adjusted and unadjusted. Some parenting models showed significant associations with attainment, however due to considerable multi-collinearity and problems with regressing latent variables the interpretation requires great caution due to model instability; see Appendix G for tables.

5.10 Do parenting and the family environment mediate the relationship between parental substance use and children's educational attainment?

Classes that showed the highest substance use were the 'partner-heavy' and 'dual-parent heavy' classes. These will be used as exposures in analysis, as done previously in Chapter 4 for ALSPAC. Model fit statistics are shown throughout, with statistically significant pathways in bold. While the analytical approach aimed to use FIML for missing data, this posed numerous errors in models as they did not converge and the indirect effect could not be calculated (Muthén and Muthén 2017). As a result, the models were conducted using Weighted Least Squares Means and Variance (WLSMV) estimators, which are recommended for dependent variables which are binary (Muthén and Muthén 2017). Despite that FIML was not used, WLSMV uses a pairwise approach to missing data. The number of observations for maximum likelihood and WLSMV were compared, and did not differ, so missing data bias was not a concern. The SRMR was not available in this version of Mplus, but the WRMR statistic was; however, this can be unreliable (Muthén and Muthén 2017), so it is not interpreted.

Model fit was judged before interpretation. For adequate model fit, the χ^2 should not be significant, but small differences can lead to this when using large sample sizes; the RMSEA must be <0.08 and CFI, TLI >0.90. For good fit, the RMSEA must be <0.05 and CFI, TLI >0.95 – the same as the EFA and CFA. The circular variables represent latent variables, and rectangular variables represent manifest, or single, variables. The curved arrows represent correlation. The direct effect is the association between the predicted probability of the partner-heavy, or dual-heavy class on KS1 – 4, the indirect effect is the mediator associations. As OR was not available, the coefficients are probit estimates which are interpreted in a similar way. The next section show SEM mediation models for the predicted probability of the partner-heavy class on KS1 - 4, and the dual-heavy class on KS1 – 4.

5.10.1 SEM mediation models: partner-heavy class

5.10.1.1 KS1

The model had adequate fit (n=14,197 χ^2 = 10319.11, RMSEA = 0.05, CFI = 0.92, TLI = 0.91, WRMR = 5.17). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.62, p<0.05), the partner-child interaction and school involvement (R^2=0.25, p<0.05), interparental conflict and parenting competency (R^2=-0.31, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

The direct effect shows that an increase in the probability of the partner-heavy class is associated with an increase in KS1 results (0.12, p<0.05), and this was statistically significant. An increase in the probability of being in the partner-heavy class did not significantly predict many parenting behaviours or household conflict, much of the estimates were small (0.02 – 0.07). However, attendance at parents evening was significantly increased (0.19, *p*<0.05), and so was the mother-child interaction (0.10, *p*<0.05). In contrast, many of these behaviours significantly predicted KS1 outcomes. Mother-child closeness increased KS1 outcomes (0.12, *p*<0.05), as did attendance at parents evening (0.26, *p*<0.05), breakfast frequency and a regular bedtime (0.20, 0.17, *p*<0.05). Likewise, parenting competency increased KS1 (0.08, *p*<0.05) as did the mother-child interaction (0.07, *p*<0.05) and the partner-child interaction (0.06, *p*<0.05). In contrast, interparental conflict decreased KS1 (-0.07, *p*<0.05). The total effect of the model was β=0.21 (*p*<0.05), with the indirect effect being β=0.09 (*p*<0.05). Significant indirect effects included parents evening (0.04, *p*<0.05); see Figure 21.

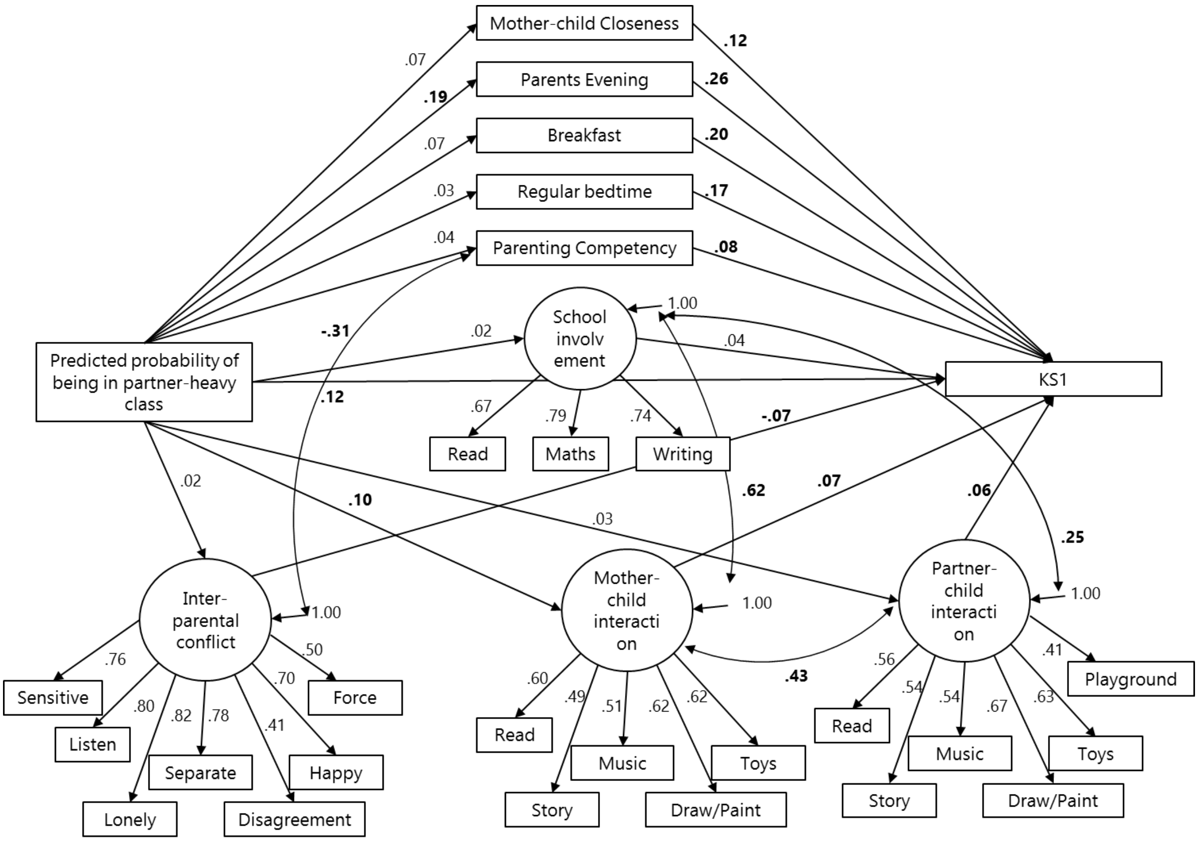

Figure 21: SEM mediation model for the partner-heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

5.10.1.2 KS2

The model had adequate fit (n=14,125 χ^2 = 10319.11, RMSEA = 0.05, CFI = 0.92, TLI = 0.91, WRMR = 5.15). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.62, p<0.05), the partner-child interaction and school involvement (R^2=0.25, p<0.05), interparental conflict and parenting competency (R^2=-0.31, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

The direct effect was not significant (0.08, p=0.22). An increase in the probability of being in the partner-heavy class did not significantly predict many parenting behaviours or household conflict, much of the estimates were small (0.02 – 0.07). However, attendance at parents evening was significantly increased (0.19, p<0.05), and so was the mother-child interaction (0.10, p<0.05). In contrast, many behaviours significantly predicted KS2 outcomes. Mother-child closeness increased KS2 outcomes (0.12, p<0.05), as did attendance at parents evening (0.20, p<0.05). Also, breakfast frequency and a regular bedtime was positively associated with KS2 (0.17, 0.16, p<0.05). Likewise, parenting competency increased KS2 (0.07 p<0.05); both parent-child interactions were not significant for KS2. The presence of interparental conflict decreased the chances of KS2 outcomes (-0.06, p<0.05). The total effect of the model was β=0.15 (p<0.05), with the indirect effect being β=0.07 (p<0.05). Significant indirect effects included the attendance at parents evening (0.04, p<0.05); see Figure 22.

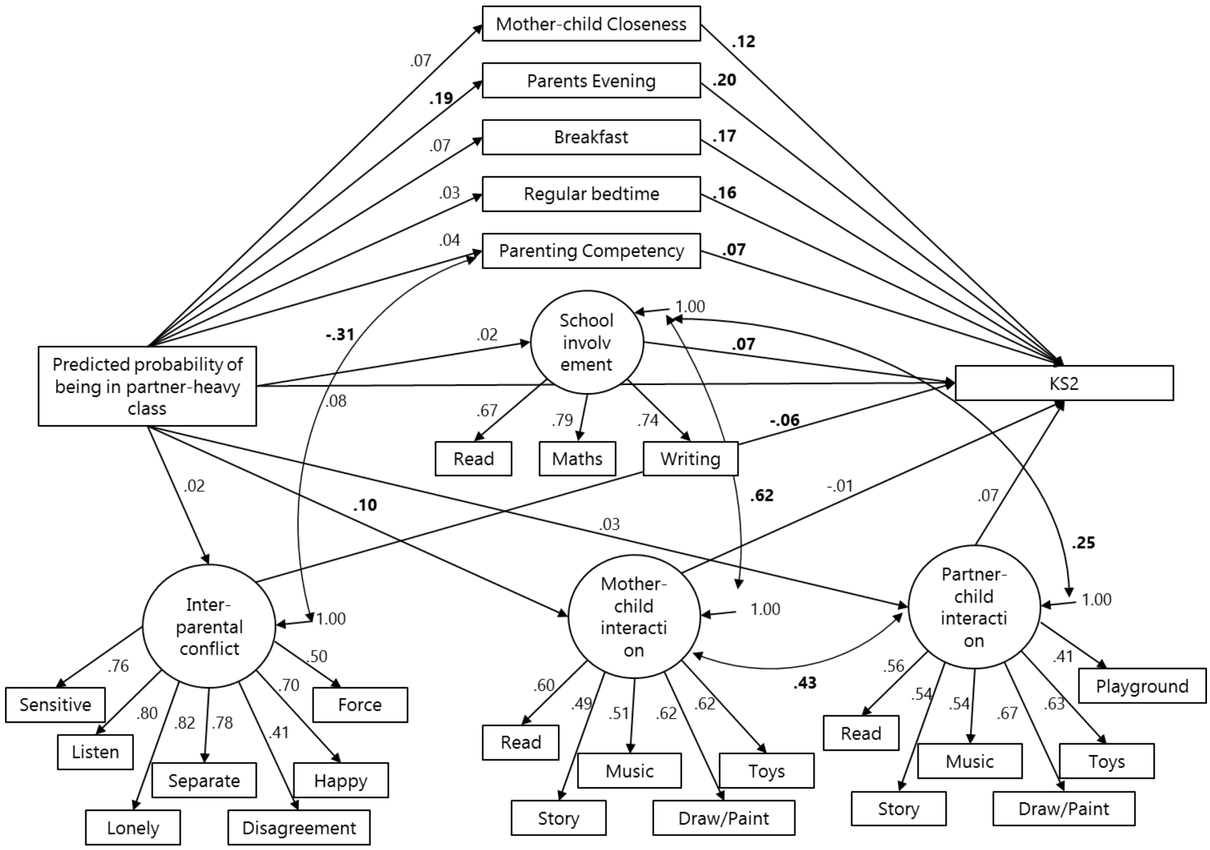

Figure 22: SEM mediation model for the partner-heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

5.10.1.3 KS4

The model had adequate fit (n=14,132, χ2 = 10261.49, RMSEA = 0.05, CFI = 0.92, TLI = 0.91, WRMR = 5.16). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.62, p<0.05), the partner-child interaction and school involvement (R^2=0.25, p<0.05), interparental conflict and parenting competency (R^2=-0.31, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05). An increase in the partner-heavy class predicted an increase in KS4 results (0.05, p=0.40), but this was not statistically significant. An increase in the probability of being in the partner-heavy class was positively associated with parents evening (0.19, p<0.05), and the mother-child interaction (0.10, p<0.05). In contrast, many behaviours significantly predicted KS4. Attendance at parents evening increased KS4 (0.25, p<0.05), as did breakfast frequency and bedtime (0.20, 0.11, p<0.05). Likewise, parenting competency increased KS4 (0.09, p<0.05). In contrast, interparental conflict decreased outcomes (-0.04, p<0.05). The total effect of the model was β=0.12 (p<0.05), the indirect effect was β=0.08 (p<0.05). Parents evening (0.05, p<0.05) was an indirect effect; see Figure 23.

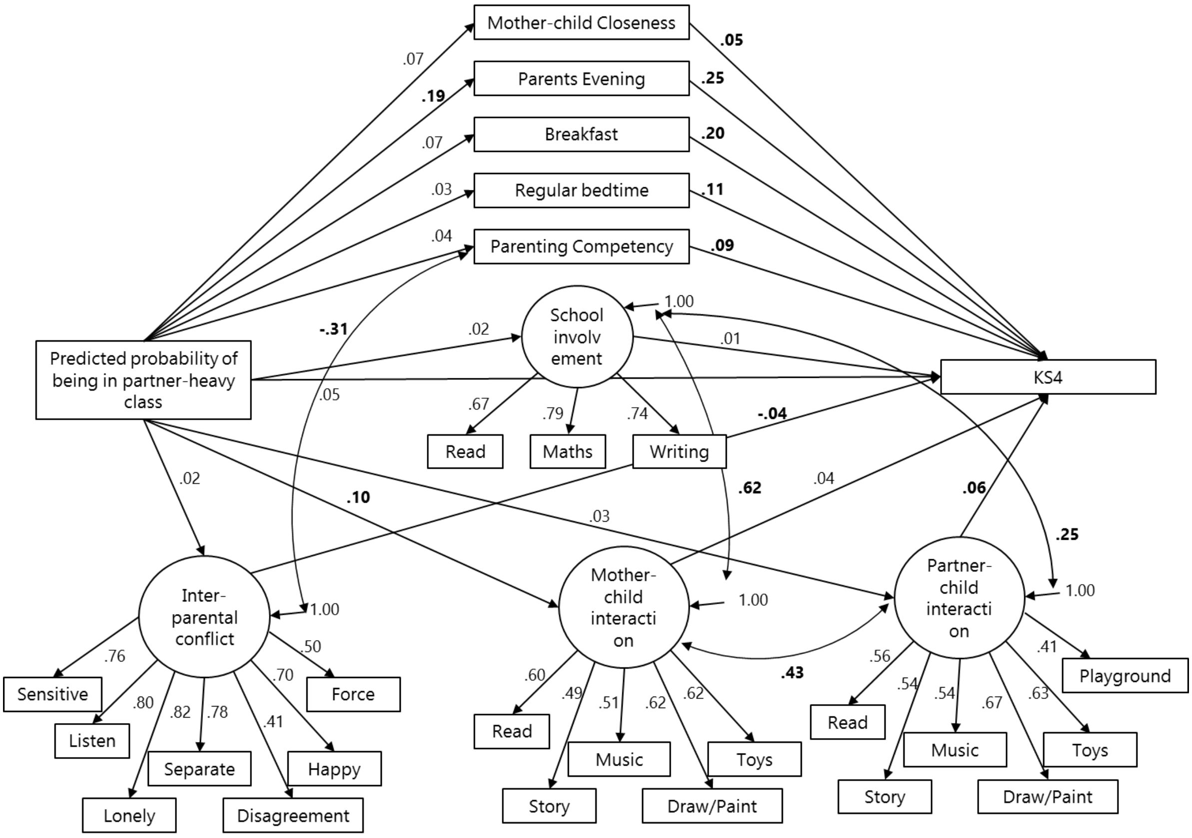

Figure 23: SEM mediation model for the partner-heavy class and KS4, with parenting and the family environment as mediators. Significant associations are bold (p<0.05), curved arrows represent correlations (R^2)

5.10.2 SEM mediation models: dual-heavy class

5.10.2.1 KS1

The model had adequate fit (n=14,197, $\chi2$ = 10290.36, RMSEA = 0.05, CFI = 0.92, TLI = 0.91, WRMR = 5.17). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.62, p<0.05), the partner-child interaction and school involvement (R^2=0.26, p<0.05), interparental conflict and parenting competency (R^2=-0.31, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

The direct effect shows that an increase in being in the dual-heavy class predicted an increase in KS1 results and this was statistically significant (0.25, p<0.05). An increase in the probability of being in the dual-heavy class did significantly predict some parenting behaviours family environment variables, but some estimates were small (-0.03 – 0.08). Breakfast frequency was increased when the predicted probability of being in the dual-heavy class increased (0.16, p<0.05). However, parenting competency decreased when the probability of the dual-heavy class increased (-0.21, p<0.05), as did school involvement (-0.19, p<0.05), and mother-child interaction (-0.10, p<0.05). In addition, the presence of interparental conflict increased when the class probability increased (0.17, p<0.05). Many parenting behaviours and household conflict predicted KS1 outcomes. Mother-child closeness increased KS1 (0.12, p<0.05), as did attendance at parents evening (0.26, p<0.05). The frequency of breakfast and sleep routines also increased KS1 outcomes (0.19, 0.17, p<0.05). Likewise, parenting competency (0.08, p<0.05), the mother-child interaction (0.07, p<0.05) and partner-child interaction (0.06, p<0.05) had positive relationships with KS1 outcomes. The total effect of the model was β=0.25 (p<0.05), with the indirect effect being β=-0.00 (p=0.87). Significant indirect effects included breakfast (0.03, p<0.05), parenting competency (-0.02, p<0.05), and interparental conflict (-0.01, p<0.05). For the full model, see Figure 24.

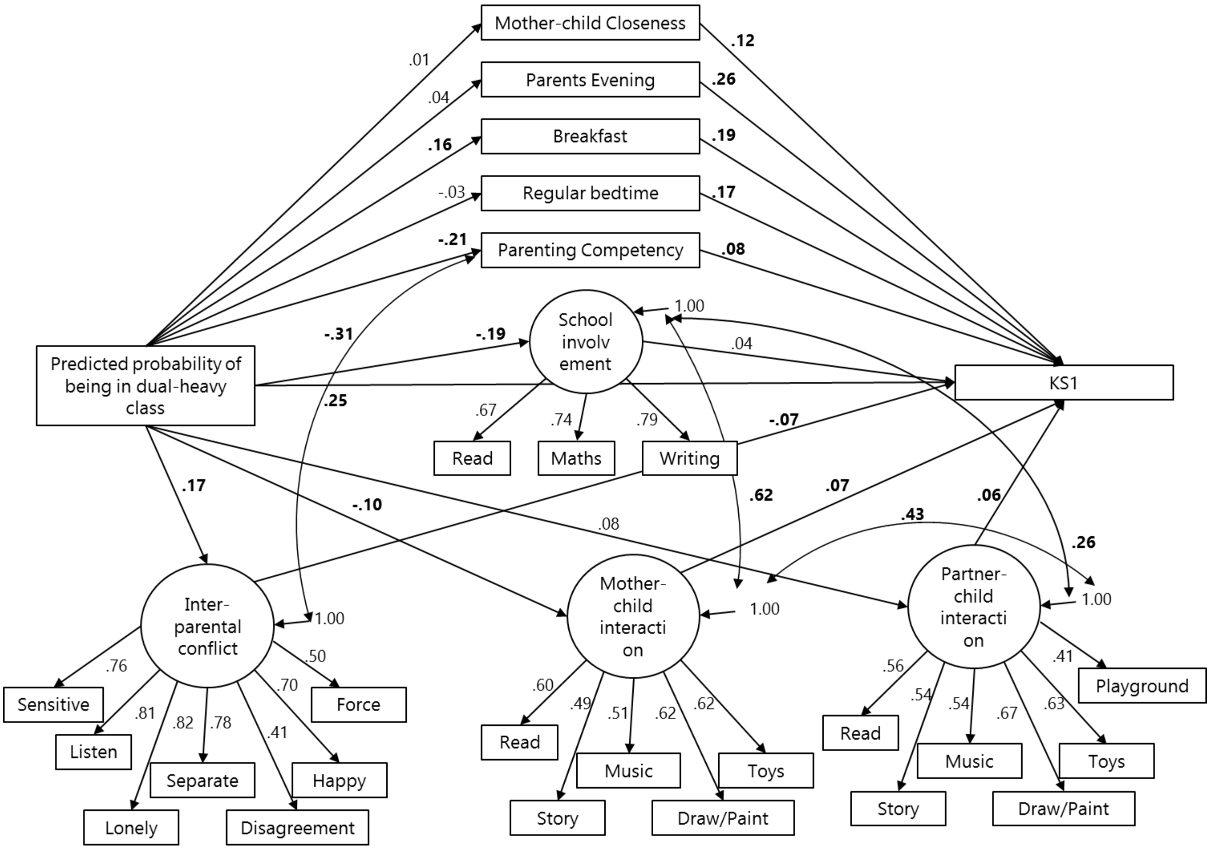

Figure 24: SEM mediation model for the dual-heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

5.10.2.2 KS2

The model had adequate fit (n=14,125, χ^2 = 10189.44, RMSEA = 0.05, CFI = 0.92, TLI = 0.91, WRMR = 5.14). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.62, p<0.05), the partner-child interaction and school involvement (R^2=0.26, p<0.05), interparental conflict and parenting competency (R^2=-0.31, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

The direct effect shows that an increase in being in the dual-heavy class predicted an increase in KS2 results and this was statistically significant (0.18, p<0.05). An increase in the probability of being in the dual-heavy class did significantly predict some parenting behaviours or family environment aspects, but some estimates were small (0.01 – 0.06). Breakfast frequency was increased when the predicted probability of being in the dual-heavy class increased (0.16,

p<0.05). However, parenting competency decreased when the probability of the dual-heavy class increased (-0.21, p<0.05), as did school involvement (-0.19, p<0.05) and mother-child interaction (-0.10, p<0.05). In addition, the presence of interparental conflict increased when the class probability increased (0.17, p<0.05). Many parenting behaviours and household conflict predicted KS2 outcomes. Attendance at parents evening increased the probability of KS2 (0.20, p<0.05). The frequency of breakfast and sleep routines also increased KS2 outcomes (0.17, 0.16, p<0.05). Likewise, parenting competency (0.07, p<0.05) had a positive relationship with KS2 outcomes. In contrast, interparental conflict had a negative relationship with KS2 outcomes (-0.06, p<0.05). The total effect of the model was β=0.18 (p<0.05), with the indirect effect being β=-0.00 (p=0.96). Significant indirect effects included breakfast (0.03, p<0.05), parenting competency (-0.02, p<0.05) and interparental conflict (-0.01, p<0.05); see Figure 25.

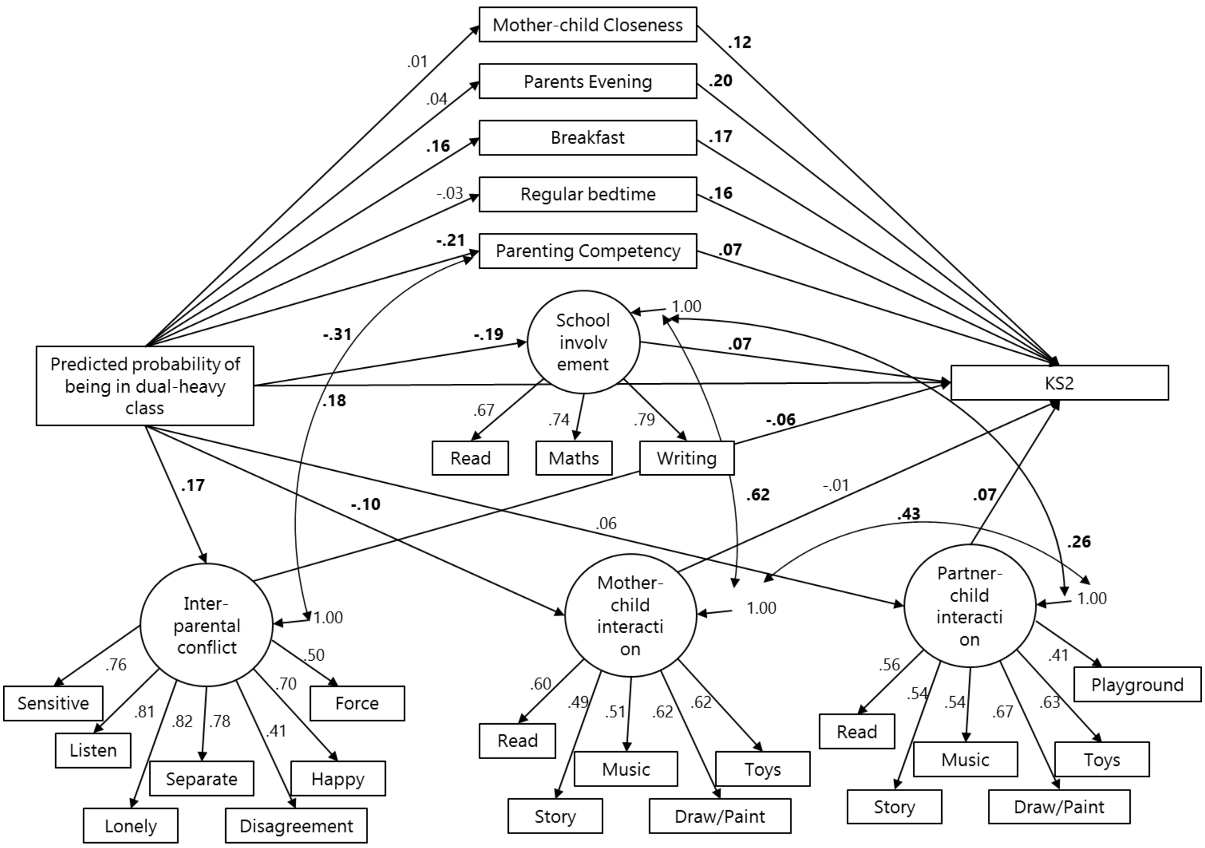

Figure 25: SEM mediation model for the dual-heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

5.10.2.3 KS4

The model had adequate fit (n=14,132, $\chi2$ = 10232.58, RMSEA = 0.05, CFI = 0.92, TLI = 0.91, WRMR = 5.15). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.62, p<0.05), the partner-child interaction and school involvement (R^2=0.26, p<0.05), interparental conflict and parenting competency (R^2=-0.31, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

The direct effect shows that an increase in being in the dual-heavy class predicted an increase in KS4 results (0.15, p<0.05). An increase in the probability of being in the dual-heavy class did significantly predict some parenting behaviours and family environment aspects, but some estimates were small (0.01 – 0.06). Breakfast frequency was increased when the predicted probability of being in the dual-heavy class increased (0.16, p<0.05). However, parenting competency decreased when the probability of the dual-heavy class increased (-0.21, p<0.05), as did school involvement (-0.19, p<0.05) and mother-child interaction (-0.10, p<0.05). In addition, the presence of interparental conflict increased when the class probability increased (0.17, p<0.05). Many parenting behaviours and household conflict predicted KS4 outcomes. Attendance at parents evening increased KS4 outcomes (0.25, p<0.05), as did the frequency of breakfast (0.20, p<0.05) and bedtime routines (0.11, p<0.05). Likewise, parenting competency (0.09, p<0.05) had a positive relationship with KS4 outcomes. In contrast, interparental conflict had a negative relationship with KS4 outcomes (-0.04, p<0.05).

The total effect of the model was β=0.17 (p<0.05), with the indirect effect being β=0.01 (p=0.68). Significant indirect effects included breakfast (0.03, p<0.05), parenting competency (-0.02, p<0.05), interparental conflict was near significance (-0.01, p=0.06); see Figure 26.

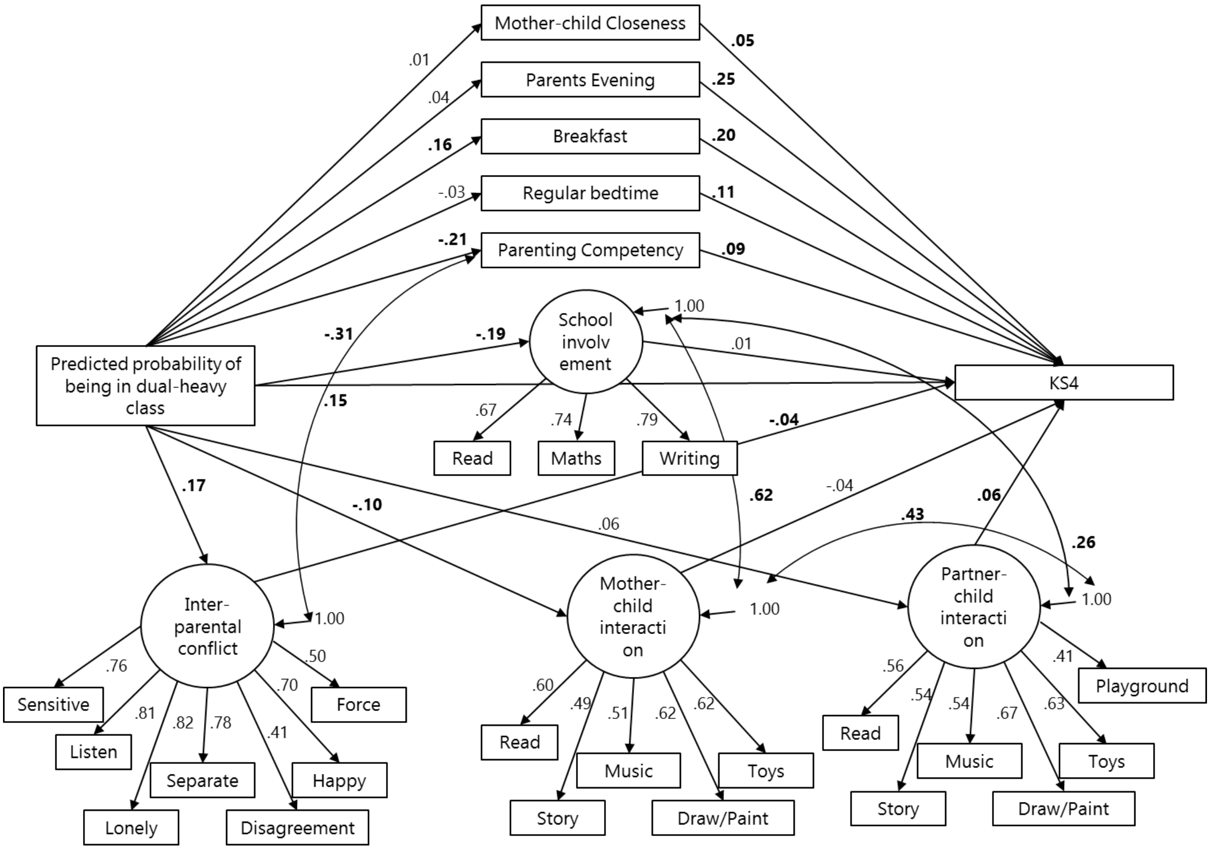

Figure 26: SEM mediation model for the dual-heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2)

5.11 Summary of findings

This chapter includes a replica analysis of Chapter 4 to answer the research questions on the relationship between parental substance use and children's educational outcomes. The latent class analysis showed four distinct classes of parental substance use – low users, moderate users, partner-heavy users, and dual-heavy users. The moderate and dual-heavy users had a positive association with educational attainment, whereas the low users class had a negative association. The partner-heavy class had no statistically significant associations with educational attainment; but it was in a positive direction. Once adjusted for demographic and environmental aspects, the effects of substance use classes were largely annulled, except for the adjusted low users class model (Table 36). Despite there being a positive association with the two highest consumption classes (dual-heavy and partner-heavy), an analysis of the indirect effects was explored to understand the associations of parenting and the family environment from parental substance use to educational attainment.

Both latent and manifest variables were used to understand this relationship. EFA of interparental conflict, mother-child interaction, partner-child interaction, and school involvement were conducted. All models showed that a 1-factor solution was the best fit, and this was confirmed by CFA. These variables were then used in the SEM mediation models. The SEM mediation models showed some evidence of indirect pathways, this was mainly in the dual-heavy substance use models, and less so for partner-heavy models. Notably, decreased parenting competency, interparental conflict, and school involvement from both parents were key mediators in the dual-heavy models, and in the partner-heavy models to a lesser extent. However, as with ALSPAC, there were some unexpected findings in the regressions and mediation models whereby positive associations were found between parental substance use and educational outcomes.

As a result, the next chapter (Chapter 6) explores the unexpected findings from both Chapter 4 and 5; namely the unexpected positive associations found between parental substance use and educational outcomes. Alongside this, it also includes a cross-cohort analysis of all findings in Chapter 4, 5 and 6 and considers replicability and generalisability of the findings.

Chapter 6 Exploratory Analysis and Cross-Cohort Analysis

For both Chapter 4 and 5, the predicted probability of being in a heavy class had a positive association with KS1, 2 and 4 outcomes. For ALSPAC, this was in the mediation analysis, for MCS this was in the unadjusted regression analysis and mediation analysis for the dual-heavy class. This is despite that some indirect effects (interpreted as associations) existed via parenting and the family environment. As discussed in Chapter 2, research shows that both substance use (Bonevski et al. 2014) and parenting and the family environment is associated with socioeconomic status (Hill 2006). However, socioeconomic status is multi-dimensional. Income can mean greater access to alcohol, or illicit drugs, by monetary resources, but parental education can be related to less use of alcohol or illicit drugs due to greater access to health behaviour information (Melotti et al. 2011). Likewise, parents in low socioeconomic conditions may face considerable strain and stress, and the reaction to this through parenting could be increased punitive discipline or authoritarian practices (Hill 2006); these practices are theorised to be negatively associated with educational attainment (Masud et al. 2015).

6.1 Outline

From this, it is theorised that the positive associations captured in the SEM mediation models, and regression models, could be explained by socioeconomic status. As the literature suggests that substance use is patterned by socioeconomic status, the exposure variable, that is high substance using classes, will be explored across socioeconomic status contexts. As educational outcomes are the focus, the measure of parental education is better suited as the measure of socioeconomic status. However, given the complexity around the measurement of socioeconomic status, the models will be explored by income as a sensitivity analysis. Following this, the results of Chapters 4, 5 and 6 are summarised in a cross-cohort analysis; this consolidates the findings across cohorts, highlighting their similarities and differences. Therefore, research questions four and five are explored in this chapter:

4. Does the relationship between parental substance use and children's educational attainment differ across socioeconomic contexts?
5. How do the findings compare across cohort studies in terms of replicability?

6.2 Socioeconomic patterning of the LCA

Cross-tabulations were conducted between the latent classes and socioeconomic status.

6.2.1 ALSPAC cross-tabulation findings

For ALSPAC, low-income groups had high proportions of very low users compared to high income groups (42% vs 27%). However, high income groups had greater proportions of low and moderate users classes compared to low-income groups (31% vs 38%, and 22% vs 32%). The heavy class was equally split across income (4%). Greater qualifications had higher proportions of those in the moderate class. However, for the heavy class, the distribution at the ends of the qualification spectrum, for 'None' and 'Degree', were similar (6% and 5% respectively). A greater proportion of those with fewer qualifications had larger proportions of the very low users class, indicating socioeconomic patterning whereby greater qualifications had higher proportions of low, and moderate substance use; see Table 40 and 41.

	Low Income	**High Income**
Very low users	849 *42%*	1,751 *27%*
Low users	634 *31%*	2,509 *38%*
Moderate users	447 *22%*	2,071 *32%*
Heavy users	85 *4%*	243 *4%*
Total	2,015 *100%*	6,574 *100%*

Table 40: Cross-tabulation of the ALPSAC latent classes by high- and low-income groups

	None	CSE	Vocational	Higher vocational	A-levels	Degree +
Very low users	156 *49%*	330 *42%*	321 *39%*	1,091 *33%*	513 *23%*	217 *37%*
Low users	84 *26%*	255 *32%*	309 *38%*	1,269 *39%*	840 *37%*	496 *37%*
Moderate users	59 *19%*	184 *23%*	163 *20%*	816 *25%*	836 *37%*	566 *42%*
Heavy users	19 *6%*	21 *3%*	20 *2%*	118 *4%*	86 *4%*	71 *5%*
Total	318 *100%*	790 *100%*	813 *100%*	3,294 *100%*	2,275 *100%*	1,350 *100%*

Table 41: Cross-tabulation of the ALSPAC latent classes by mothers highest qualification

6.2.2 MCS cross-tabulation findings

By income, see Table 42, low-income groups had near three times the proportion of low users compared to high income groups (28% vs 12%). However, high income groups had a greater proportion of moderate users (54% vs 58%), and double the proportion across the partner-heavy class (9% vs 18%). However, higher income families had a higher proportion of the dual-heavy class compared to lower income families (8% vs 12%). Likewise, greater qualifications had higher proportions of those in the moderate class, partner-heavy class, and dual-heavy class; a greater proportion of those with less qualifications were in the low class; see Table 43.

	Low income	High income
Low users	1,987 *28%*	757 *12%*
Moderate users	3,819 *54%*	3,632 *58%*
Partner-heavy	647 *9%*	1,108 *18%*
Dual-heavy	562 *8%*	765 *12%*
Total	7,015 *100%*	6,262 *100%*

Table 42: Cross-tabulation of the MCS latent classes by high- and low-income groups

	None	GCSE D - G	GCSE	A-level	First Degree	Higher Degree
Low users	922	294	855	401	584	82
	43%	*24%*	*20%*	*19%*	*14%*	*15%*
Moderate users	910	725	2,580	1,266	2,404	288
	42%	*59%*	*60%*	*59%*	*58%*	*54%*
Partner-heavy	183	109	509	309	666	82
	9%	*9%*	*12%*	*14%*	*16%*	*15%*
Dual-heavy	138	94	381	184	526	81
	6%	*8%*	*9%*	*9%*	*13%*	*15%*
Total	2,153	1,222	4,325	2,160	4,180	533
	100%	*100%*	*100%*	*100%*	*100%*	*100%*

Table 43: Cross-tabulation of the MCS latent classes by mothers' highest qualification level

This analysis has shown that the LCA has clear socioeconomic patterning, and further analysis is required. To explore the socioeconomic patterning of the LCA, a measurement invariance is required. Measurement invariance in LCA is a relatively new technique, and is constantly in development (Geiser et al. 2006; Finch 2015; Nylund-Gibson and Masyn 2016; Masyn 2017; Olivera-Aguilar and Rikoon 2018). Due to the complexity of this analysis, a multiple-group latent class analysis was conducted using the webnotes of the UCLA website, and are replicated in the Mplus User's guide (Muthén and Muthén 2017; UCLA 2020). The groups compared in this analysis were parents who were educated to degree level and non-degree level. To begin, the groups were regressed on to the classes, and the values of each class across groups were compared. Then, a model allowing differences in item means or thresholds and class probabilities across groups, with item variances (if continuous) fixed across groups and classes was conducted (UCLA 2020). To compare the measurement models across groups, the starting values of each variable was used, metrics were taken from the first model. Using a Wald test, classes were compared for the categorical variables. No Wald test can be used for the reference class in Mplus. For the sensitivity analysis of income, this was not conducted due to computational cost; differences were assumed given the cross-tabulations.

If models are not equivalent across qualifications, then the analysis for research questions one, two and three require reconducting for both lower and higher qualification groups. Alongside the analysis of qualifications, a sensitivity analysis of income will be performed. To improve modelling, models were clustered by household ID where possible. This ensures that models adjust for households with twins who have the same parental responses (~1% in both datasets); note, that this made no difference to results when compared to non-clustered models (see Appendix H). Following this, the results presented in the next sections are the measurement invariance of the LCA for ALSPAC and MCS, and any further analysis that is required.

6.3 ALPSAC: Exploratory findings

Section 6.3. will include all data from ALSPAC and begin with the measurement invariance of the LCA model by degree, and non-degree samples to explore whether further analysis is required.

6.3.1 Measurement invariance of the LCA

The original LCA consisted of four classes: very low users, low users, moderate users, and heavy users (n=8,840). When conducting measurement invariance, new classes are generated in each sample – degree and non-degree educated in this analysis. In this analysis, Class 1 appeared to show moderate use of substances for both qualification groups; Class 2 appeared to show some heavy use of substances, particularly alcohol and drugs for the degree educated groups. Class 3 appeared to be the low use group, with the degree qualified group showing higher use. Class 4 was mixed, and showed little similarity across groups, with the non-degree educated group showing very high alcohol and drug use, compared to degree educated groups which showed low use. All estimates are shown in Table 44.

		Non-degree educated				Degree educated			
	Class	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Mothers alcohol use		93.69	95.69	-62.41	97.02	95.84	97.17	94.15	0.00
Partner's alcohol use (units >4 over a month) (%)	**None**	15%	5%	31%	7%	9%	4%	24%	37%
	1 - 2 days	22%	10%	23%	3%	18%	1%	20%	20%
	3 - 4 days	25%	19%	17%	9%	18%	12%	22%	14%
	5 - 10 days	25%	35%	16%	12%	31%	9%	24%	14%
	> 10 days	10%	25%	9%	33%	20%	37%	8%	9%
	Everyday	3%	6%	4%	35%	5%	37%	2%	5%
Mothers drug use	**Yes (%)**	3%	7%	4%	16%	9%	27%	2%	3%

Table 44: Variable means and proportions for separate classes in measurement invariance for ALSPAC

Class 1 was not invariant (or equivalent), as the Wald test showed statistical significance (Wald=4.35, *df*=31, $p<0.05$). Partial invariance was conducted, whereby mother's drug use was fixed; other variables could not be fixed due an Mplus error. Once fixed, the Wald test showed invariance, but the model was not stable, and no further thresholds could be fixed to test for partial invariance. Class 2 showed invariance for the full class (Wald=0.77, *df*=1, $p=0.09$). Class 3 did not show invariance (Wald=5.09, *df*=1, $p<0.05$); partial invariance was found when fixing the mother's drugs variable at zero (Wald=0.82, *df*=1, $p=0.37$). However, the model was not stable, and the computational cost for further analysis was very high. Class 4 was not conducted as this was the reference category for the LCA. No further invariance could be explored due to model errors alerted by Mplus. Due to the model showing variance and instability the LCA is deemed variant across educational qualifications.

As a result, each qualification group will have new LCA's conducted, and the classes with the highest substance use will be used in regression analysis and SEM mediation models. The results of each sample, degree educated, or non-degree educated are discussed.

6.3.2 *Degree educated sample*

All findings under section 6.3.2. are for the degree educated sample in ALSPAC.

6.3.2.1 *Latent Class Analysis*

LCA which was discussed in Chapter 3, 4 and 5 as "a statistical procedure that can be used to classify individuals into homogeneous subgroups… [which can] test theories about typological differences between individuals" (Geiser 2013, p.233) was conducted with the mothers and partner's alcohol use, and mothers drug use. To recap, the best fitting models have the lowest AIC, BIC and adjusted BIC values, good class classification (above 80%), and Entropy (>0.70). The VLMR, LMR LRT, and Bootstrap LRT suggests if a model with more classes is better than one less (*k*-1). The next section discusses the LCA for the degree-educated sample for ALPSAC.

The degree educated sample included 1,350 participants. The 4-class solution was chosen as it had the lowest BIC, and although the AIC and adjusted BIC was higher in the 5-class solution, it was marginal, and not supported by other metrics. The 4-class solution had the highest entropy, with all models showing acceptable entropy ranges. The classification probabilities were acceptable for the 4-class solution, between 97% - 84%. The LRT tests suggested the 4-class solution was better than the 3-class solution, but the 5-class solution was not better than the 4-class; see Table 45.

	2-class	**3-class**	**4-class**	**5-class**
AIC	28203.18	27662.68	27459.51	27432.50
BIC	28380.25	27881.41	27719.90	27734.56
Adjusted BIC	28272.24	27747.99	27561.07	27550.32
Proportions	59%	58%	48%	36%
	41%	26%	32%	29%
		16%	15%	17%
			4%	14%
				3%
Entropy	0.75	0.79	0.80	0.70
Probability of most likely latent class membership	95%	92%	90%	77%

	90%	90%	84%	75%
		86%	97%	74%
			84%	100%
				87%
VLMR LRT	*p*<0.05	*p*<0.05	*p*<0.05	*p*=0.09
LMR LRT	*p*<0.05	*p*<0.05	*p*<0.05	*p*=0.10
Bootstrap LRT	-	-	-	-

Table 45: Statistical criteria for the degree educated sample for ALSPAC; selected solution in grey

The 4-class solution showed distinct classes of very low users, low users, moderate users, and heavy users of substances; proportions have not been given due to SDC. Mothers in the very low user's class consumed near no alcohol Monday through to Sunday, and this was also reflected in their partner's use of alcohol. Most partners were in the lower use categories, as 37% of partners responded 'None' and 20% responded '1 – 2 days'. Mothers drug use was low, with <5% using drugs. For the low class, mothers consumed alcohol in small amounts during the week, with Saturday showing the highest use (1.21 glasses). Their partners reflected this use, with two-thirds of the sample in the '1 – 2 days', '3 – 4 days' and '5 – 10 days' category; this class had low reports of drug use. The moderate class consumed at least a glass of alcohol each day, with this increasing to two glasses over the weekend; their partners reflected this use, with 33% responding '5 – 10 days' and 23% responding '> 10 days'. Mothers' drug use was higher in this class (10%). The heavy class included mothers who consumed over three glasses of alcohol daily, with this close to five glasses on Friday and Saturday. Their partners mirrored this use, with 35% being in both the '> 10 days' category, and in the 'Every day' category; mothers drug use was the highest in this category at 27%. This is all summarised in Table 46.

	Very low users	Low users	Moderate users	Heavy users
Mothers alcohol use				
Monday	0.00	0.26	1.00	3.61
Tuesday	0.00	0.28	1.22	3.62
Wednesday	0.00	0.32	1.28	3.88
Thursday	0.00	0.43	1.21	3.71
Friday	0.00	0.78	2.05	4.73
Saturday	0.01	1.21	2.55	4.92
Sunday	0.00	0.71	1.60	3.34
Partners >4 units use a month				
None	37%	23%	<5%	~
1 - 2 days	20%	21%	15%	~
3 - 4 days	15%	22%	17%	~10%
5 - 10 days	15%	24%	33%	~10%
> 10 days	~10%	~10%	23%	35%
Everyday	<5%	<5%	~10%	35%
Mothers drug use				
Yes	>95%	>95%	90%	27%
No	<5%	<5%	10%	73%

Table 46: Means of mothers alcohol use, and proportions of partners alcohol use, and mothers drug use by class for the degree educated sample in ALSPAC

6.3.2.2 Regressions

6.3.2.2.1.1 Unadjusted model

Table 47 shows the predicted probability of being in the heavy class; it was positively associated with KS1 – KS4 outcomes (OR 18.02, 2.82, and 3.46), none of these estimates were statistically significant and the confidence intervals were large so should be interpreted with caution.

	KS1		KS2		KS4	
	n=1074		n=1074		n=1074	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Heavy users	18.02	0.46 – 709.63	2.82	0.20 – 39.01	3.46	0.74 – 12.64

Table 47: Binary logistic regressions of each class predicted on to KS1 – 4 outcomes for the degree sample in ALSPAC

6.3.2.2.2 Adjusted model

Table 48 shows the unadjusted regression model. The predicted probability of being in the heavy class increased the chances of achieving KS1 - 4 outcomes (OR 17.64, 1.95, 4.47) but these estimates were not statistically significant. Moreover, the confidence intervals are considerably large, and caution is warranted for interpretation. Prenatal smoking was associated with a decrease for all outcomes (OR 0.91, p<0.05, 0.99, and 0.77); prenatal drug use was also negatively associated, however there is an intersection of the null, so these are unlikely to be robust despite showing significance. Mother's age was statistically significant for KS1 (OR 1.12, p<0.05). Females had a higher chance of attaining KS1 - 4 (OR 2.48, 1.16, 2.30), only KS4 was statistically significant but KS1 and KS2 were in the same direction; KS2 intersected the null. Ethnic minorities had a lower chance of attainment at KS2 (OR 0.45, p<0.05), this was reflected in KS1 and KS4 in the same direction. Mothers wellbeing was statistically significant for KS1 and 2 (OR 0.87 and 0.89 p<0.05), and KS4 was in the same direction; these findings were unexpected, suggesting greater wellbeing is associated with lower attainment.

	KS1		**KS2**		**KS4**	
	n=955		n=955		n=995	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Heavy class	17.64	0.21 – 1506.39	1.95	0.12 – 31.96	4.47	0.48 – 41.38
Prenatal smoking	**0.91**	0.57 – 1.48	0.99	0.57 – 1.73	0.77	0.54 – 1.10
Prenatal alcohol use	0.96	0.61 - 1.51	1.26	0.82 – 1.94	1.15	0.90 - 1.48
Prenatal drug use	**0.22**	0.05 – 1.08	**0.32**	0.07 – 1.41	3.94	0.49 – 31.57
Mothers age at delivery	**1.12**	1.01 - 1.23	0.99	0.91 - 1.08	0.97	0.92 - 1.02
Child sex	2.84	1.29 – 6.23	1.16	0.65 – 2.10	**2.30**	1.56 - 3.39
Child ethnicity	0.25	0.06 – 0.94	**0.45**	0.14 - 1.49	0.61	0.24 - 1.56
Mother's wellbeing	**0.87**	0.78 – 0.97	**0.89**	0.81 – 0.98	0.95	0.89 - 1.01

Table 48: Adjusted binary logistic regression of the heavy class on KS1 – 4 outcomes for the degree sample for ALSPAC

6.3.2.3 SEM mediation models

This section includes the SEM mediation models for the degree sample for KS1 – 4.

6.3.2.3.1 KS1

Figure 27 shows the degree sample model for ALSPAC, KS1. The model had good fit (n=1,334, χ^2 = 340.72, *df*=158, *p*<0.05, RMSEA = 0.03, CFI = 0.96, TLI = 0.96, SRMR = 0.07). This fit was achieved as the variables of mothers and partners help with homework, mothers help with homework and mother-child interaction, and abuse and interparental conflict were correlated (R^2 0.45, 0.46 and 0.40 respectively). The mediation model shows the direct effect between the predicted probability of being in the heavy substance use class and KS1 was positive, and not statistically significant (-5.41, *p*=0.72). The only statistically significant path in this model was the relationship between substance use and interparental conflict (0.60, *p*<0.05), which showed an increase. The total effect of this model was β=1.23 (*p*=0.55) and the indirect effect was β=6.64 (*p*=0.66) which shows evidence for a larger indirect effect than direct effect, but this was not statistically significant.

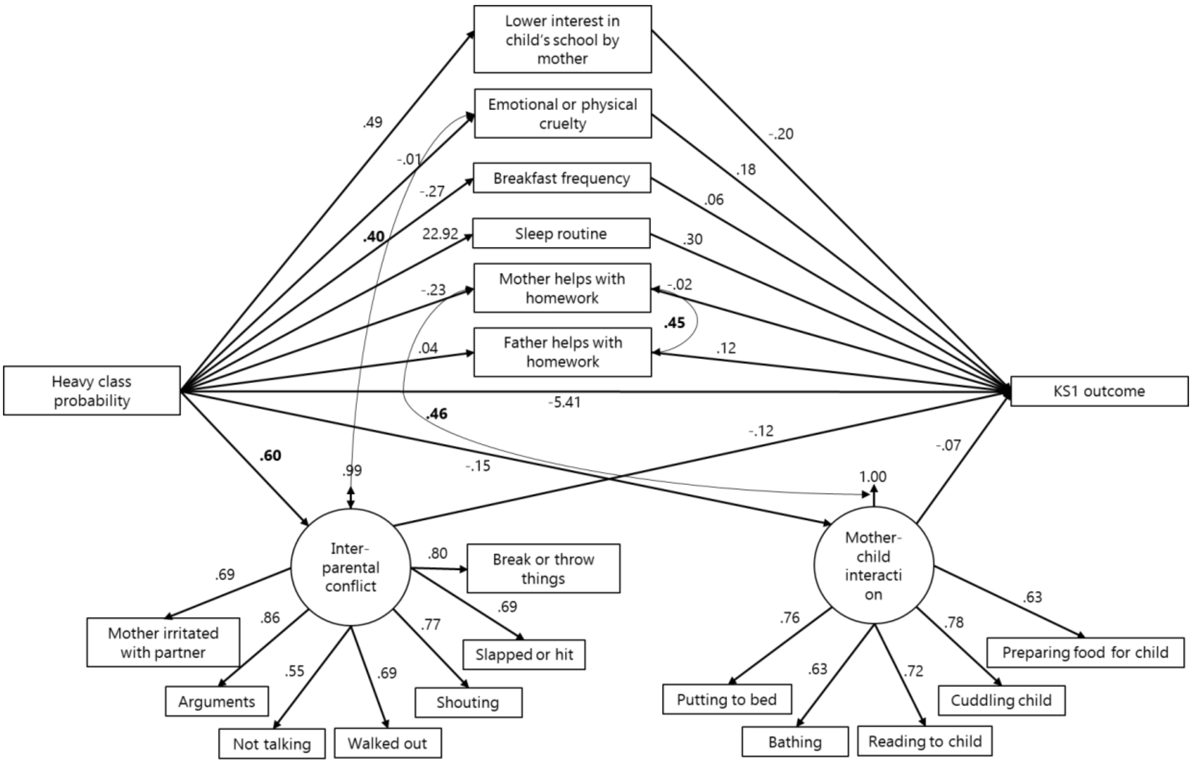

Figure 27: SEM mediation model for the heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (ALSPAC degree sample)

6.3.2.3.2 KS2

Figure 28 shows the degree sample model for ALSPAC, KS2. The model had good fit (n=1,335, χ^2 = 343.34, *df* = 158, p<0.05, RMSEA = 0.03, CFI = 0.96, TLI = 0.96, SRMR = 0.07). To achieve this model fit, the variables of mothers and partners help with homework, mothers help with homework and mother-child interaction, and cruelty and interparental conflict were correlated (R^2 0.45, 0.46 and 0.40 respectively). The mediation model shows the direct effect between the predicted probability of being in the heavy substance use class and KS2 was negative, and not statistically significant (-9.06, p=0.67). The only statistically significant path in this model was the relationship between substance use and interparental conflict (0.60, p<0.05) and sleep routine (0.42, p<0.05). The total effect of this model was β=0.44 (p=0.32) and the indirect effect was β=9.50 (p=0.65) which shows evidence for a larger indirect effect than direct effect, but this was not statistically significant.

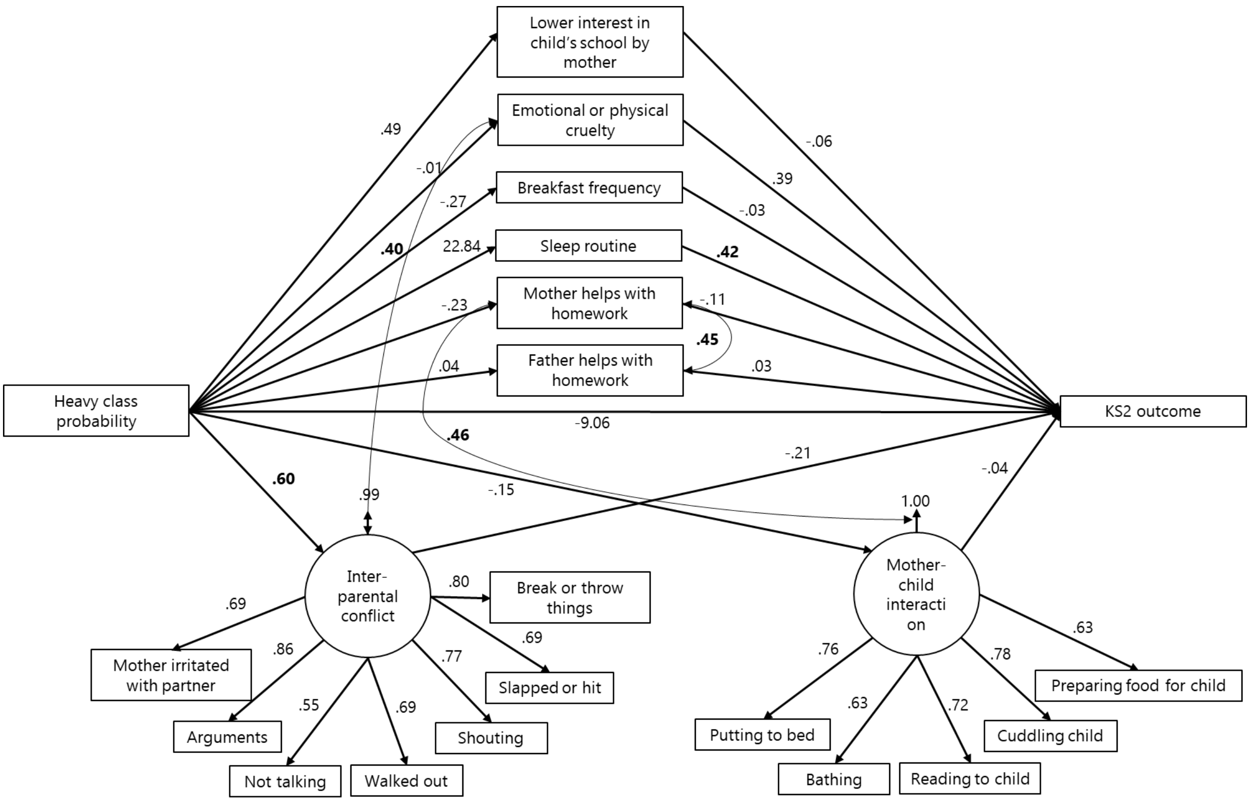

Figure 28: SEM mediation model for the heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (ALSPAC degree sample)

6.3.2.3.3 KS4

Figure 29 shows the degree sample model for ALSPAC, KS4. The model had good fit (n=1,336, χ^2 = 345.79, *df* = 158, *p*<0.05, RMSEA = 0.03, CFI = 0.96, TLI = 0.96, SRMR = 0.07). To achieve this model fit, the variables of mothers and partners help with homework, mothers help with homework and mother-child interaction, and cruelty and interparental conflict were correlated (R^2 0.45, 0.46 and 0.40 respectively). The mediation model shows the direct effect between the predicted probability of being in the heavy substance use class and KS4 was negative, and not statistically significant (-6.03, *p*=0.68). The only statistically significant paths in this model were the relationship between substance use and interparental conflict (0.60, *p*<0.05) and sleep routine (0.29, *p*<0.05). The total effect of this model was β=0.64 (*p*=0.08) and the indirect effect was β=6.68 (*p*=0.65) which shows a larger indirect effect, but this was not statistically significant.

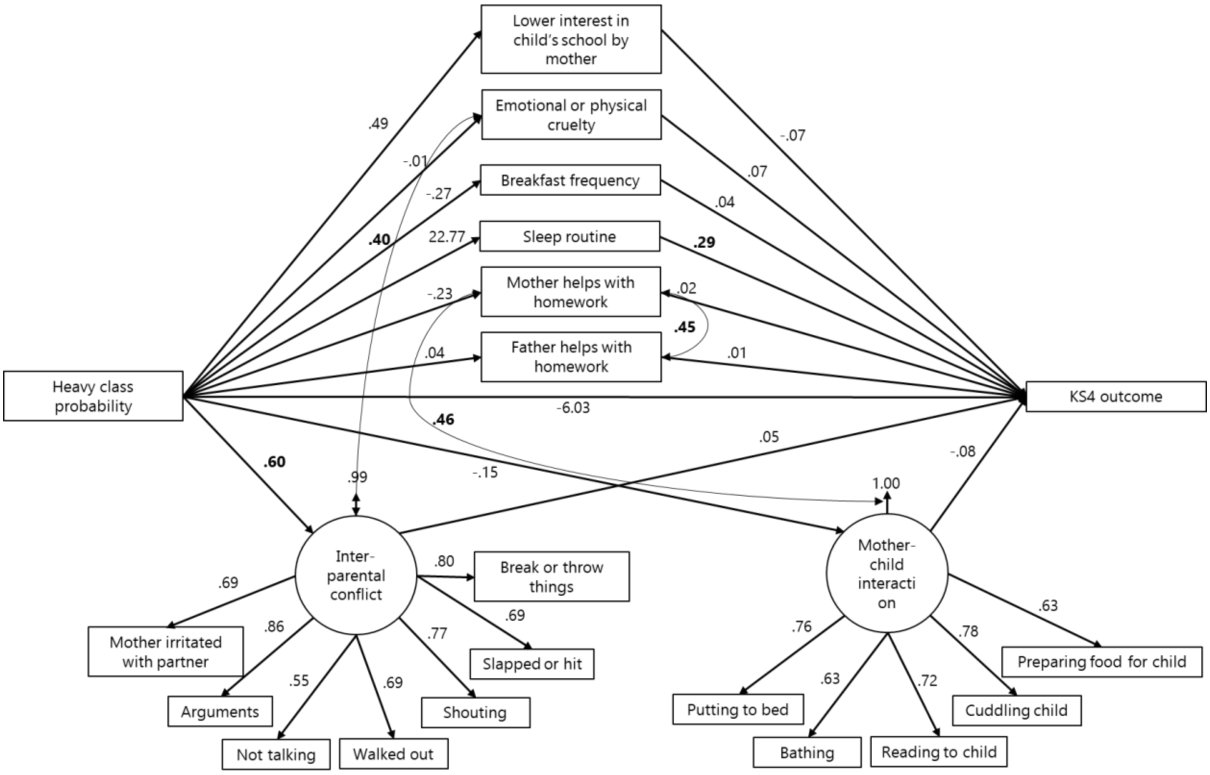

Figure 29: SEM mediation model for the heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (ALSPAC degree sample)

6.3.3 Summary of findings

The findings suggest that the degree educated parents use more substances in the heavy users class than the overall sample. The predicted probability of the heavy class was not associated with KS1 – 4 in unadjusted and adjusted models; the models showed large 95% CI's which warrant caution in interpretation. The SEM mediation models showed near no associations, with only interparental conflict having positive associations with the probability of being in the heavy class; sleep was also statistically significant for KS2 and KS4. These findings largely differ to the total sample, suggesting that being in a high socioeconomic group is a protective factor.

6.3.4 Non-degree educated sample

All findings under section 6.3.4 are for the non-degree educated sample in ALSPAC.

6.3.4.1 Latent class analysis

The non-degree sample included 7,490 participants. The 4-class solution was the best solution as it had the lowest BIC, low AIC, and adjusted BIC values; whilst the AIC and adjusted BIC were higher in the 5-class solution, it was marginal. The 4-class solution had an acceptable entropy (0.72), with all models showing acceptable entropy ranges. The classification probabilities were mostly high for the 4-class solution (100% - 66%). Although 66% is slightly out of the acceptable range, the LRT tests suggested the 4-class solution was better than the 3-class solution, but the 5-class solution was not better than the 4-class; see Table 49.

	2-class	**3-class**	**4-class**	**5-class**
AIC	125794.80	123856.32	123389.23	123353.89
BIC	126030.13	124147.01	123735.29	123755.33
Adjusted BIC	125922.08	124013.55	123576.40	123571.02
Proportions	51%	48%	37%	36%
	49%	29%	30%	30%
		22%	28%	28%
			5%	6%
				0.2%
Entropy	0.76	0.76	0.72	0.74

Probability of most likely latent class membership	93%	89%	80%	79%
	94%	100%	80%	78%
		80%	100%	100%
			66%	63%
				55%
VLMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.33$
LMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.33$
Bootstrap LRT	-	-	-	-

Table 49: Statistical criteria for the non-degree educated sample for ALSPAC, with the selected solution in grey

The 4-class solution had distinct classes of very low users, low users, moderate users, and heavy users of substances; Table 50 illustrates this. Mothers in the very low users class consumed no alcohol Monday through to Sunday, and this was also reflected in their partner's use of alcohol. Most partners were in the lower use categories, as 31% of partners responded 'None' and 23% responded '1 – 2 days'; mothers drug use was also low (4%). The low users class of mothers consumed alcohol in small amounts during the week, with Saturday showing the highest use (1.30 glasses). Near three-quarters of the partners responded '1 – 2 days', '3 – 4 days' and '5 – 10 days' category; mothers drug use was 3%. The moderate class consumed near a glass of alcohol each day, with this increasing to two glasses on Saturday; their partners reflected this use, with 35% responding '5 – 10 days' and 24% responding '> 10 days'. Mothers drug use was high in this class (7%). The heavy class included mothers who consumed near three glasses of alcohol daily, with this being highest on Friday and Saturday. Their partners mirrored this use, with 34% being in the '> 10 days' category, and 35% in the 'Every day' category; mothers drug use was highest in this category (16%).

	Very low users	Low users	Moderate users	Heavy users
Mothers alcohol use				
Monday	0.00	0.09	0.79	3.03
Tuesday	0.00	0.10	0.81	2.83
Wednesday	0.00	0.18	0.93	2.60
Thursday	0.00	0.16	0.97	2.71

Friday	0.00	0.62	1.48	3.17
Saturday	0.01	1.30	2.00	3.55
Sunday	0.00	0.58	1.22	2.78
Partners frequency of >4 units				
None	31%	15%	6%	7%
1 - 2 days	23%	22%	11%	3%
3 - 4 days	17%	25%	19%	9%
5 - 10 days	16%	24%	35%	12%
> 10 days	9%	10%	24%	34%
Everyday	4%	3%	5%	35%
Mothers drug use				
Yes	96%	97%	93%	16%
No	4%	3%	7%	84%

Table 50: Means of mothers alcohol use, and proportions of partners alcohol use, and mothers drug use by class for non-degree educated sample in ALSPAC

6.3.4.2 Regressions

6.3.4.2.1 Unadjusted models

The model shows that being in the heavy class was positively associated with KS2 (OR 1.38), but this was not statistically significant; KS1 and KS4 outcomes showed a negative association (OR 0.96 and 0.95); see Table 51.

	KS1		**KS2**		**KS4**	
	n=6355		n=6355		n=6355	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Heavy users	0.96	0.62 – 1.51	1.38	0.91 – 2.07	0.95	0.69 – 1.32

Table 51: Binary logistic regressions of each class predicted on to KS1 – 4 outcomes for the non-degree sample in ALSPAC

6.3.4.2.2 Adjusted model

Table 52 shows the adjusted model. The predicted probability of being in heavy class increased the chances of achieving KS2 outcomes (OR 1.55) but these estimates were not statistically significant; KS1 showed no effect (OR 1.00) and KS4 showed a negative association (OR 0.91), both were not significant. Prenatal smoking was associated with a decrease for all outcomes (OR 0.81, 0.86, and 0.83, $p<0.05$). Prenatal alcohol use showed statistical significance for KS1, 2 and 4 (OR 1.17, and 1.11, $p<0.05$). Prenatal drug use showed a statistically significant decrease for KS1 (0.56, p<0.05), KS2 and KS4 was mixed. Mother's age was statistically significant for KS1-4 (OR 1.03, 1.04, and 1.06, p<0.05). Females had a higher chance of attaining KS1 - 4 (OR 2.20, 1.38, 1.51, p<0.05). Improved wellbeing was associated with KS1 - 4 (OR 1.05, 1.03, and 1.03, p<0.05).

	KS1		**KS2**		**KS4**	
	n=5226		n=5226		n=5226	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Heavy class	1.00	0.58 – 1.71	1.55	0.94 – 2.56	0.91	0.61 – 1.34
Prenatal smoking	**0.81**	0.76 – 0.86	**0.86**	0.81 – 0.91	**0.83**	0.78 – 0.87
Prenatal alcohol use	**1.17**	1.03 – 1.32	**1.12**	1.01 – 1.24	**1.11**	1.02 – 1.21
Prenatal drug use	**0.56**	0.32 – 0.98	1.11	0.61 – 2.00	0.96	0.59 – 1.56
Mothers age at delivery	**1.03**	1.01 – 1.05	**1.04**	1.03 – 1.06	**1.06**	1.04 – 1.07
Child sex	**2.20**	1.85 – 2.62	**1.38**	1.20 – 1.58	**1.51**	1.34 – 1.70
Child ethnicity	0.75	0.49 – 1.15	0.89	0.60 – 1.32	0.83	0.59 – 1.18
Mother's wellbeing	**1.05**	1.03 – 1.08	**1.03**	1.01 – 1.05	**1.03**	1.01 – 1.05

Table 52: Adjusted binary logistic regression for the heavy class on KS1 – 4 outcomes for the non-degree sample for ALSPAC

6.3.4.3 SEM Mediation models

The SEM mediation models for the non-degree sample are explored for KS1, 2 and 4.

6.3.4.4 KS1

Figure 30 shows the non-degree sample model for ALSPAC, KS1. The model had good fit (n=7,383, χ^2 = 1563.87, df = 159, p<0.05, RMSEA = 0.04, CFI = 0.96, TLI = 0.95, SRMR = 0.07). The model fit was achieved by adding a correlation between the mothers and partners help with homework, and mothers help with homework and mother-child interaction (R^2 0.41 and 0.53 respectively). The mediation model shows the direct effect between the predicted probability of being in the heavy substance use class and KS1 was positive, and not statistically significant (0.17, *p*=0.21). Lowered interest in school was increased by substance use (0.57, *p*<0.05) and this followed a decrease in KS1 outcomes (-0.16, *p*<0.05); this indirect path was statistically significant (-0.09, *p*<0.05). Emotional and physical cruelty increased significantly as substance use increased (0.54, *p*<0.05). Breakfast frequency and sleep routine had a positive association with KS1 (0.17 and 0.23 respectively, *p*<0.05).

Both parent's homework help decreased as substance use increased (-0.23 and -0.24, *p*<0.05). However, partners had a positive association (0.13, *p*<0.05). Interparental conflict increased as substance use increased (0.37, *p*<0.05). Mother-child interaction had a positive association with KS1 (0.10, *p*<0.05). The total effect of this model was β=-0.02 (*p*=0.88) and the indirect effect was β=-0.19 (*p*<0.05) was significant. Statistically significant indirect paths included school interest, mothers and partners help with homework (0.04, -0.03, *p*<0.05).

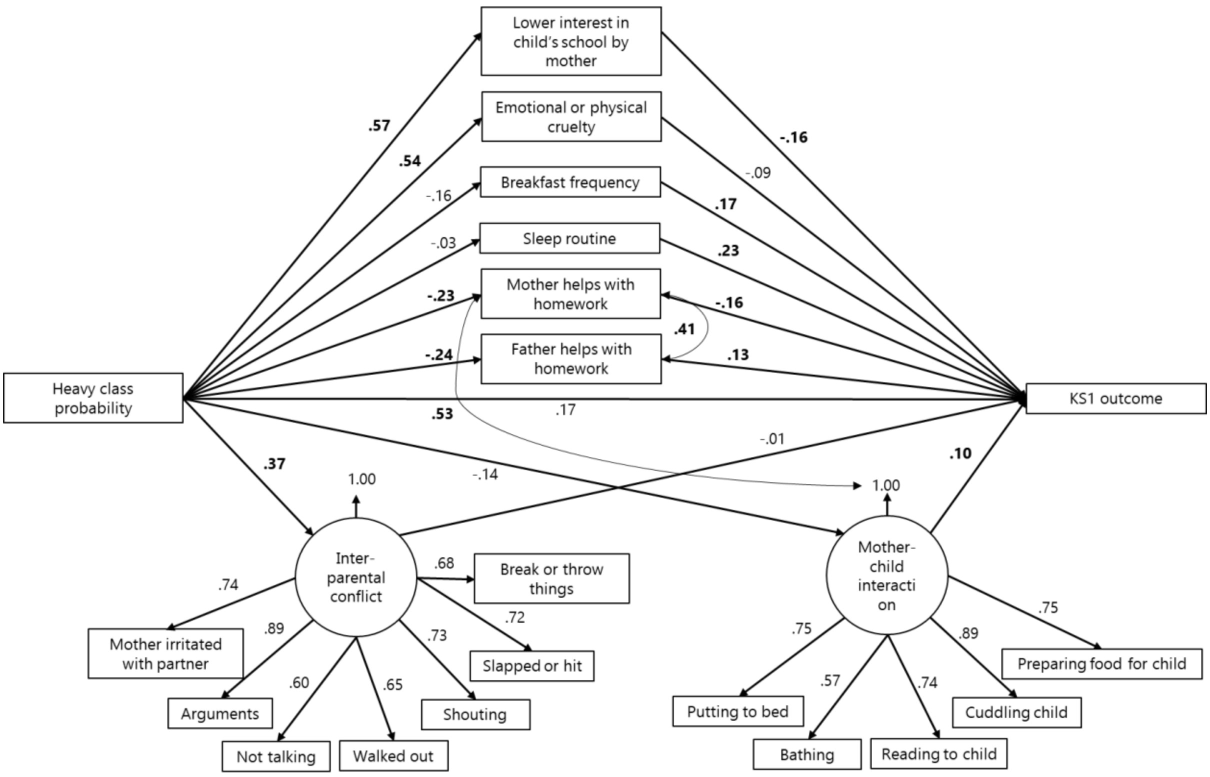

Figure 30: SEM mediation model for the heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (ALSPAC non-degree sample)

6.3.4.5 KS2

Figure 31 shows the non-degree sample model for ALSPAC, KS2. The model had good fit (n=7,397, χ^2 = 1561.51, *df* = 159, p<0.05, RMSEA = 0.04, CFI = 0.96, TLI = 0.95, SRMR = 0.07). The model fit was improved by adding a correlation between the mothers and partners help with homework, and mothers help with homework and mother-child interaction (R^2 0.41 and 0.53 respectively). The mediation model shows the direct effect between the predicted probability of being in the heavy substance use class and KS2 was positive, and statistically significant (0.35, p<0.05). Lowered interest in school was increased by substance use (0.57, p<0.05) and this followed a decrease in KS2 outcomes (-0.14, p<0.05); this indirect path was statistically significant (-0.08, p<0.05). Emotional and physical cruelty increased significantly as substance use increased (0.54, p<0.05). Breakfast frequency and sleep routine had a positive association with KS2 (0.18 and 0.15 respectively, p<0.05).

Both parents' homework help decreased as substance use increased (-0.23 and -0.24, p<0.05). However, mothers help had a negative association with KS2 (-0.11, p<0.05) and their partner had a positive association (0.08, p<0.05). Interparental conflict increased as substance use increased (0.37, p<0.05). Mother-child interaction had a positive association with KS2 (0.11, p<0.05). The variables of mothers and partners help with homework and mothers help with homework and mother-child interaction (R^2 0.41 and 0.53 respectively). The total effect of this model was β=0.18 (p=0.11) and the indirect effect was β=-0.16 (p<0.05). Statistically significant indirect paths included school interest, mothers and partners help with homework (0.03, -0.02, p<0.05).

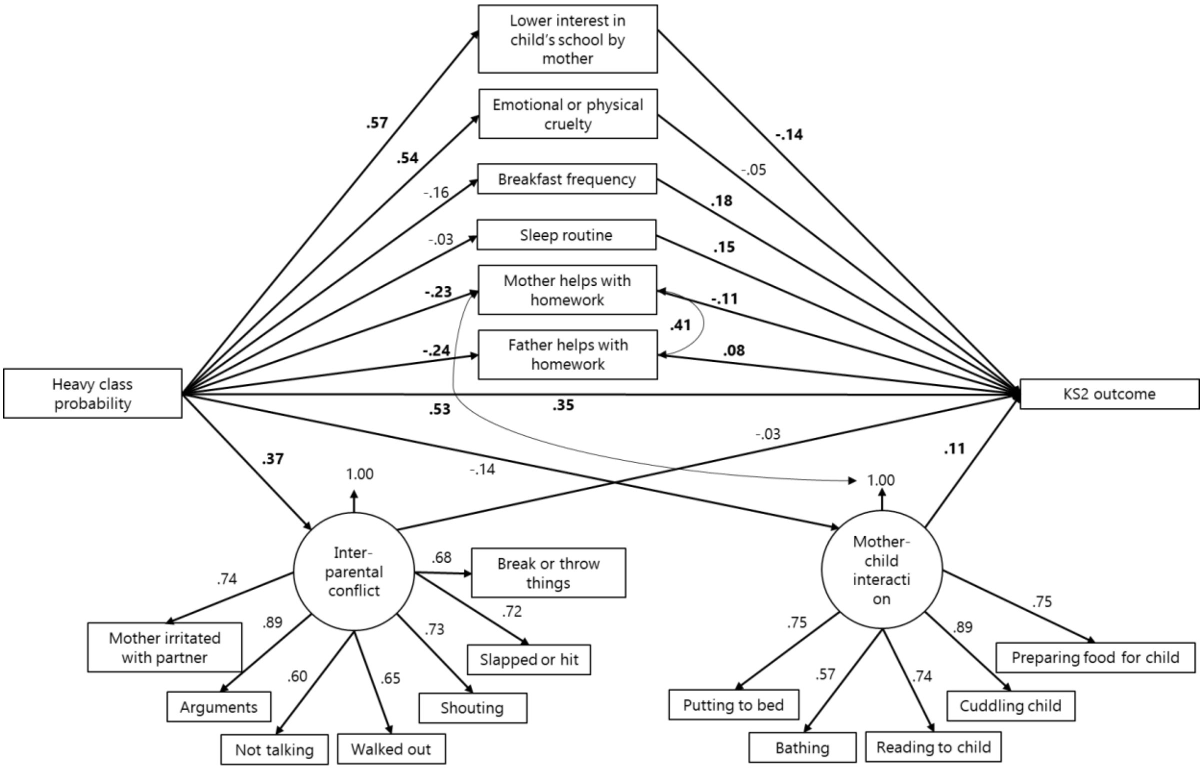

Figure 31: SEM mediation model for the heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (ALSPAC non-degree sample)

6.3.4.6 KS4

Figure 32 shows the non-degree sample model for ALSPAC, KS4. The model had good fit (n=7,394, χ^2 = 1569.95, *df* = 159, p<0.05, RMSEA = 0.04, CFI = 0.96, TLI = 0.95, SRMR = 0.07). The model fit was improved by adding a correlation between the mothers and partners help with homework, and mothers help with homework and mother-child interaction (R^2 0.41 and 0.53 respectively). The mediation model shows the direct effect between the predicted probability of being in the heavy substance use class and KS4 was positive, and not statistically significant (0.13, p=0.25). Lowered interest in school was increased by substance use (0.58, p<0.05) and this followed a decrease in KS4 outcomes (-0.14, p<0.05); this indirect path was statistically significant (-0.08, p<0.05). Emotional and physical cruelty increased significantly as substance use increased (0.54, p<0.05). Breakfast frequency and sleep routine had a positive association with KS4 (0.17 and 0.22 respectively, p<0.05).

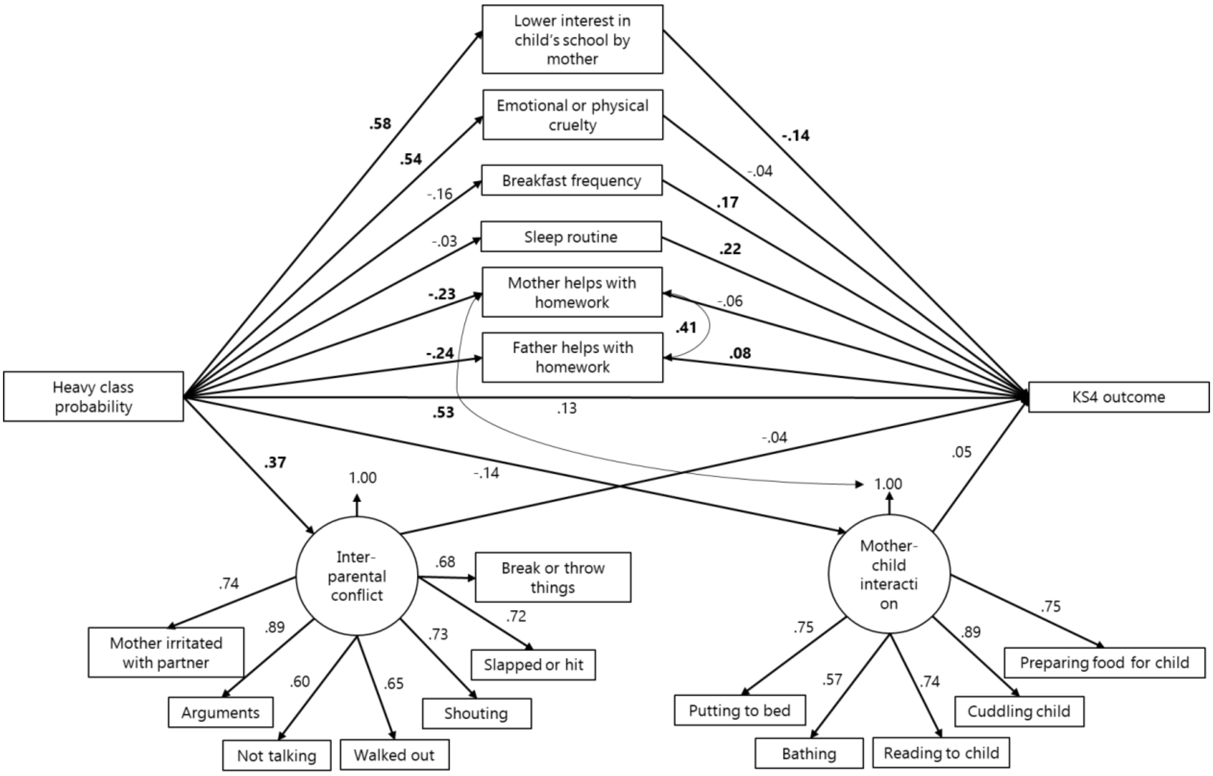

Figure 32: SEM mediation model for the heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (ALSPAC non-degree sample)

Both parents' homework help decreased as substance use increased (-0.23 and -0.24, $p<0.05$). The partners help with homework had a positive association with KS4 (0.08, $p<0.05$). Interparental conflict increased as substance use increased (0.37, $p<0.05$). Total effect of this model was β=-0.03, ($p=0.77$) and the indirect effect was β=-0.17 ($p<0.05$). Statistically significant indirect paths included school interest and partners help with homework (-0.02, $p<0.05$).

6.3.4.7 Summary of findings for analysis split by qualifications

The findings suggest that non-degree educated parents use less substances in the heavy users class than the overall sample. This class was not associated with KS1 – 4 in unadjusted and adjusted models. The SEM mediation models showed many associations, with school interest and school homework help being indirect pathways. Many of the parenting and family environment variables were associated with KS1 – 4 in theorised directions. Likewise, substance use had a positive association with lower school interest, cruelty, and interparental conflict.

These findings contrast with the degree educated sample, suggesting that lower socioeconomic groups may face greater strain with parenting and the family environment. However, there are many explanations, of which are explored in Chapter 7.

6.3.4.8 Sensitivity analysis: income

As research suggests that different measures of socioeconomic status can be related to substance use, the analysis was reconducted with high- and low-income groups; these are in Appendix I. The analysis included reconducting the latent class analysis and SEM mediation models. The results found little differences across income and the original total sample models, whereby low- and high-income groups did not differ much in associations. As a result, there is a clear distinction between the resources and protective factors that parental education offers compared to parental income, which is likely through cultural practices and access.

6.4 MCS: Exploratory findings

Section 6.4. will include all data from MCS and begin with the measurement invariance of the LCA model by degree, and non-degree samples.

6.4.1 Measurement invariance of latent class analysis by educational qualifications

To compare non-degree educated and degree educated samples in the LCA a measurement invariance has been employed. The total number of observations totalled n=14,838 with non-degree educated parents being over half of the sample (n=8,664) and degree educated parents made less than half of the sample (n=6,174). When the models were compared, the model fit was improved in terms of entropy (0.78), and the classes were similar in terms of their proportions; see Table 53.

	Non-degree educated	**Degree educated**
Class 1 - Low	(25%) Low	(25%) Low
Class 2 - Inconsistent	(11%) Dual-heavy	(11%) Partner Heavy
Class 3 - Moderate	(48%) Moderate	(48%) Moderate
Class 4 - Inconsistent	(16%) Partner Heavy	(16%) Dual-heavy

Table 53: Measurement invariance class proportions for the LCA in MCS

For the non-degree educated sample, Class 1 compromised of 25% of the parents who used alcohol in low amounts, however, non-degree parents used less alcohol compared to degree educated parents, but used a higher proportion of drugs. Class 2 contributed 11% each for the groups, but the non-degree educated group constituted of a partner-heavy class type, whereas the degree educated group constituted of a dual-heavy type. Class 3 constituted of a moderate class (48%), however, the degree educated sample used a higher proportion of alcohol compared to the non-degree group who used a greater proportion of drugs. Class 4 was an inconsistent class, as the non-degree educated group contributed 16% for partner-heavy alcohol use, whereas the degree-educated had 16% of dual-heavy use. The class proportions for each sample for the measurement invariance are in Appendix J. Measurement invariance showed full invariance for the low class, however other classes could not be computed due to convergence problems and high computational cost (over 24 hours to run each test with no convergence). Therefore, as the classes showed differences and achieving invariance was not stable, the analysis will be re-conducted for non-degree and degree educated samples.

6.4.2 Non-degree sample

All findings under section 6.4.2. are for the non-degree educated sample in MCS.

6.4.2.1 Latent Class Analysis

LCA which was discussed in Chapter 3, 4 and 5 as "a statistical procedure that can be used to classify individuals into homogeneous subgroups… [which can] test theories about typological differences between individuals" (Geiser 2013, p.233) was conducted. Eleven variables for the mothers and their partner's usual alcohol habits, drug use and the CAGE alcohol tool were used. To recap, the best fitting models have the lowest AIC, BIC and adjusted BIC values, good class classification (above 80%), and Entropy (>0.70). The VLMR, LMR LRT, and Bootstrap LRT suggests if a model with more classes is better than one less (k-1).

For the non-degree sample, the 3-class model was accepted for use (n=8664). This was selected over the 2 and 4-class model as the AIC, BIC, and adjusted BIC was the lower; the 4-class model showed lower values, but this was not as large of a difference compared to the 2-

class model. Although. the 4-class model had the highest entropy (0.72) and had all class probabilities above 0.80 as recommended it could not be accepted due a non-significant LRT. Therefore, after balancing theoretical judgement and statistical criteria, the 3-class model was accepted; see Table 54.

	2-class	**3-class**	**4-class**
AIC	70494.47	69071.94	67724.77
BIC	70812.48	69552.49	68367.86
Adjusted BIC	70669.48	69336.40	68078.68
Proportions	70%	67%	46%
	30%	23%	27%
		10%	18%
			9%
Entropy	0.66	0.69	0.72
Probability of most likely latent class membership	90%	85%	80%
	92%	90%	93%
		89%	88%
			90%
VLMR LRT	$p<0.05$	$p<0.05$	$p=0.49$
LMR LRT	$p<0.05$	$p<0.05$	$p=0.49$

Table 54: Statistical criteria for the non-degree educated sample for MCS; selected solution in grey

	Dual-heavy		Partner-heavy		Low users	
	Partner	Mother	Partner	Partner	Mother	Partner
Usual drinking						
Never	<5%	<5%	14%	<5%	34%	26%
Less than once month	6%	<5%	20%	<5%	24%	17%
1 – 2 times a month	6%	8%	23%	7%	20%	19%
1 – 2 times per week	38%	29%	33%	36%	20%	31%
3 – 4 times a week	29%	27%	7%	29%	<5%	5%
5 – 6 times a week	10%	15%	<5%	9%	<5%	<5%
Everyday	11%	12%	<5%	15%	<5%	<5%
Cut down						
No	24%	59%	>95%	30%	>95%	>95%
Yes	76%	41%	<5%	70%	<5%	<5%
Criticise						
No	77%	88%	>95%	73%	>95%	>95%
Yes	23%	12%	<5%	28%	<5%	<5%
Guilty						
No	61%	83%	>95%	65%	>95%	>95%
Yes	39%	17%	<5%	35%	<5%	<5%
First thing						
No	93%	95%	>95%	89%	>95%	>95%
Yes	7%	5%	<5%	12%	<5%	<5%
Drug use						
No	86%	82%	>95%	85%	>95%	94%
Yes	15%	18%	<5%	15%	<5%	6%

Table 55: Proportions of each variable in the LCA for the non-degree sample (MCS)

The latent class analysis of the non-degree sample showed three distinct classes low users, partner-heavy and dual-heavy; see Table 55. The low class was characterised by the mother and their partner having greater proportions in the 'Less than once a month' and '1 – 2 times a week' categories for alcohol use. They also had low proportions on the CAGE questions, and for drug use (<5% and 6%). The partner-heavy class was characterised by the partner having higher proportions on the CAGE questions, and over half of partners' responses were in the three heaviest responses categories for alcohol use; 15% of partners also used drugs in the past year. Lastly, the dual-heavy class was characterised by the mother and their partner having high proportions on the CAGE questions compared to other classes, and over half of both parents were in the heaviest three categories for alcohol use; 15% of mothers had used drugs, and so had 18% of their partners. Given that both the partner-heavy and dual-heavy class had higher alcohol and drug use, and high proportions on the CAGE questionnaire, both classes will be explored to predict KS1 – 4 in regressions and SEM mediation models.

6.4.2.2 Regressions

6.4.2.2.1 Unadjusted

Table 56 shows that the increased probability of being in the partner-heavy class had no statistically significant association with KS2 and KS4 (OR 1.13, 1.06), but was found for KS1 (OR 1.35, $p<0.05$). Likewise, the increased probability of being in the dual-heavy class did not show a significant relationship with KS1 - 4 (OR 1.17, 1.17 and 1.07). However, both classes show a positive direction.

	KS1		**KS2**		**KS4**	
	n=4982		n=4982		n=4982	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Partner-heavy	**1.35**	1.09 – 1.67	1.13	0.88 – 1.46	1.06	0.86 – 1.31
Dual-heavy	1.17	0.92 – 1.50	1.17	0.88 – 1.56	1.07	0.85 – 1.36

Table 56: Binary logistic regressions of each class predicted on to KS1 – 4 outcomes for the non-degree sample in MCS

6.4.2.2.2 Adjusted

6.4.2.2.2.1 Partner-heavy

Table 57 shows that an increase in the predicted probability of being in the partner-heavy class did not predict KS1 – 4 results. Prenatal smoking was associated with a significant decrease in KS1, 2 and 4 results (OR 0.97, 0.97 0.95, p<0.05). Prenatal alcohol use was only significantly associated with KS1 outcomes (OR 1.08, p<0.05). An increase in mothers age increased KS1, 2, and 4 outcomes (OR 1.02, 1.02, 1.04, p<0.05). Female children had a higher probability of achieving KS1, 2 and 4 (OR 1.84, 1.24 and 1.74, p<0.05). Children of an ethnic minority background were less likely to attain KS1 (OR 0.73, p<0.05), but this was not replicated for KS2 and KS4 and in the reverse direction. An increase in mother's distress significantly decreased KS1 – 4 results (OR 0.96, p<0.05).

	KS1		**KS2**		**KS4**	
	n=3713		n=3713		n=3713	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Partner-heavy	1.24	0.96 – 1.60	1.12	0.83 – 1.52	1.14	0.89 – 1.15
Prenatal smoking	**0.97**	0.95 – 0.98	**0.97**	0.96 – 0.99	**0.95**	0.94 – 0.97
Prenatal alcohol use	**1.08**	1.00 – 1.18	1.04	0.94 – 1.14	1.04	0.97 – 1.13
Mothers age at delivery	**1.02**	1.00 – 1.03	**1.02**	1.01 – 1.04	**1.04**	1.03 – 1.06
Child sex	**1.84**	1.57 – 2.16	**1.24**	1.03 – 1.49	**1.74**	1.49 – 2.02
Child ethnicity	**0.73**	0.58 – 0.93	1.07	0.81 – 1.42	1.17	0.93 – 1.47
Mother's distress	**0.96**	0.94 – 0.98	**0.96**	0.94 – 0.98	**0.96**	0.94 – 0.98

Table 57: Adjusted binary logistic regression of the partner-heavy class on KS1 – 4 outcomes for the non-degree sample in MCS

6.4.2.2.2.2 Dual-heavy

An increase in the predicted probability of being in the dual-heavy class did not predict KS1 – 4 results significantly. Prenatal smoking was associated with a significant decrease in KS1, 2 and 4 results (OR 0.97, 0.97, 0.95, p<0.05). Prenatal alcohol use was only associated with KS1 (1.09, p<0.05). An increase in mothers age increased KS1, 2, 4 outcomes (OR 1.02, 1.02, 1.04, p<0.05). Female children had a higher probability of achieving KS1, 2 and 4 (OR 1.84, 1.24 and

1.74, $p<0.05$). Children of an ethnic minority background were less likely to attain KS1 (0.72, $p<0.05$), but this was not replicated for KS2 and KS4 and reversed in direction. An increase in mother's distress significantly decreased KS1 – 4 results (OR 0.96, 0.95, 0.96, $p<0.05$).

	KS1		**KS2**		**KS4**	
	n=3713		n=3713		n=3713	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Dual Heavy	0.96	0.72 – 1.27	1.17	0.83 – 1.65	1.08	0.82 – 1.43
Prenatal smoking	**0.97**	0.95 – 0.98	**0.97**	0.96 – 0.99	**0.95**	0.94 – 0.97
Prenatal alcohol use	**1.09**	1.00 – 1.18	1.03	0.93 – 1.14	1.04	0.96 – 1.12
Mothers age at delivery	**1.02**	1.00 – 1.03	**1.02**	1.01 – 1.04	**1.04**	1.03 – 1.05
Child sex	**1.84**	1.57 – 2.15	**1.24**	1.03 – 1.50	**1.74**	1.50 – 2.02
Child ethnicity	**0.72**	0.56 - 0.91	1.07	0.80 – 1.42	1.16	0.93 – 1.46
Mother's distress	**0.96**	0.94 – 0.98	**0.95**	0.93 – 0.97	**0.96**	0.94 – 0.98

Table 58: Adjusted binary logistic regression of the dual-heavy class on KS1 – 4 outcomes for the non-degree sample for MCS

Following this, the SEM mediation models are shown for the partner-heavy class for KS1, 2 and 4 outcomes, and then for the dual-heavy class for KS1, 2, and 4 outcomes.

6.4.2.3 SEM mediation models

6.4.2.3.1 Partner-heavy class

6.4.2.3.1.1 KS1

Figure 33 shows the non-degree sample model for MCS, KS1. The model had adequate fit (n=7,694, χ^2 = 5383.37, RMSEA = 0.04, CFI = 0.92, TLI = 0.90, WRMR = 3.72). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.65, $p<0.05$), the partner-child interaction and school involvement (R^2=0.28, $p<0.05$), interparental conflict and parenting competency (R^2=-0.33, $p<0.05$), and mother-child interaction and partner-child interaction (R^2=0.42, $p<0.05$).

There was a positive association between the predicted probability of being in the partner-heavy class and KS1, but this was not significant (0.13). Pathways from the partner-heavy class and parenting and the family environment variables did not show much significance; only mother-child interaction was this significant (0.11, $p<0.05$). In contrast, parenting and household conflict predicted KS1 significantly. Mother-child closeness increased KS1 (0.10, $p<0.05$), as did parents evening (0.21, $p<0.05$), and partner-child interaction (0.08, $p<0.05$). Likewise, breakfast frequency (0.12, $p<0.05$) and a regular bedtime (0.18, $p<0.05$) was associated with KS1. Parenting competency (0.07, $p<0.05$) also significantly predicted KS1. The total effect of the model was β=0.18 ($p<0.05$), the indirect effect was β=0.05 ($p=0.07$); no statistically significant indirect pathways were observed.

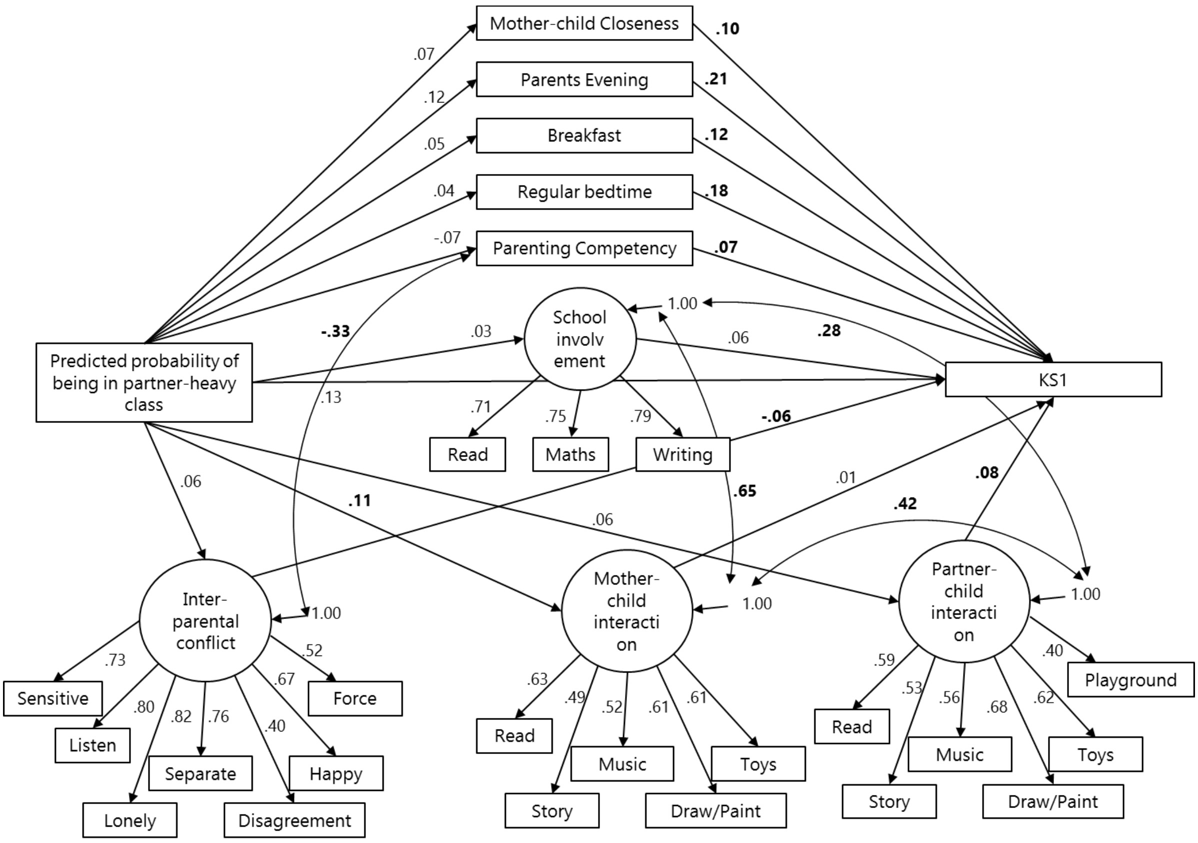

Figure 33: SEM mediation model for the partner-heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS non-degree sample)

6.4.2.3.1.2 KS2

Figure 34 shows the non-degree sample model for MCS, KS2. The model had adequate fit (n=7,642, χ^2 = 5344.37, RMSEA = 0.04, CFI = 0.92, TLI = 0.91, WRMR = 3.71). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.65, p<0.05), the partner-child interaction and school involvement (R^2=0.28, p<0.05), interparental conflict and parenting competency (R^2=-0.33, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.42, p<0.05). The direct effect shows an increase between the predicted probability of being in the partner-heavy class and KS2, but this was not significant. Pathways from the partner-heavy class towards parenting and household conflict variables did not show much significance. Only mother-child interaction was significant (0.11, p<0.05). In contrast, parenting and household conflict predicted KS2 significantly. Mother-child closeness increased KS2 (0.12, p<0.05), as did parents evening (0.14, p<0.05). Likewise, breakfast frequency (0.13, p<0.05) and a regular bedtime (0.16, p<0.05) was associated with KS2. Likewise, parenting competency (0.09, p<0.05) was positively associated with KS2. The total effect of the model was β=0.07 (p=0.35), the indirect effect was β=0.03 (p=0.13); no indirect pathways were observed that were statistically significant.

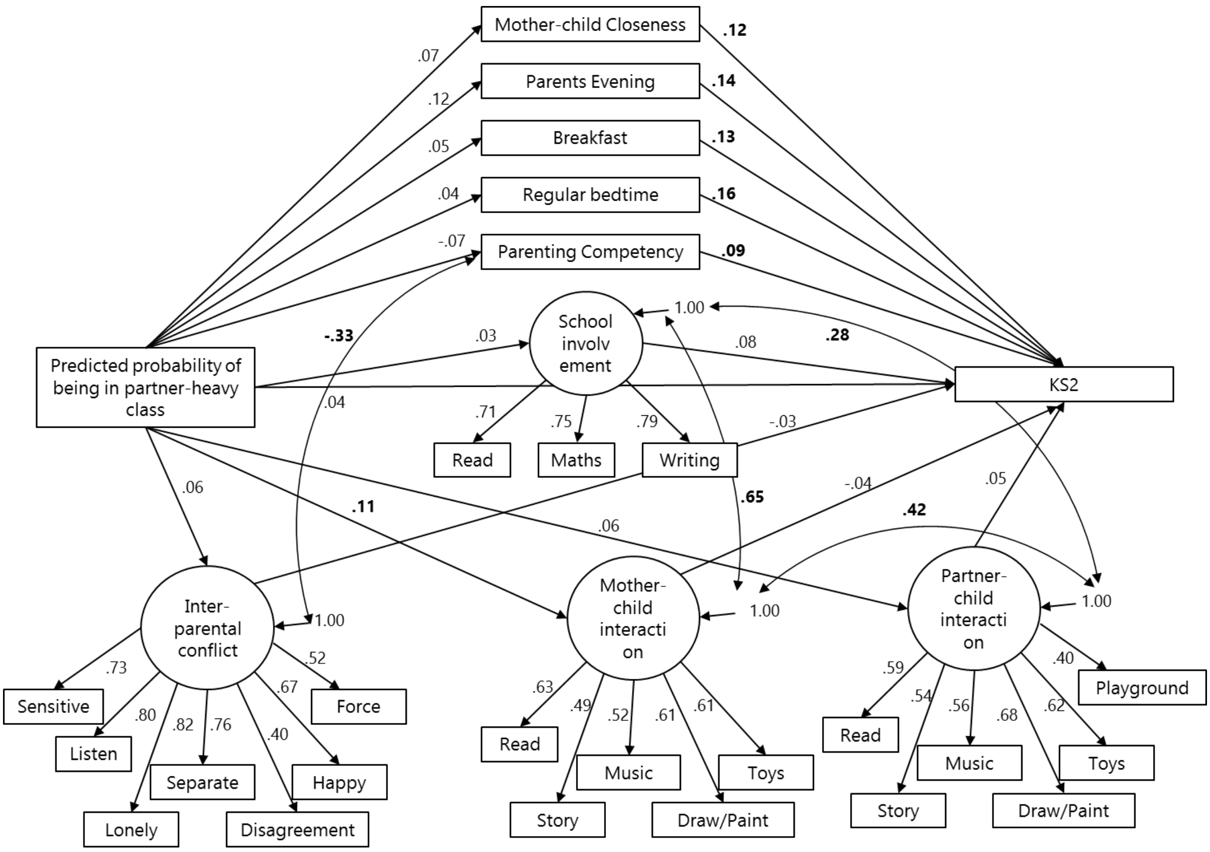

Figure 34: SEM mediation model for the partner-heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS non-degree sample)

6.4.2.3.1.3 KS4

Figure 35 shows the non-degree sample model for MCS, KS4. The model had adequate fit (n=7,644, χ^2 = 5387.83, RMSEA = 0.04, CFI = 0.92, TLI = 0.91, WRMR = 3.73). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.65, p<0.05), the partner-child interaction and school involvement (R^2=0.28, p<0.05), interparental conflict and parenting competency (R^2=-0.33, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05). There was no association between the partner-heavy class and KS4. Only the mother-child interaction was significantly associated with substance use (0.11, p<0.05). In contrast, parenting predicted KS4 significantly. Parents evening (0.24, p<0.05), breakfast frequency (0.19, p<0.05) and a regular bedtime (0.11, p<0.05) were associated with KS4; parenting competency (0.10, p<0.05) also significantly predicted KS4. The total effect of the model was β=0.04 (p=0.56), the indirect effect was β=0.04 (p=0.15); no statistically significant indirect pathways were observed.

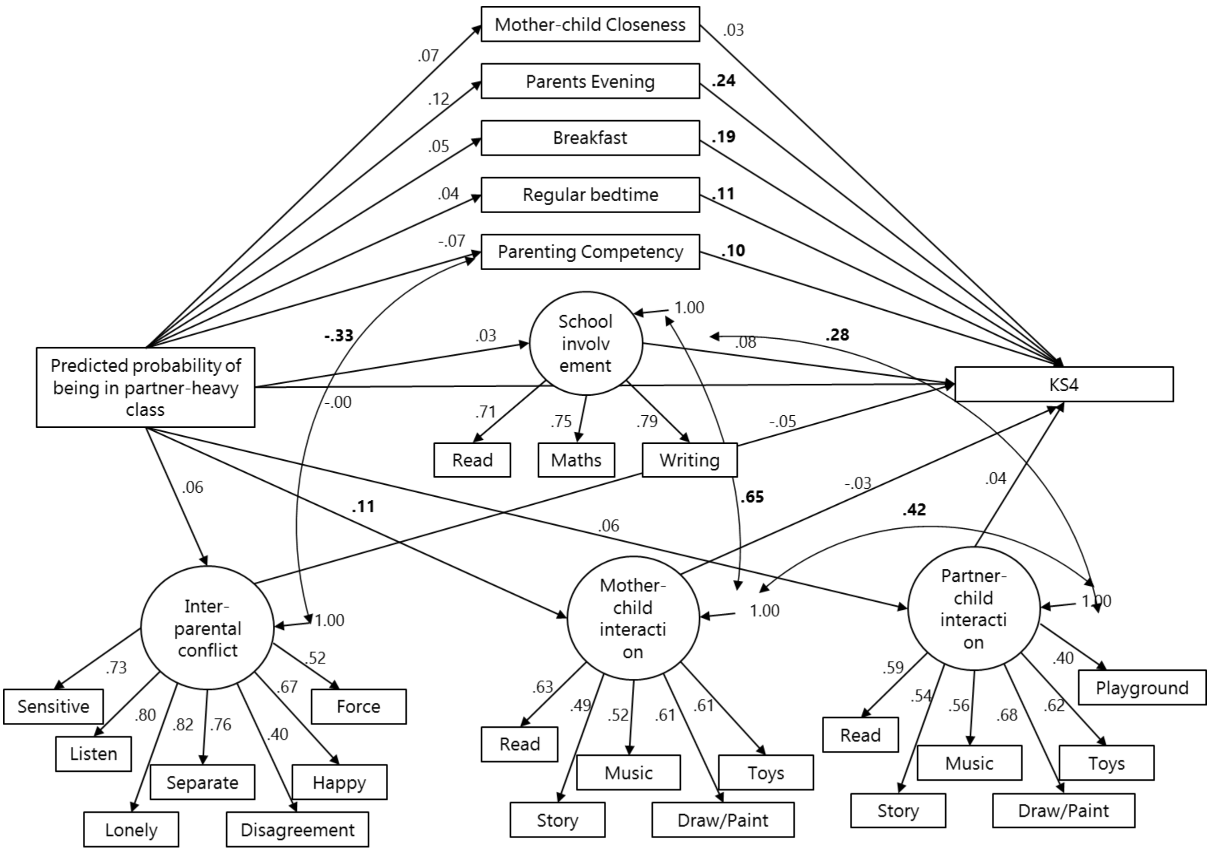

Figure 35: SEM mediation model for the partner-heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS non-degree sample)

6.4.2.3.2 *Dual-heavy class*

6.4.2.3.2.1 *KS1*

Figure 36 shows the non-degree sample model for MCS, KS1. The model had adequate fit (n=7,694, χ^2 = 5354.49, RMSEA = 0.04, CFI = 0.92, TLI = 0.91, WRMR = 3.71). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.65, p<0.05), the partner-child interaction and school involvement (R^2=0.28, p<0.05), interparental conflict and parenting competency (R^2=-0.33, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

The direct effect shows an increase between the predicted probability of being in the partner-heavy class and KS1, but this was not significant (0.15). There was an indirect pathway via parenting competency as an increase in dual-heavy class decreased parenting competency (-0.21, p<0.05), which had a positive association with KS1 (0.07, p<0.05). In addition, school involvement had a negative association when the probability of being in the dual-heavy class increased (-0.16, p<0.05). Interparental conflict also increased as the probability of being in the class increased (0.20, p<0.05). In contrast, parenting and household conflict predicted KS1 significantly. Both mother-child closeness (0.10, p<0.05) and parents evening (0.21, p<0.05) were positively associated with KS1. Likewise, breakfast frequency (0.12, p<0.05) and a regular bedtime (0.18, p<0.05) was associated with KS1. Partner-child interaction also positively predicted KS1 outcomes (0.08, p<0.05). The total effect of the model was β=0.09 (p=0.20), the indirect effect was β=-0.05 (p=0.07); the parenting competency pathway was significant (-0.02, p<0.05).

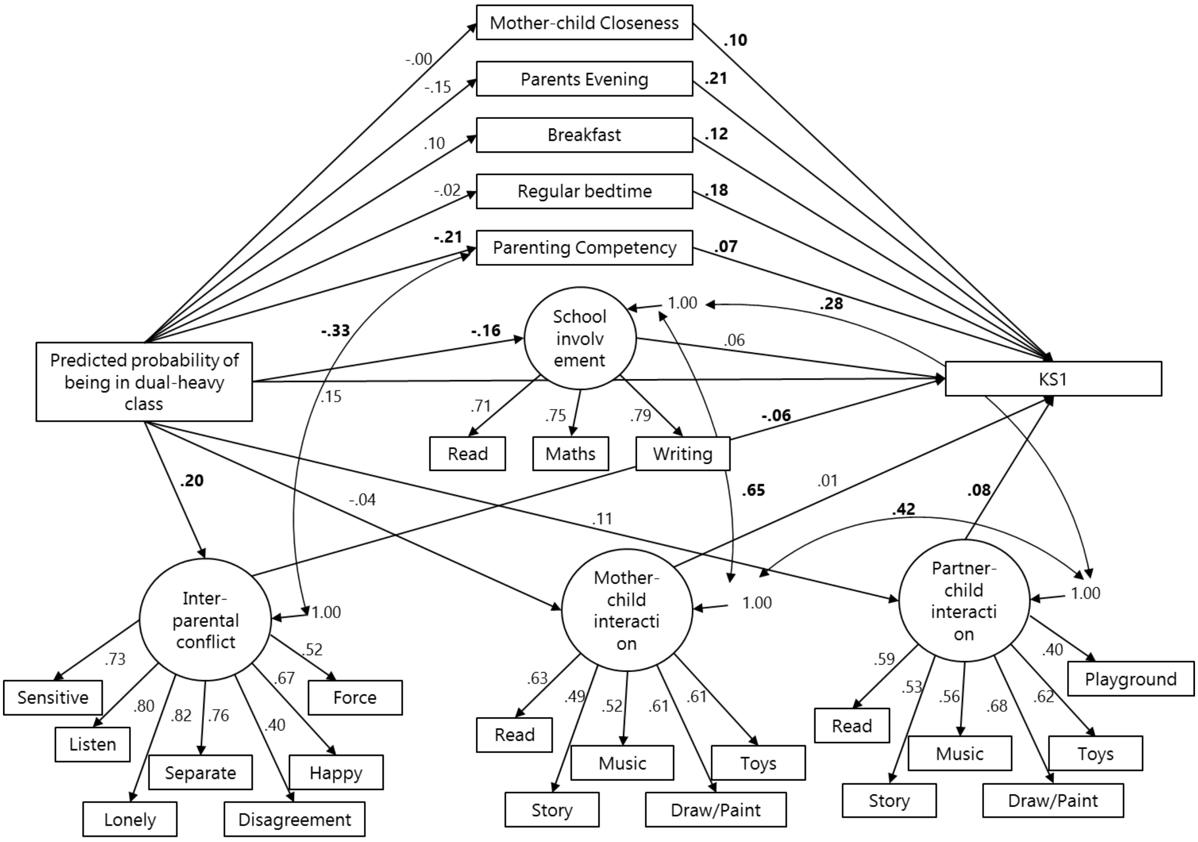

Figure 36: SEM mediation model for the dual-heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS non-degree sample)

6.4.2.3.2.2 KS2

Figure 37 shows the non-degree sample model for MCS, KS2. The model had adequate fit (n=7,642, χ^2 = 5315.62, RMSEA = 0.04, CFI = 0.92, TLI = 0.91, WRMR = 3.70). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.65, p<0.05), the partner-child interaction and school involvement (R^2=0.28, p<0.05), interparental conflict and parenting competency (R^2=-0.33, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

There was a positive association between the dual-heavy class and KS2, but this was not significant (0.13). There was an indirect pathway via parenting competency, whereby an increase in being in the dual-heavy class decreased parenting competency (-0.21, p<0.05), which has a positive association with KS2 (0.09, p<0.05). In addition, school involvement had a negative association with an increase in the dual-heavy class (-0.16, p<0.05). Interparental conflict also increased as the probability of being in the class increased (0.20, p<0.05). Likewise, parenting and household conflict predicted KS2 significantly. Both mother-child closeness (0.12, p<0.05) and parents evening (0.14, p<0.05) were positively associated with KS2. Likewise, breakfast frequency (0.13, p<0.05) and a regular bedtime (0.16, p<0.05) was associated with KS2. The total effect of the model was β=0.09 (p=0.30), the indirect effect was -0.04 (p=0.11); the parenting competency pathway was significant (-0.02, p<0.05).

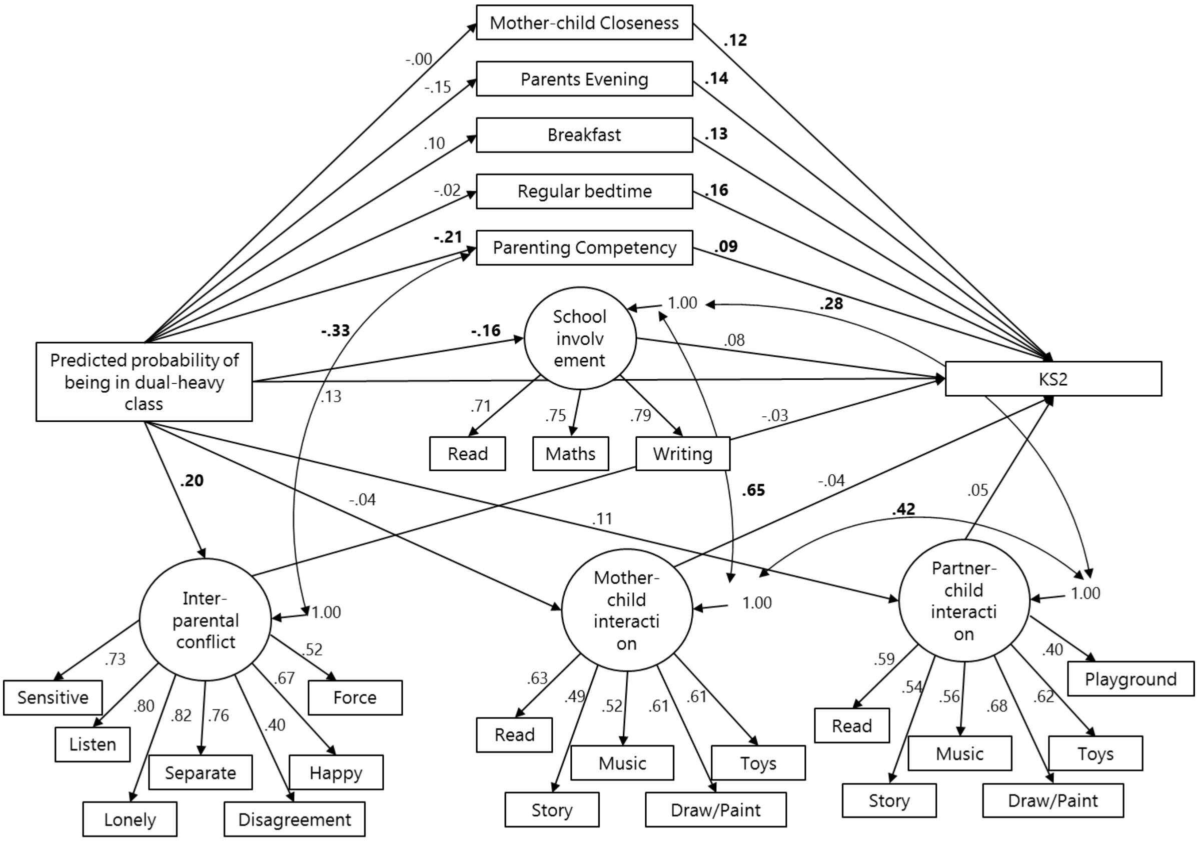

Figure 37: SEM mediation model for the dual-heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS non-degree sample)

6.4.2.3.2.3 KS4

Figure 38 shows the non-degree sample model for MCS, KS4. The model had adequate fit (n=7,644, χ^2 = 5358.99, RMSEA = 0.04, CFI = 0.92, TLI = 0.90, WRMR = 3.71). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.65, p<0.05), the partner-child interaction and school involvement (R^2=0.28, p<0.05), interparental conflict and parenting competency (R^2=-0.33, p<0.05), and mother-child interaction and partner-child interaction (R^2=0.43, p<0.05).

The direct effect shows an increase between the predicted probability of being in the dual-heavy class and KS4, but this was not significant (0.10). There was an indirect pathway via parenting competency, whereby an increase in being in the dual-heavy class decreased parenting competency (-0.21, $p<0.05$), when it has a positive association with KS4 (0.10, $p<0.05$). In addition, school involvement had a negative association with an increase in the dual-heavy class (-0.16, $p<0.05$). Interparental conflict also increased as the probability of being in the dual-heavy class increased (0.20, $p<0.05$). Likewise, parenting and household conflict predicted KS4 significantly. Parents evening (0.21 $p<0.05$), breakfast frequency (0.19, $p<0.05$) and a regular bedtime (0.11, $p<0.05$) was positively associated with KS4. The total effect of the model was β=0.04 (p=0.57), the indirect effect was β=-0.06 (p=0.06); the parenting competency pathway was significant (-0.02, $p<0.05$).

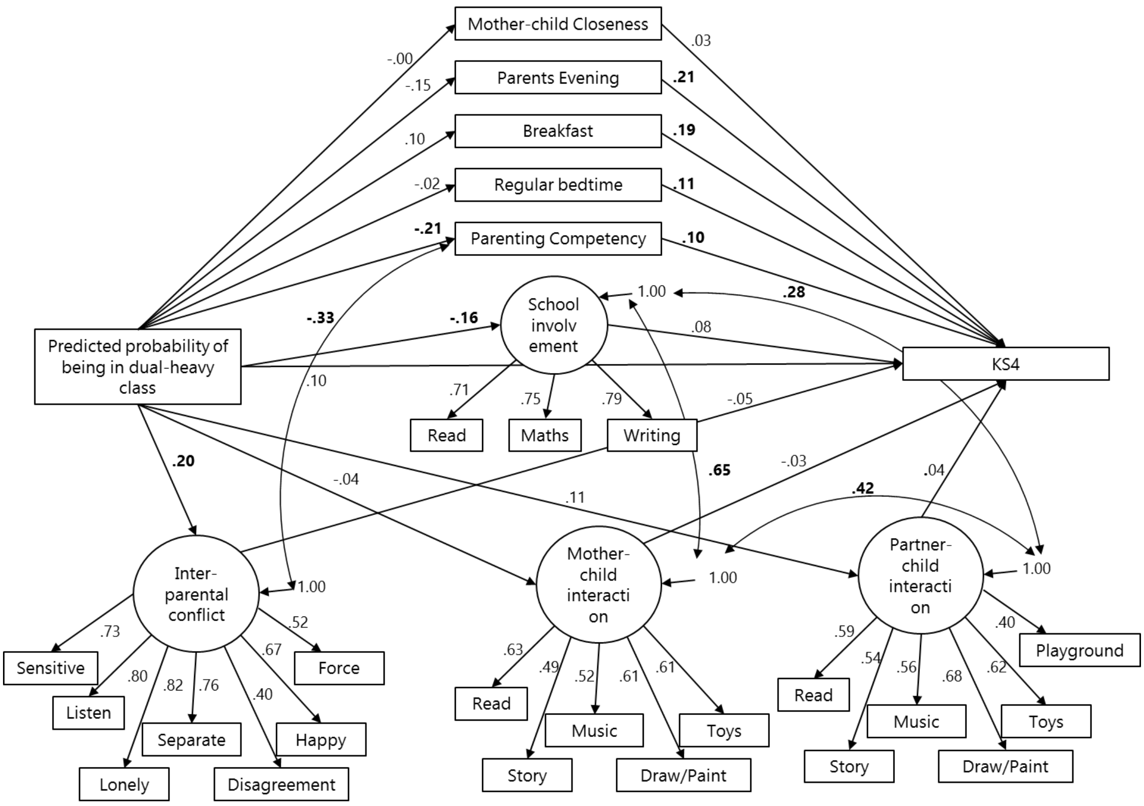

Figure 38: SEM mediation model for the dual-heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS non-degree sample)

6.4.2.4 Summary of findings

The findings suggest that the non-degree educated parents sample had a higher proportion of participants who used less substances compared to the total sample. This was evidenced by lower substance use classes emerging in the latent class analysis compared to the total sample. Although lower classes emerged, the higher consumption classes were like the total sample as they were the dual-heavy class and partner-heavy class. Both classes were not associated with KS1 – 4 in unadjusted and adjusted regression models. The SEM mediation models showed many associations, with parenting competency being an indirect effect across all models for the dual-heavy class. Interparental conflict was positively associated with both classes, with greater effect sizes in the dual-heavy class. The mother-child interaction was only associated with substance use in the partner-heavy class. Many of the parenting and family environment variables were associated with KS1 – 4, in the theorised directions for both classes.

6.4.3 Degree educated sample

All findings under section 6.4.3 are for the degree educated sample in MCS which includes: LCA, regressions (unadjusted and adjusted), and SEM mediation models.

6.4.3.1 Latent class analysis

For the degree educated group, the 3-class model was accepted (n=6,174). This was selected over the 2-class model as the AIC, BIC, and adjusted BIC was lower; the 4-class model showed lower values, but this was not as large of a difference compared to the 2 or 3-class models. The 3-class model had the highest entropy (0.71) and had class probabilities that were above 0.80 as recommended. The 4-class model could not be accepted due a non-significant LRT. Therefore, after balancing theoretical judgement and statistical criteria, the 3-class model was accepted; statistical solutions are shown in Table 59.

	2-class	**3-class**	**4-class**
AIC	59526.66	58433.06	57530.79
BIC	59829.42	58890.57	58143.04
Adjusted BIC	59686.40	58674.48	57853.87
Proportions	61%	51%	46%
	39%	37%	25%
		12%	17%
			12%

Entropy	0.68	0.71	0.70
Probability of most likely latent class membership	91%	88%	83%
	90%	82%	81%
		94%	84%
			89%
VLMR LRT	$p<0.05$	$p<0.05$	$p=0.43$
LMR LRT	$p<0.05$	$p<0.05$	$p=0.43$

Table 59: Statistical criteria for the degree educated sample for MCS, with the selected solution in grey

The latent class analysis of the degree educated group showed three distinct classes. First, the low users class whereby alcohol use was often 'Never', 'Less than a month', and '1 – 2 times a month' for mothers' and their partner's; although, partner's drinking was more frequent than mothers. However, they both had low proportions for the CAGE questions and of drug use (<5%). Second, the partner-heavy class had partners who had larger proportions saying 'Yes' for the CAGE questions, and over two-thirds of the alcohol responses for partner's were in the three heaviest response categories; 8% of partners had also used drugs in the past year. Lastly, the dual-heavy class, whereby both the mother and their partner had higher proportions of 'Yes' for the CAGE questions, and with over two-thirds of both parents being in the heaviest three categories of alcohol use (>3 - 4 times a week); 10% of mothers had used drugs, and so had 13% of their partners. From this, the partner-heavy and dual-heavy classes were saved as a predicted probabilities, and are used to predict direct and indirect effects; see Table 60.

Measure	Dual-heavy		Partner-heavy		Low	
	Mother	Partner	Mother	Partner	Mother	Partner
Usual drinking						
Never	<5%	<5%	8%	<5%	26%	16%
Less than once month	<5%	<5%	10%	<5%	22%	16%
1 – 2 times a month	<5%	<5%	13%	<5%	24%	23%
1 – 2 times per week	21%	23%	37%	29%	24%	37%
3 – 4 times a week	36%	30%	23%	39%	<5%	7%
5 – 6 times a week	23%	21%	5%	15%	<5%	<5%
Everyday	16%	21%	<5%	13%	<5%	<5%
Cut down						
No	10%	48%	>95%	48%	>95%	>95%
Yes	90%	52%	<5%	52%	<5%	<5%
Criticise						
No	86%	92%	>95%	86%	>95%	>95%
Yes	14%	8%	<5%	14%	<5%	<5%
Guilty						
No	63%	83%	>95%	77%	>95%	>95%
Yes	37%	17%	<5%	23%	<5%	<5%
First thing						
No	>95%	>95%	>95%	>95%	>95%	>95%
Yes	<5%	<5%	<5%	<5%	<5%	<5%
Drug use						
No	90%	87%	>95%	92%	>95%	>95%
Yes	10%	13%	<5%	8%	<5%	<5%

Table 60: Proportions of each variable in the LCA for the degree sample in MCS

6.4.3.2 Regressions

6.4.3.2.1 Unadjusted

The results show that the partner-heavy class significantly predicted KS1 and 2 (OR 1.49, 1.66, $p<0.05$), however this was not the same for KS4 with intersecting confidence intervals. Likewise, the dual-heavy class did not predict KS1 – 4 (OR 1.33, 0.88 and 1.05); see Table 61.

	KS1		KS2		KS4	
	n=3799		n=3799		n=3799	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Partner-heavy	**1.49**	1.12 – 1.97	**1.66**	1.16 – 2.36	0.95	0.78 – 1.16
Dual-heavy	1.33	0.91 – 1.94	0.88	0.58 – 1.32	1.05	0.82 – 1.35

Table 61: Binary logistic regressions of each class predicted on to KS1 – 4 outcomes for the degree sample in MCS

6.4.3.2.2 Adjusted

Table 62 shows that an increase in the partner-heavy class did not predict KS1 or 4 results significantly, but did for KS2 (1.71, $p<0.05$) Prenatal smoking was associated with a significant decrease in KS1 and KS4. An increase in mothers age was associated with KS4 outcomes (OR 1.04, $p<0.05$). Female children had a higher probability of achieving KS1 - 4 (OR 1.87, 1.52, 1.45, $p<0.05$). An increase in mother's distress reduced KS1 (OR 0.93, $p<0.05$).

	KS1		KS2		KS4	
	n=3287		n=3287		n=3287	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Partner-heavy	1.26	0.92 – 1.72	**1.71**	1.14 – 2.58	0.89	0.71 – 1.10
Prenatal smoking	**0.95**	0.92 - 0.97	**0.95**	0.92 – 0.98	**0.95**	0.92 – 0.98
Prenatal alcohol use	1.02	0.91 – 1.13	1.10	0.96 – 1.26	0.97	0.9 – 1.04
Mothers age at delivery	1.01	0.98 – 1.04	1.02	0.99 – 1.06	**1.04**	1.02 - 1.06
Child sex	**1.87**	1.46 – 2.40	**1.52**	1.13 – 2.04	**1.45**	1.22 – 1.72
Child ethnicity	0.79	0.56 – 1.11	1.25	0.80 – 1.94	0.87	0.68 – 1.12
Mother's distress	**0.93**	0.90 – 0.96	0.98	0.94 – 1.03	0.99	0.96 – 1.02

Table 62: Adjusted binary logistic regression of the partner-heavy class on KS1 – 4 outcomes for the degree sample for MCS

	KS1		KS2		KS4	
	n=3287		n=3287		n=3287	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Dual-heavy	1.21	0.79 – 1.87	0.71	0.45 – 1.12	1.06	0.80 – 1.41
Prenatal smoking	**0.95**	0.92 – 0.97	**0.95**	0.92 – 0.98	**0.95**	0.92 – 0.98
Prenatal alcohol use	1.00	0.90 – 1.13	1.15	0.99 – 1.32	0.96	0.89 – 1.03
Mothers age at delivery	1.01	0.98 – 1.04	1.02	0.99 – 1.06	**1.03**	1.02 – 1.06
Child sex	**1.88**	1.46 – 2.41	**1.55**	1.15 – 2.07	**1.45**	1.22 – 1.71
Child ethnicity	0.76	0.54 – 1.06	1.11	0.72 – 1.71	0.89	0.70 – 1.14
Mother's distress	**0.92**	0.89 – 0.96	0.98	0.93 – 1.03	0.99	0.96 – 1.02

Table 63: Adjusted binary logistic regression of the dual-heavy class on KS1 – 4 outcomes for the degree sample for MCS

An increase in the predicted probability of being in the dual-heavy class did not predict KS1 – 4 results significantly. Prenatal smoking was associated with a significant decrease in KS1 – 4 (OR 0.95, p<0.05). An increase in mothers age increased KS4 outcomes (OR 1.03, p<0.05). Female children had a higher probability of achieving KS1, 2 and 4 (OR 1.88, 1.55 and 1.45, p<0.05). An increase in mother's distress decreased KS1 (OR 0.92, p<0.05), and KS2 and 4 were in the same direction.

6.4.3.3 SEM Mediation models

This next section includes the SEM mediation models for both classes.

6.4.3.3.1 Partner-heavy

6.4.3.3.1.1 KS1

Figure 39 shows the degree sample model for MCS, KS1. The model had adequate fit (n=5,775, χ^2 =4525.70, RMSEA = 0.05, CFI = 0.92, TLI = 0.91, WRMR = 3.48). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.59, p<0.05), the partner-child interaction and mother-child interaction (R^2=0.42, p<0.05), and interparental conflict and parenting competency (R^2=-0.28, p<0.05). There was a positive association between the predicted probability of being in the partner-heavy class and KS1, but this was not significant (0.08). Pathways to parenting and household conflict variables from the probability of being in the partner-heavy class did show some significance. Mother-child closeness (0.15, p<0.05), parenting competency (0.13, p<0.05), breakfast (0.17, p<0.05) and parents evening (0.24, p<0.05); however, interparental conflict reduced (-0.10, p<0.05). In turn, mother-child closeness increased KS1 (0.09, p<0.05), as did parents evening (0.19, p<0.05). Likewise, breakfast frequency (0.24, p<0.05) and a regular bedtime (0.09, p<0.05) was associated with KS1. Parenting competency (0.07, p<0.05) also significantly predicted KS1. The total effect of the model was β=0.20 (p<0.05), the indirect effect was β=0.13 (p<0.05); indirect pathways were breakfast (0.04, p<0.05), closeness (0.01, p<0.05).

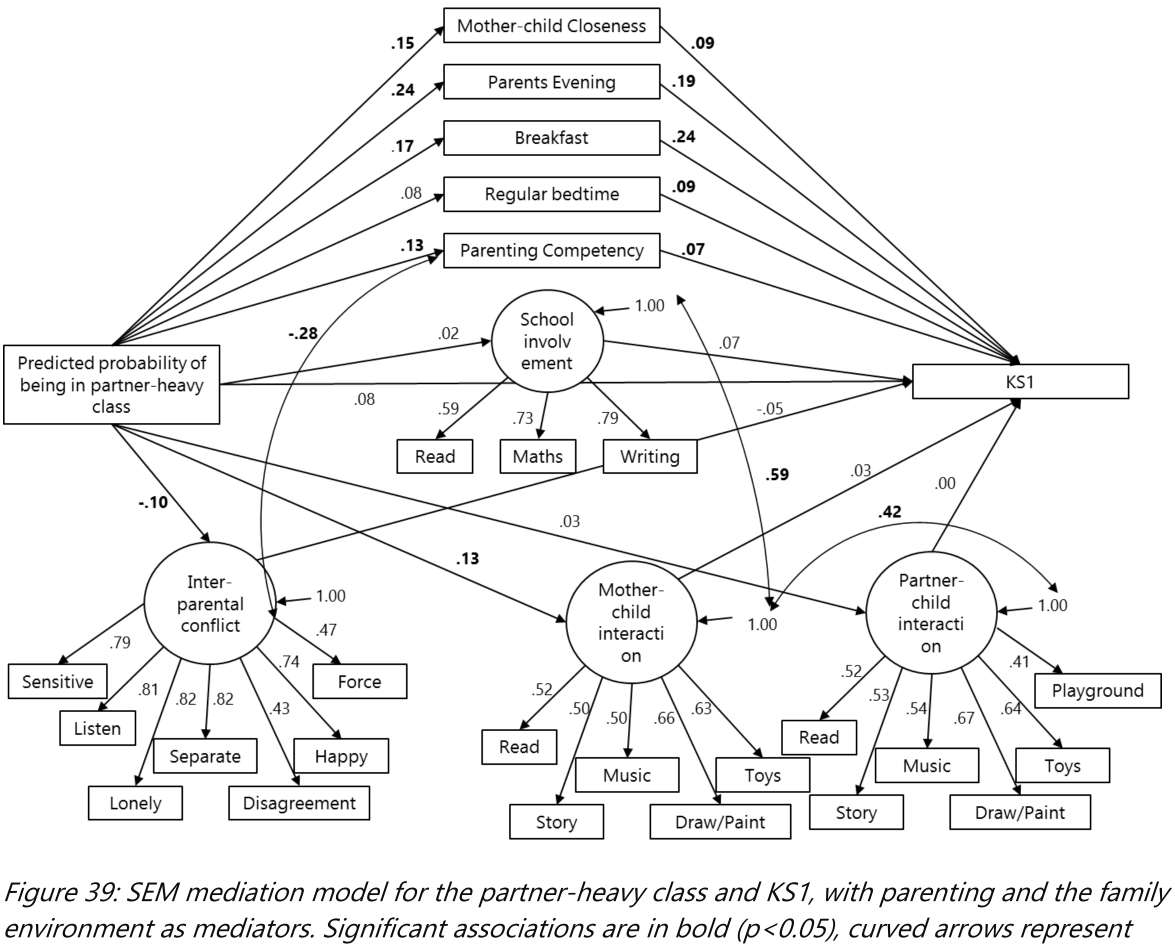

Figure 39: SEM mediation model for the partner-heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS degree sample)

6.4.3.3.1.2 KS2

Figure 40 shows the degree sample model for MCS, KS2. The model had adequate fit (n=5,758, χ^2 = 5250.94, RMSEA = 0.05, CFI = 0.91, TLI = 0.90, WRMR = 3.77). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.59, p<0.05), and the partner-child interaction and mother-child interaction (R^2=0.42, p<0.05). The partner-heavy class was associated with KS2, and this was significant (0.19, p<0.05). Pathways to parenting and household conflict variables from the probability of being in the partner-heavy class did show some significance. Mother-child closeness (0.15, p<0.05), parenting competency (0.13, p<0.05), parents evening (0.24, p<0.05), mother-child interaction (0.13, p<0.05), and breakfast (0.17, p<0.05) was increased; whereas interparental conflict decreased (-0.10, p<0.05). In contrast, only breakfast frequency (0.17, p<0.05) and a regular bedtime (0.09, p<0.05) was associated with KS2. The total effect of the model was β=0.25 (p<0.05), the indirect effect was β=0.06 (p=0.07); no statistically significant indirect pathways were observed.

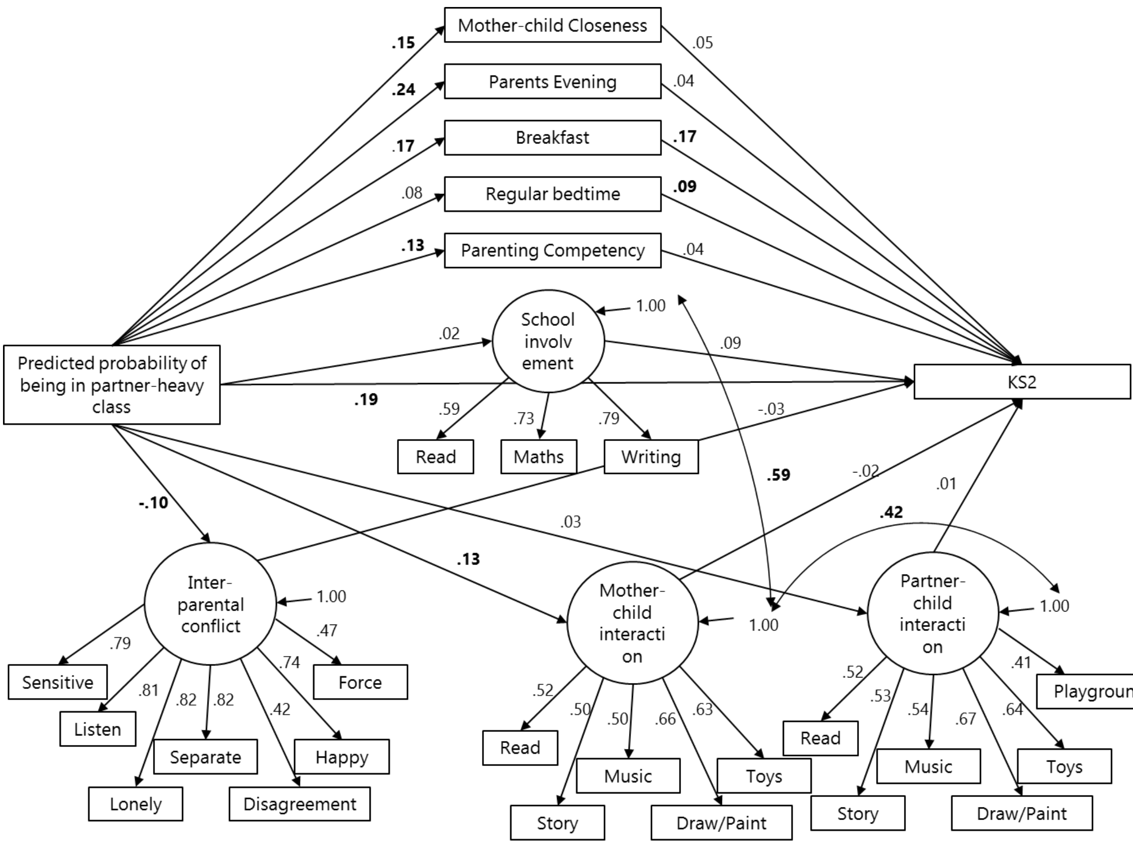

Figure 40: SEM mediation model for the partner-heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS degree sample)

6.4.3.3.1.3 KS4

Figure 41 shows the degree sample model for MCS, KS4. The model had adequate fit (n=5,761, χ^2 = 5251.28, RMSEA = 0.05, CFI = 0.91, TLI = 0.90, WRMR = 3.77). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.59, p<0.05), and the partner-child interaction and mother-child interaction (R^2=0.42, p<0.05). No significant association was found between the partner-heavy class and KS4 (-0.08). Pathways to parenting and household conflict variables from the increased probability of being in the partner-heavy class did show some significance. Mother-child closeness (0.15, p<0.05), parents evening (0.24, p<0.05), breakfast (0.17, p<0.05), mother-child interaction (0.13, p<0.05) and parenting competency was increased (0.13, p<0.05); whereas interparental conflict decreased (-0.10, p<0.05). The total effect of the model was β=-0.03 (p=0.62), the indirect effect was β=0.05 (p=0.06); no indirect pathways were statistically significant.

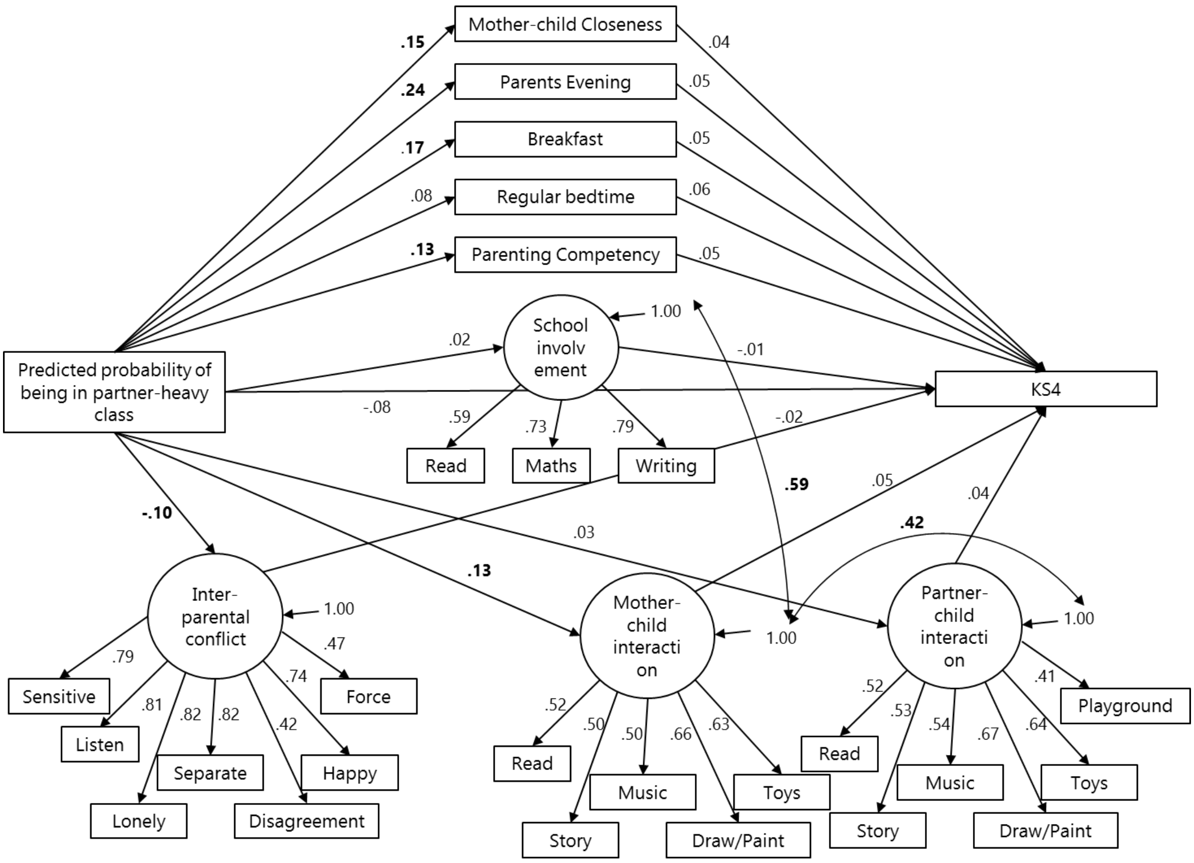

Figure 41: SEM mediation model for the partner-heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS degree sample)

6.4.3.3.2 Dual-heavy

6.4.3.3.2.1 KS1

Figure 42 shows the degree sample model for MCS, KS1. The model had adequate fit (n=5,773, χ^2 = 3993.31, RMSEA = 0.06, CFI = 0.92, TLI = 0.91, WRMR = 4.08). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.58); the model would not converge with the partner-child interaction variable. The association between the predicted probability of being in the dual-heavy class and KS1, was positive but not significant (0.14). Pathways from the dual-heavy class and parenting and household conflict variables did show some significance. Parenting competency (-0.23, p<0.05), school involvement (-0.23, p<0.05), mother-child interaction (-0.24, p<0.05) and interparental conflict (0.20, p<0.05) were associated with the dual-heavy class. In contrast, mother-child closeness (0.10, p<0.05), parents evening (0.20, p<0.05), breakfast (0.24, p<0.05), and a regular bedtime (0.09 p<0.05) was associated with KS1. Likewise, parenting competency (0.10, p<0.05) and interparental conflict (-0.08, p<0.05) was associated with KS1. The total effect of the model was β=0.15 (p=0.12), the indirect effect was β=0.00 (p=0.94); parenting competency (-0.02, p<0.05) and interparental conflict were significant indirect pathways (-0.02, p<0.05).

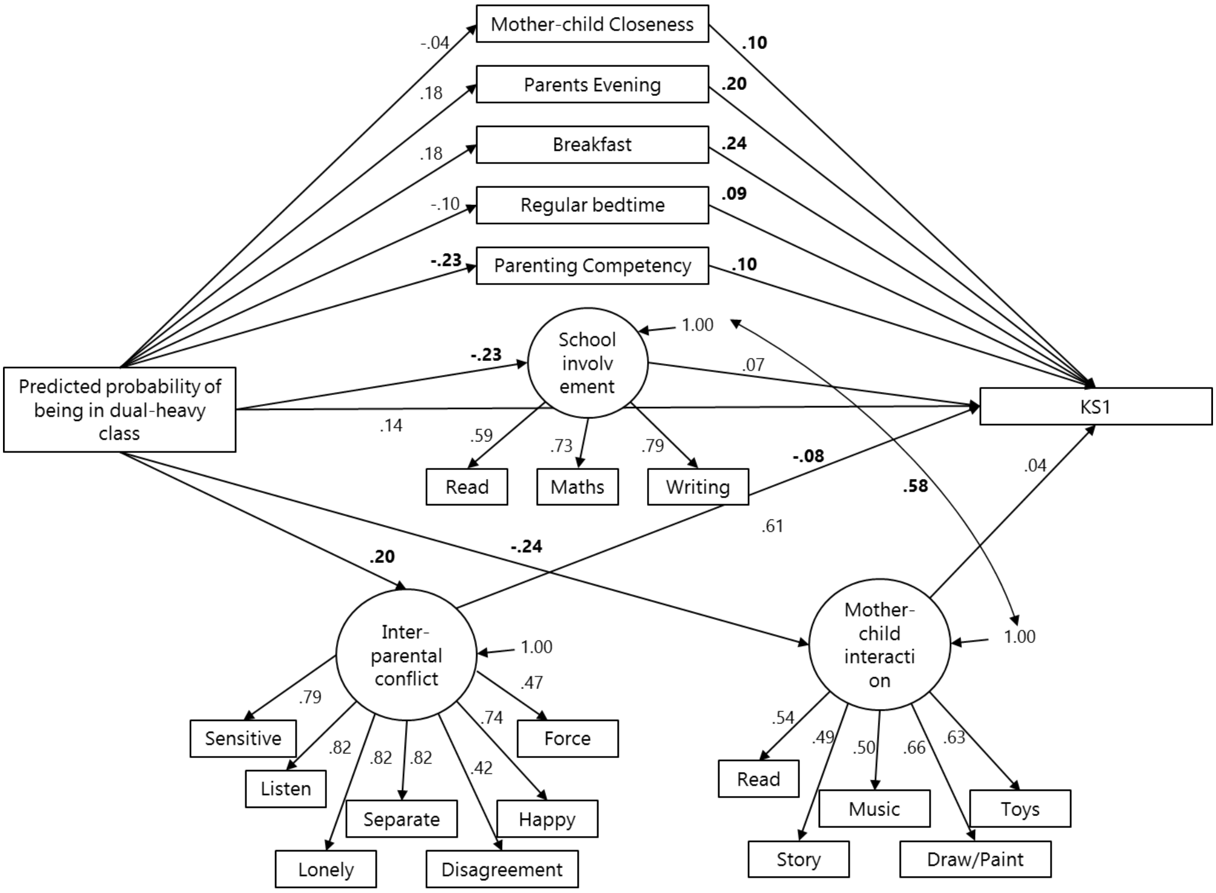

Figure 42: SEM mediation model for the dual-heavy class and KS1, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS degree sample)

6.4.3.3.2.2 KS2

Figure 43 shows the degree sample model for MCS, KS2. The model had adequate fit (n=5,758, χ^2 = 5215.05, RMSEA = 0.05, CFI = 0.91, TLI = 0.90, WRMR = 3.76). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.58, p<0.05), and the partner-child interaction and mother-child interaction (R^2=0.42, p<0.05). The association between the dual-heavy class and KS2, was small and non-significant (-0.06). Pathways to parenting and household conflict variables from the probability of being in the dual-heavy class did show some significance. Parenting competency (-0.23, p<0.05), school involvement (-0.22, p<0.05), mother-child interaction (-0.24, p<0.05) and interparental conflict (0.20, p<0.05) was associated with the probability of being in the dual-heavy class. In contrast, breakfast (0.17, p<0.05) and a regular bedtime (0.09, p<0.05) was associated with KS2. The total effect of the model was β=-0.07 (p=0.52), the indirect effect was β=-0.01 (p=0.89); no indirect pathways were observed that were statistically significant.

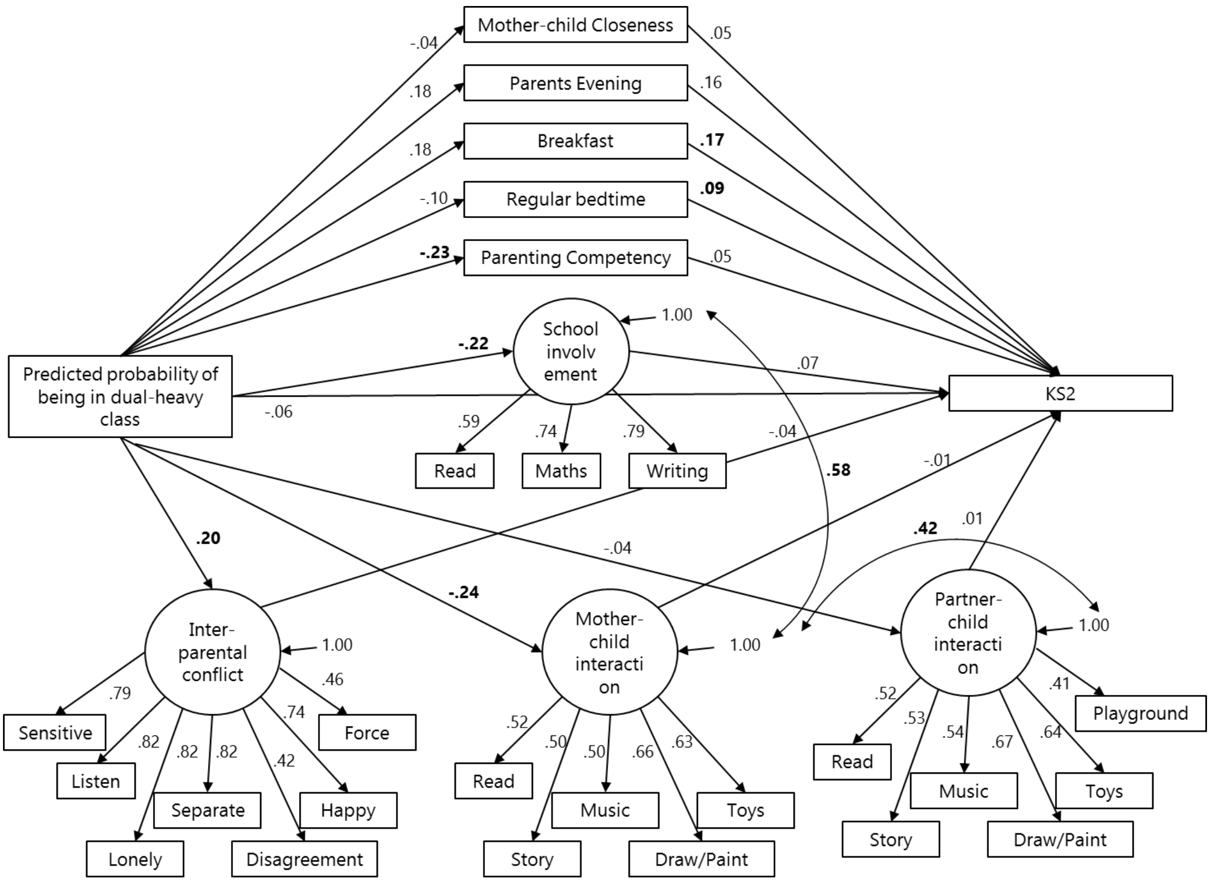

Figure 43: SEM mediation model for the dual-heavy class and KS2, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS degree sample)

6.4.3.3.2.3 KS4

Figure 44 shows the degree sample model for MCS, KS4. The model had adequate fit (n=5,761, χ^2 = 5214.94, RMSEA = 0.05, CFI = 0.91, TLI = 0.90, WRMR = 3.76). This fit was achieved by adding correlations between school involvement and mother-child interaction (R^2=0.58, p<0.05), and the partner-child interaction and mother-child interaction (R^2=0.42, p<0.05). The dual-heavy class had no significant association with and KS4 (0.05). Pathways from the dual-heavy class to parenting and household conflict variables did show some significance. Parenting competency (-0.23, p<0.05), school involvement (-0.22, p<0.05), mother-child interaction (-0.24, p<0.05) and interparental conflict (0.20, p<0.05) was decreased by an increase in the dual-heavy class. In contrast, no significant pathways were found between parenting and household conflict and KS4. The total effect of the model was β=0.03 (*p*=0.68), the indirect effect was β=-0.02 (*p*=0.52); no indirect pathways were observed that were statistically significant.

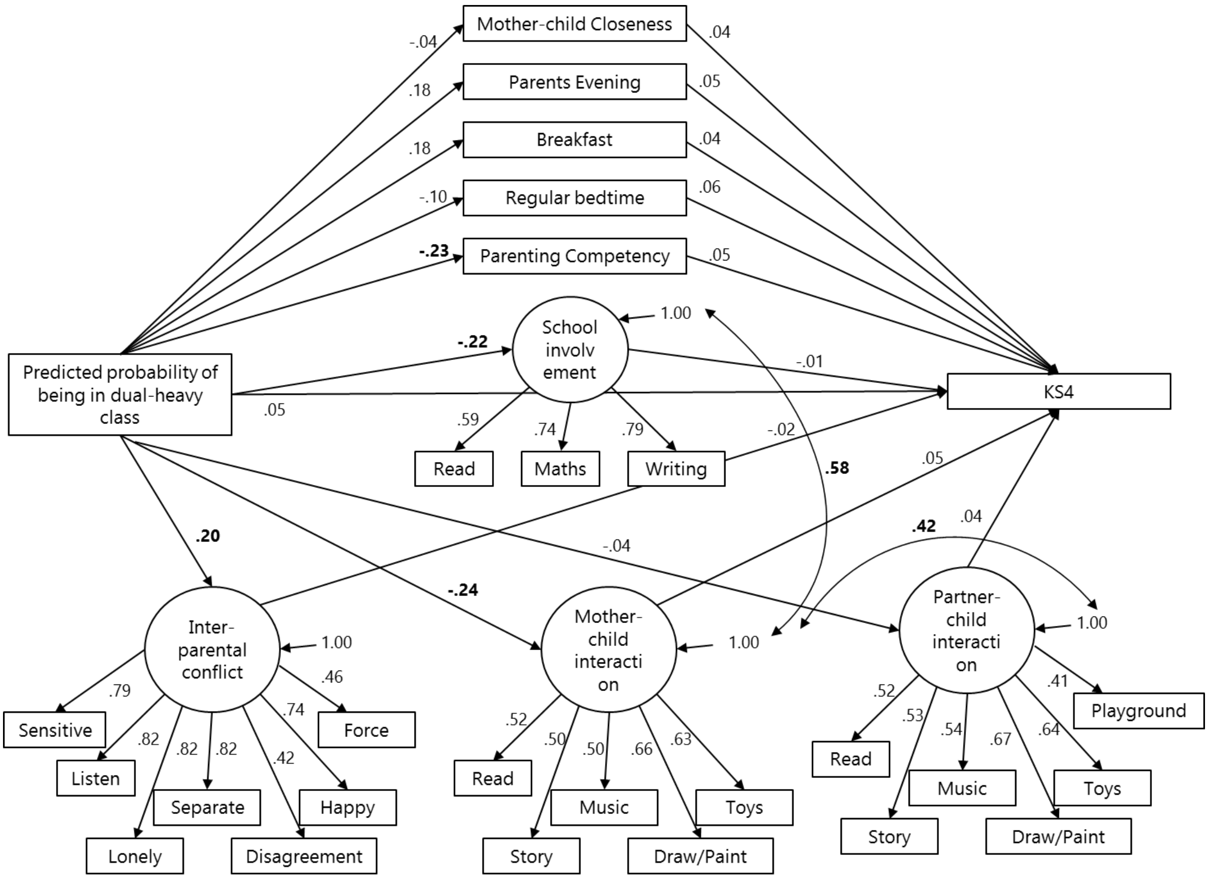

Figure 44: SEM mediation model for the dual-heavy class and KS4, with parenting and the family environment as mediators. Significant associations are in bold (p<0.05), curved arrows represent correlations (R^2) (MCS degree sample)

6.4.3.4 Summary of findings

The findings suggest that the degree educated parents use more substances in the heavy users' class than the overall sample. This class was not associated with KS1 – 4 in unadjusted and adjusted models. The partner-heavy class was present in both samples, however the degree educated sample had more positive associations between substance use and parenting, whereas few were present for the non-degree educated; however, there was a negative association between substance use and inter-parental conflict in the degree educated sample. In the instance of partner-heavy substance use, the non-degree sample had greater associations from parenting to KS1 – 4, which included a negative association between inter-parental conflict and attainment. For the dual-heavy classes, the models were somewhat similar in for KS1. Substance use reduced parenting competency, school involvement, mother-child interaction and increased inter-parental conflict for both. Both groups had significant associations from parenting to attainment, with the non-degree sample having slightly more. Over-time, the degree educated sample reduced in the number of significant associations and the size of them between parenting and attainment – whereas these remained for the non-degree sample. However, the associations between substance use and interparental conflict, school involvement and parenting competency remained for both samples overtime. These results differ to the total sample, suggesting high socioeconomic groups may have a buffer to any negative associations occurring indirectly from parental substance use via parenting and the family environment; this is explored more in Chapter 7.

6.4.3.5 Sensitivity Analysis of Income

As with ALSPAC, the analysis was reconducted with high- and low-income groups; these are in Appendix K. For the partner-heavy class, there were greater associations in the low-income group than the high-income in both directions. The lower income group showed greater interparental conflict, and more associations via parenting and the family environment with KS1 – 4. For the dual-heavy class, the income groups were similar in their associations from parental substance use to parenting and the family environment for KS1. However, the lower income group had more associations via parenting and family environment variables to KS1. However, in KS2 and KS4 the groups were more similar their associations for both directions. Overall, income illustrates a more mixed result with lower socioeconomic groups still more likely to have indirect associations. The next section is the cross-cohort analysis.

6.5 Cross-cohort analysis

To answer the final research question, this section will discuss the cross-cohort analysis. It has been used in this research to develop an understanding of the replicability, validity, and generalisability of the findings. This chapter will synthesise the body of research from Chapters 4, 5 and 6 to discuss the findings across both cohorts in terms of the measures, LCA, latent variables, regressions, indirect effects, and socioeconomic patterning. Therefore, this section attempts to answer research question 5: How do the findings compare across cohort studies in terms of replicability?

6.5.1 Measures

The measures used in analysis for exposures, mediators and outcomes for both cohorts are discussed.

6.5.1.1 Substance use

Parental substance use variables were both taken when the child was aged 3 years old. There were considerable differences between the two studies, with ALSPAC being more consumption focused, and MCS being occasion and frequency focused. The responses between mother and their partner were more harmonious in MCS compared to ALSPAC. Both ALSPAC and MCS used the same measure of drug use, with ALSPAC being more detailed. The clear limitation with ALSPAC is the low response rate from the partner in terms of the use of drugs; See Table 64 for a summary.

	ALSPAC	**MCS**
Mothers use of alcohol	Seven variables for each day of the week totalling the number of units consumed each day (analysed as a latent variable for analysis)	Usual drinking pattern over a month ranging from 'Never' to 'Every day' CAGE questionnaire
Partners use of alcohol	Mother reported frequency of partners use equalling >4 units on one occasion from 'Never' to 'Every day'	Usual drinking pattern over a month ranging from 'Never' to 'Every day' CAGE questionnaire
Mothers use of drugs	Use of drugs in the past year (Yes/No)	Use of drugs in the past year (Yes/No)
Partners use of drugs	Not available due to low response	Use of drugs in the past year (Yes/No)

Table 64: Cross-cohort comparison of substance use variables for ALSPAC and MCS

6.5.1.2 *Parenting and the family environment*

Both datasets included similar questions for mother-child interactions, and were taken at similar time points, when the child was aged between 5 and 6 years old. However, ALSPAC included more measures on cuddling, bathing, and outdoor activities, which allowed for the 'warmth' factor to be developed, whereas MCS focused more on creative activities. The school involvement variables were similar in terms of homework, but ALSPAC did not have parent reports of parents evening at age 5 or 6. The routine variables were mirrored in terms of questions and timing, as was interparental conflict. ALSPAC benefitted from asking questions on child emotional and physical 'cruelty', whereas MCS benefits from questions on mother-child closeness and parenting competency. Therefore, the datasets have some key harmonisation points and differences which benefit this research; see Table 65.

	ALSPAC	MCS
Mother-child interaction	Twelve questions on reading, stories, cuddling, bathing, and putting to bed were used to form a latent variable *Taken when the child was age 6*	Seven questions on reading, stories, music, and other creative activities were used to form a latent variable *Taken when the child was age 5*
Partner-child interaction	"	"
Parental school involvement	Mothers school interest Mothers/Partners help with homework *Taken when the child was age 6*	Parents evening, Help with homework (latent variable) *Taken when the child was age 5*
Routine	Child has regular sleeping routine Frequency of breakfast *Taken when the child was age 5*	Child has regular sleeping routine Frequency of breakfast *Taken when the child was age 5*
Cruelty	Mother or partner physically or emotionally 'cruel' to the child *Taken when the child was age 5*	Not available
Interparental conflict	Eight questions on irritability, arguments, walking out and force – transformed to a latent variable. *Taken when the child was age 6*	Seven questions on disagreement, listening, happiness and force – transformed to a latent variable. *Taken when the child was age 5*
Mother-child closeness	Not available	How close the mother and child are *Taken when the child was age 5*

Parenting competency	Not available	How 'good' you are as a parent *Taken when the child was age 5*

Table 65: Cross-cohort comparison of parenting variables for ALSPAC and MCS

6.5.1.3 Educational attainment

For ALSPAC, every key stage measure was linked (age 7, 10, 14 and 16); however, the sample was only for English schools. The MCS did not have data on Key Stage 3 (age 14), but did collect data on KS1, 2 and 4 for both England and Wales. Note that the linkage rate is higher in ALSPAC compared to MCS due to when linkage consent was taken; see Table 66.

	ALSPAC	**MCS**
KS1	Yes – England only	Yes – England and Wales
KS2	Yes – England only	Yes – England
KS4	Yes – England only	Yes – England

Table 66: Cross-cohort comparison of education data across ALPSAC and MCS

6.5.2 Demographics

Datasets differ in terms of methodology, and the demographic profile reflects this. The average age of the mother at the child's delivery is 28 years in ALSPAC, compared to 29 years in MCS; this reflects birth changes in society. Income is more difficult to synthesise as the measures differ, but both show that the middle band is the most common, however 28% of ALSPAC are in the top income band compared to 7% in MCS. Qualifications are the same across both cohorts, with 'GCSE's/O-levels' being the most common qualification. However, ALSPAC had less mothers with a degree (13.7%), compared to MCS (30.1%) which reflects the increase in university attendance. Both wellbeing/distress scores showed to be low in the overall sample. The gender proportions of children was similar, but there was near four times more children from ethnic minority backgrounds in MCS (18.6%) compared to ALSPAC (5.1%), which is likely to be due to differences in sampling; this is summarised in Table 67.

	ALSPAC	**MCS**
Age of mother	Mean: 28 *Taken at delivery of child*	Mean: 29 *Taken at 9 months*

Income	Mode: £200 - £299 (26.2%) *Weekly total income – child is 3 years old*	Mode: £11,000.01 - £22,000 (29.6%) *Net pay over a year – child is 3 years old*
Qualifications	Mode: O-level (37.0%) *Mother's qualifications - child age 2*	Mode: GCSE (29.9%) *Household qualifications – child 9 months*
Wellbeing and distress	Mean/Median: 25.90/26.00 *Taken when child was aged 2. CCEI index, a higher score equals increased wellbeing.*	Mean/Median: 9.31/8.85 *Taken when child was aged 3. A higher score equals increased distress symptoms.*
Gender of the child	51.4% are Male	51.3% are Male
Ethnicity of the child	5.1% are from Ethnic Minority backgrounds *Taken 32 weeks gestation*	18.6% are from Ethnic Minority backgrounds *Taken 9 months old*

Table 67: Cross-cohort comparison of demographics across ALSPAC and MCS

6.5.3 Latent class analysis

The purpose of the LCA was to identify high consumption families, adjusting for both parents and alcohol and illicit drugs. Substance use variables differed and are shown in Table 68. The key difference is that ALSPAC was more consumption based, whereas MCS used a screening tool, which had the ability to identify 'problem drinking', and dual-parent drug use. Both cohorts suggested a 4-class solution was the best, balancing statistical criteria and theoretical interpretation. The statistical criteria were better in the ALSPAC model compared to MCS, with the entropy being 0.06 higher in ALSPAC compared to MCS.

ALSPAC	**MCS**
Entropy: 0.74 Average class probability: 86% BLRT: p<0.05	Entropy: 0.68 Average class probability: 84% BLRT: p<0.05
Very low class (27%) - Mothers did not use alcohol. Partners did not use >4 units often over a month, and 4% of mothers used drugs.	*Low class (22%)* – Mothers and partners did not use alcohol often, if at all. >95% of mothers and their partners did not answer 'Yes' to the CAGE questions. Less or equal

	to 5% of mothers and their partners had used drugs.
Low class (38%) - Mothers used alcohol in low amounts on the weekend (up to 1 glass). Partners did not use >4 units over a month often, and 3% of mothers used drugs.	*Moderate class (50%)* – Mothers and their partners used alcohol often (usually 1 – 2 times a week). Most mothers and partners did not answer 'Yes' to any CAGE questions. Less than 5% of mothers had used drugs, compared to 6% of partners.
Moderate class (30%) - Mother's used alcohol every day, with heavier use on the weekend (1 – 2 glasses). Partners used >4 units more often, and 8% of mothers used drugs.	*Partner-heavy class (17%)* – Mothers did not use alcohol often, with use being between the low and moderate class. Their partners used alcohol often, with high proportions using it '3 – 4 times a week' – or more. Mothers did not answer 'Yes' on CAGE questions; partners did the opposite, e.g., 89% said they needed to cut down. Partners drug use was high (14%) compared to mothers (<5%).
Heavy class (5%) - Mothers averaged 3 glasses of alcohol a day and near 4 on the weekend. Two-thirds of partners used >4 units a month 'Every day' or '>10 days', and 19% of mothers used drugs.	*Dual-heavy class (11%)* – Mothers and their partners used alcohol in heavy amounts. Both had higher proportions on the CAGE questionnaires, e.g. 79% mothers said they needed to cut down. Mothers and their partners used drugs in higher proportions (13% and 15% respectively).

Table 68: Cross-cohort comparison of the distinct latent classes found in ALSPAC and MCS

The cohorts shared some similarities. Both had identified a low class, where both parents did not use alcohol often, if at all, and did not use drugs. Likewise, both cohorts had a moderate class, where both parents use alcohol more often, but not in great quantities; both parents did not use drugs in high proportions. Both cohorts showed a class where both parents used alcohol in high quantities and used it often which was paired with higher drug use; this suggests that in some cases, poly-drug use was prevalent. The differences exist where ALSPAC found the very low class, where mothers did not use alcohol and partners used alcohol in lower amounts. This is unlike MCS, where the partner-heavy class showed dynamics whereby the mother does not use alcohol or drugs in high amounts, but the partner did, which may be related to the self-reported partner responses in MCS.

6.5.4 Latent variables

While there was similarity in parenting constructs across cohorts, there were also conceptual differences. Interparental conflict items for ALSPAC captured more relationship conflict compared to MCS; MCS's measure captured more relationship satisfaction and happiness. For the mother-child interaction, ALSPAC had 17 measures of interaction which consisted of warmth, creative play, and life preparation with the child. MCS only included seven measures, most of which focused on creative play. In the analysis, ALSPAC showed 2-factors, one of warmth (cuddling, reading, and putting to bed) and creative play (painting, drawing, and singing). Warmth was selected in ALSPAC as this was a key mediator in the literature. However, in MCS, this was not possible as not many warmth related interactions were captured. This distinction is however useful, as both interactions can be explored. The ALSPAC data did not support latent variables for school involvement and partner-interactions. However, MCS supported a latent variable of homework help, and the partner-child interaction. While this is not mirrored, the distinction provides a useful exploration into mother and partner influences.

6.5.5 Measurement invariance

Both cohorts showed support for some, or partial invariance across all parenting and family environment latent variables for high- and low-income groups. Some variables showed stronger invariance than others, but SEM models can be generalised across income.

6.5.6 Relationship between parental substance use and educational outcomes

To answer research question one, each latent class was used as a predicted probability and regressed on to KS1, 2 and 4 outcomes. The increased probability of being in the very low class in ALSPAC, and low class in MCS was consistently related to a lower chance of attaining KS1 - 4 outcomes. Whereas an increased probability of being in the low class (for ALSPAC) and moderate class (ALSPAC and MCS) was related to a higher chance of attaining KS1 – 4. Both datasets showed that an increased probability of being in the heavy-substance use classes were positively associated with KS1 – KS4. Notably, the heavy class in ALSPAC, and the partner-heavy class in MCS showed little statistical significance. However, the dual-heavy class in MCS showed a positive, statistically significant association with KS1 – 4 outcomes.

6.5.7 Adjusted relationship between parental substance use and educational outcomes

To answer research question two, the models were adjusted for confounders. Both datasets were similar whereby once confounders were adjusted for, most significant relationships between the substance use classes and KS1 – 4 outcomes were annulled, and effect sizes decreased. Overall, the confounders had greater effect sizes for ALSPAC compared to MCS. Prenatal use of substances showed that smoking significantly reduced the chances of attainment. Mothers' age was more consistently associated with increased attainment for both cohorts. Likewise, female children were more likely to attain KS1 – 4 and this was consistent across cohorts. Children who were ethnic minorities had a reduced chance of attaining KS1, this was a greater effect size in ALSPAC compared to MCS; KS2 and KS4 showed mixed results with flipped OR's. Both income and qualifications were associated with attainment, with this being greater effect size wise in ALSPAC compared to MCS. Furthermore, the mothers' wellbeing (ALSPAC) or distress (MCS) were related to attainment whereby improved wellbeing was positively associated with attainment, and vice-versa for distress; see Table 69.

	ALSPAC	**MCS**
Prenatal smoking	OR 0.89 – 0.93	OR 0.98 – 0.96
Prenatal alcohol use	Inconsistent and NS	Inconsistent and NS
Prenatal drug use	Inconsistent and NS	Not available
Mothers age	OR 1.03 – 1.04	OR 1.02 – 1.04
Child sex	OR 1.56 – 2.23	OR 1.33 – 1.96
Child ethnicity	OR 0.68 – 0.69	OR 0.72 - 0.77
Family income	OR 1.25 – 1.33	OR 1.08 – 1.22
Mother's qualifications	OR 1.41 – 1.53	OR 1.25 – 1.37
Wellbeing (ALSPAC), Distress (MCS)	OR 1.03	OR 0.96 – 0.98

Table 69: Cross-cohort comparison of main confounder's effect size over KS1-4 for ALSPAC and MCS

6.5.8 *Indirect effects through parental substance use and educational attainment*

To answer research question three, indirect effects via parenting and the household environment were explored. For this section, only KS1 and KS4 will be compared, as many of the regression coefficients are similar overtime so the most temporally separated time points are useful in this context. In the tables, 'X ⟶ M' represents the pathway from the class probability (exposure) to the mediators, and 'M ⟶ Y' represents the pathways from the mediators to the outcome.

6.5.8.1 *KS1 outcomes*

For KS1, mother-child interactions decreased when the dual-heavy probability increased for ALSPAC and MCS (-0.17, -0.10 $p<0.05$); for the partner-heavy class, this was significantly increased in MCS (0.10, $p<0.05$). Every model showed that mother-child interaction was associated with an increase in KS1 outcomes, the effect was stronger in ALSPAC compared to MCS (0.14 rather than 0.07). Both partner-heavy and dual-heavy classes showed an association between partner-child interaction and KS1 (0.06, $p<0.05$). In ALSPAC, the heavy class was associated with an increase in lower school interest, and this was negatively associated with KS1. This is somewhat like MCS, which shows as the partner-heavy class increases, the attendance at parenting evening is significantly associated with increased KS1 results (0.23 and 0.19, $p<0.05$). No models had an association between substance use and sleep routine, but sleep was significantly associated with KS1 in all models (0.17 – 0.25, $p<0.05$). This was similar for breakfast, however an increase in the probability of being in the dual-heavy class in MCS was linked to increased frequency in breakfast (0.16, $p<0.05$). Furthermore, breakfast was associated with KS1 in all models (0.19 – 0.23, $p<0.05$).

The heavy class in ALSPAC was associated with an increase in cruelty (0.40, $p<0.05$); this was not associated with KS1. Both cohorts showed an increase in interparental conflict from the dual-heavy class, (0.41 and 0.14, $p<0.05$), but only MCS showed a relationship with KS1 (-0.07, $p<0.05$). Mother-child closeness was related with KS1 outcomes in MCS (0.12, $p<0.05$), and so was parenting competency (0.08, $p<0.05$). Help with homework for both cohorts and all classes was negatively associated with parental substance use. Furthermore, ALSPAC showed a negative association with schoolwork help and KS1 outcomes in mothers (-0.15, -0.26, $p<0.05$), partner-help in ALSPAC showed an increase (0.12, $p<0.05$) and MCS was non-significant (0.04); see Table 70.

	ALSPAC		MCS			
	Heavy class		Partner-heavy class		Dual-heavy class	
	X → M	**M → Y**	**X → M**	**M → Y**	**X → M**	**M → Y**
Mother-child interaction	**-0.17**	**0.10**	**0.10**	**0.07**	**-0.10**	**0.07**
Partner-child interaction	NA		0.03	**0.06**	0.08	**0.06**
School interest (ALSPAC) Parents evening (MCS)	**0.56**	**-0.18**	**0.19**	**0.26**	0.04	**0.26**
Sleep	0.00	**0.25**	0.03	**0.17**	-0.03	**0.17**
Breakfast	-0.12	**0.23**	0.07	**0.20**	**0.16**	**0.19**
Cruelty	**0.40**	-0.06	NA		NA	
Interparental conflict	**0.41**	-0.02	0.02	**-0.07**	**0.17**	**-0.07**
Mother-child closeness	NA		0.07	**0.12**	0.01	**0.12**
Parenting competency	NA		0.04	**0.08**	**-0.21**	**0.08**
Help with homework	**-0.26** (mother) **-0.19** (partner)	**-0.15** (mother) **0.12** (partner)	0.02	0.04	**-0.19**	0.04

Table 70: Cross-cohort comparison of the mediator associations for KS1 for ALSPAC and MCS. Significant pathways in bold (p<0.05)

The total effects were significant for MCS KS1 models, but not for ALSPAC. However, the direct effect was significant for both ALSPAC and MCS (0.28, 0.12, 0.25, $p<0.05$) and so was the indirect effect (-0.16, 0.09 $p<0.05$); however, MCS dual-heavy was not significant and this is because the indirect effects are difficult to interpret overall due to positive and negative pathways being multiplied and summed. Very little consistency was found overall for the indirect pathways, with only mother-child interaction being significant in ALSPAC and MCS, and school related variables; see Table 71 for a summary.

	ALSPAC	**MCS**	
	Heavy class	**Partner-heavy**	**Dual-heavy**
Total	0.12	**0.21**	**0.25**
Direct	**0.28**	**0.12**	**0.25**
Indirect	**-0.16**	**0.09**	-0.00
Significant Pathways	Mother-child interaction School interest Help with schoolwork	Parents evening	Breakfast Parenting competency Interparental conflict

Table 71: Cross-cohort comparison of total effects, direct effects, and indirect effects for KS1. Significant effects in bold (p<0.05)

6.5.8.2 KS4 outcomes

For the mother-child interaction, this decreased when the dual-heavy probability increased for both cohorts, but only in ALSPAC was this significant (-0.17, $p<0.05$). Likewise, only ALSPAC showed a relationship between the mother-child interaction and KS4 (0.06, $p<0.05$). The partner-child interaction in MCS had little significant associations with substance use, but was related to KS4 (0.06, $p<0.05$). In ALSPAC, the heavy class was associated with an increase in lower school interest (0.56, $p<0.05$), and this was negatively related to KS4 (-0.13, $p<0.05$). This compares somewhat to MCS, as attendance at parents evening was significantly associated with increased KS4 results (0.20 and 0.21, $p<0.05$); the partner-heavy class increased attendance (0.18, $p<0.05$). All models showed no association between substance use and sleep routine, but sleep was significantly associated with KS4 in all models (0.08 – 0.25, $p<0.05$). This was similar for breakfast (0.19 – 0.27, $p<0.05$), however, there was an unexpected increase in the dual-heavy class being positively associated to breakfast (0.16, $p<0.05$); see Table 72 for a summary.

	ALSPAC		MCS			
	Heavy class		Partner-heavy class		Dual-heavy class	
	X → M	**M → Y**	**X → M**	**M → Y**	**X → M**	**M → Y**
Mother-child interaction	**-0.17**	**0.06**	**0.10**	0.04	**-0.10**	-0.04
Partner-child interaction	NA		0.03	**0.06**	0.06	**0.06**
School interest (ALSPAC) Parents evening (MCS)	**0.56**	**-0.13**	**0.19**	**0.25**	0.04	**0.25**
Sleeping routine	0.00	**0.25**	0.03	**0.11**	-0.03	**0.11**
Breakfast	-0.12	**0.20**	0.07	**0.20**	**0.16**	**0.20**
Cruelty	**0.40**	-0.02	NA		NA	
Interparental conflict	**0.41**	-0.03	0.02	**-0.04**	**0.17**	**-0.04**
Mother-child closeness	NA		0.07	**0.05**	0.01	**0.05**
Parenting competency	NA		0.04	**0.09**	**-0.21**	**0.09**
Help with homework	**-0.26** (mother) **-0.20** (partner)	**-0.08** (mother) **0.08** (partner)	0.02	0.01	**-0.19**	0.01

Table 72: Cross-cohort comparison of the mediator associations for KS4 for ALSPAC and MCS. Significant pathways in bold (p<0.05)

ALSPAC showed that an increase in the heavy class was associated with an increase in cruelty; this was not associated with KS4. Both cohorts showed an increase in interparental conflict from the dual-heavy class, (0.41 and 0.17, p<0.05), but only MCS showed a relationship with KS4 outcomes (-0.04, p<0.05). Mother-child closeness was related with KS4 outcomes in MCS (0.05, p<0.05), and so was parenting competency for both classes (0.09, p<0.05). Mothers help with homework was negatively related to attainment in ALSPAC (-0.08, p<0.05) but had no associations in MCS - most of the respondents were mothers, but included some male partners. However, partner-help in ALSPAC which showed an increase in KS4 (0.08, p<0.05).

	ALSPAC	MCS	
	Heavy class	**Partner-heavy**	**Dual-heavy**
Total	0.12	**0.12**	**0.17**
Direct	**0.24**	0.05	**0.15**
Indirect	**-0.16**	**0.08**	0.01
Significant Pathways	School interest Help with schoolwork (mother and partner)	Parents evening	Breakfast Parenting competency Interparental conflict (*p*=0.06)

Table 73: Cross-cohort comparison of total effects, direct effects, and indirect effects for KS4. Significant effects in bold (p<0.05)

The total effects were significant for MCS models, but not for ALSPAC. The direct effect was significant for ALSPAC and MCS dual-heavy users (0.24, 0.15, $p<0.05$), but not partner-heavy MCS. The indirect effect was significant for ALSPAC and the partner-heavy class in MCS (-0.16 and -0.08, $p<0.05$); note, the indirect effects are difficult to interpret due to positive and negative pathways being multiplied and summed. Very little consistency was found overall for the indirect pathways; See Table 73.

6.5.8.3 Summary of SEM mediation models

Overall ALSPAC showed greater effect sizes, but the cohorts showed moderate similarities. Interparental conflict was significantly associated with the dual-heavy class for both cohorts, but this was near three times greater in ALSPAC. School related variables showed many associations across cohorts, including school interest and involvement; however, parents evening attendance was unaffected in most models for MCS, and mother's homework help seemed to be related to lower attainment in ALSPAC. The mother-child interaction was associated with KS1 attainment in all models; the partner-child interaction was less associated for both pathways. Breakfast and sleep routine were significantly associated with KS1 and 4 in both cohorts. Therefore, the cohorts suggest evidence for being complimentary.

6.5.9 Analysis exploring socioeconomic patterning across cohorts

After the models were conducted, both cohorts had unexpected findings. The main finding was that an increased probability of being in the heavy, dual-heavy, or partner-heavy class was associated with an increase in KS1 – 4 outcomes; only the dual-heavy class was significant.

Both cohorts showed considerable socioeconomic patterning in the latent class analysis, with higher income families and mothers with more qualifications being more likely to be in the moderate and dual-heavy families, or partner-heavy families. Therefore, samples were split by parental qualifications of whether the mother had a degree in ALSPAC, and whether either parent had a degree in MCS; this was due to the lower observation sizes in ALPSAC for partner-responses. Following this, the latent class analysis, regressions, and SEM mediation models were reconducted for each sample.

6.5.9.1 Measurement invariance of Latent Class Analysis

Both cohorts LCA's did not show invariance across educational qualifications, and partial invariance could not be achieved. Due to this, separate latent class analysis was conducted and are summarised in Table 74. Some similarities were found when both cohorts have latent class analyses for different groups. Both cohorts for both samples found the 4-class solution was the best. Lower consumption classes were found in non-degree samples rather than the degree samples which had more moderate use. Both cohorts showed that the degree sample used alcohol in greater quantities, but drug use was lower, particularly in the heavier use classes. Likewise, in the non-degree samples drug use was higher, but alcohol consumption was lower, particularly in the heavier use classes.

ALSPAC	**MCS**
• The non-degree sample had 4-classes with the same classes as the full sample • The non-degree sample used alcohol in lower amounts, and drugs in higher amounts. • The degree sample had 4-classes with the same classes as the full sample • The degree sample used alcohol in higher amounts, and drugs in lower amounts.	• The non-degree had 3-classes with no moderate class and a low class where near three-quarters of mothers and half of their partners used alcohol less than weekly • Drug use was higher in the dual-heavy class in the non-degree sample • The degree sample had 3-classes with similar classes to the full-sample • Drug use was lower in the dual-heavy class in the degree sample

Table 74: Cross-cohort comparison of the LCA for degree and non-degree samples

6.5.9.2 Regressions

Both cohorts showed very little patterning in the relationship between the heavy classes and KS1 - 4 across non-degree and degree samples. ALSPAC had greater effect sizes for the degree sample, but no effects were statistically significant, and the effect size was only slightly reduced once adjusting for confounders. For MCS, a weak pattern emerged with the degree sample having stronger positive effect sizes compared to the non-degree sample, but this was only three estimates (in bold in Table 75). From this, both cohorts were similar whereby the direct effects of each sample across cohorts were not statistically significant and showed little consistency in effect sizes; see Table 75 for a summary.

		ALSPAC				**MCS**	
		Heavy class		**Partner-heavy class**		**Dual-heavy class**	
		Non-degree	**Degree**	**Non-degree**	**Degree**	**Non-degree**	**Degree**
KS1	Unadjusted	0.96	18.02	**1.35**	**1.49**	1.17	1.33
	Adjusted	1.00	17.64	1.24	1.26	0.96	1.21
KS2	Unadjusted	1.38	2.82	1.13	**1.66**	1.17	0.88
	Adjusted	1.55	1.95	1.12	**1.71**	1.17	0.71
KS4	Unadjusted	0.95	3.46	1.06	0.95	1.07	1.05
	Adjusted	0.91	4.47	1.14	0.89	1.08	1.06

Table 75: Cross-cohort comparison of bivariate associations split by qualifications; bold = $p<0.05$.

6.5.9.3 Indirect effects

Overall, the models for degree and non-degree samples show some clear differences, and this is consistent for both cohorts. ALSPAC showed clearer socioeconomic differences compared to MCS, with less associations for the degree educated group compared to the non-degree sample for all pathways; this may be somewhat attributed to measurement. MCS shows this also, but more so for KS2 and KS4; hence, the socioeconomic effects may vary with time of exposure. Both ALSPAC and MCS show for KS2 and KS4 the non-degree sample often have high numbers of parenting variables associated with attainment, whereas for the degree sample it is the opposite. Indeed, the degree sample shows from both cohorts that KS2 and 4, that breakfast and sleep routine is the only significant association. Moreover, they both show that an increase in the probability of being in the dual-heavy class is associated with greater interparental conflict, and this is somewhat consistent over samples; but this is not associated with KS1, 2 or 4 outcomes for most models. In addition, MCS shows that parenting competency and homework help is negatively associated with substance use. Therefore, both cohorts show a relationship between the indirect effects of parenting and the family environment in the relationship of parental substance use and education outcomes; summarised in Table 76.

		ALSPAC		MCS			
		Dual-heavy class		Partner-heavy class		Dual-heavy class	
		X → M	**M → Y**	**X → M**	**M → Y**	**X → M**	**M → Y**
KS1	**Non-degree**	School interest Cruelty Homework help Interparental conflict	*All variables* excluding: Cruelty and Interparental conflict	Mother-child interaction	*All variables* excluding: Homework help and Mother-child interaction	Parenting competency Interparental conflict School involvement	*All variables* excluding: Help with homework and Mother-child interaction
	Degree	Interparental conflict	No associations	Mother-child closeness Parents evening Breakfast Parenting competency Interparental conflict Mother-child interaction	*All variables* excluding: Homework help Interparental conflict Mother/partner interaction	Parenting competency, Homework help Mother-child interaction Interparental conflict	*All variables* excluding: Mother-child interaction and Homework help
KS2	**Non-degree**	School interest Cruelty Homework help Interparental conflict	*All variables* excluding: Cruelty and Interparental conflict	Mother-child interaction	*All variables* excluding: Homework help, Interparental conflict and Mother-child interaction	Parenting competency Interparental conflict and help with homework	*All variables* excluding: Homework help, Interparental conflict, and Mother/Partner-child interaction

	Degree	Interparental conflict	Sleep routine	Mother-child closeness Parents evening Breakfast Parenting competency Interparental conflict Mother-child interaction	Breakfast Sleep routine	Parenting competency Homework help Mother-child interaction Interparental conflict	Breakfast Sleep routine
KS4	**Non-degree**	School interest Cruelty Homework help Interparental conflict	*All variables* excluding: Cruelty, Interparental conflict, and Interaction	Mother-child interaction	*All variables* excluding: Homework help, Interparental conflict, Closeness, and Mother-child interaction	Parenting competency, help with homework, and interparental conflict	All variables excluding: Homework help, Interparental conflict, Closeness, Mother-child interaction
	Degree	Interparental conflict	Sleep routine	Mother-child closeness Parents evening Breakfast Parenting competency Interparental conflict Mother-child interaction	No associations	Parenting competency Homework help Mother-child interaction Interparental conflict	No associations

Table 76: Cross-cohort comparison of the mediator associations across KS1, 2 and 4 by degree and non-degree samples for ALSPAC and MCS

6.5.10 Summary of the cross-cohort analysis

Both cohorts show similarities, suggesting evidence for replicability in findings. The measures harmonised well across the cohorts, so both consistency and individual effects could be evaluated. The latent class analysis showed to be surprisingly similar across cohorts, with both groups showing a low, moderate, and heavy use class. However, ALSPAC showed classes which used substances in very low amounts compared to MCS which highlighted a class where partners used substances in heavier amounts compared to mothers. The latent variables were also consistent, and both showed partial invariance across income groups.

The heavy use classes were shown to not be significant, except for the dual-heavy class in MCS, which was further explored. The effect size of the confounders was similar across cohorts, but the strength of socioeconomic associations were greater in ALSPAC. Both cohorts showed that parental substance use can reduce school interest and involvement and increase interparental conflict and cruelty, which in some instances was negatively associated with outcomes. The mother-child interaction was consistently significant in ALSPAC and MCS; the difference in effect sizes highlights the importance in the differences in measurement (warmth compared to creative play). The unexpected finding regarding the negative association of homework help with outcomes in ALSPAC. Sleep and breakfast were also consistently associated with educational outcomes. Overall, both cohorts showed evidence for indirect effects, but due to unexpected positive associations with substance use and educational outcomes, further analysis was required.

Further analysis showed that the latent class analysis in both cohorts was largely driven by socioeconomic patterning. When conducted separately for non-degree educated and degree educated samples, the non-degree sample had greater drug use, but lower alcohol use, which was found to be the opposite in degree educated groups. The direct effects did not show much patterning, but the SEM mediation models did. There were greater indirect effects for the non-degree sample, with the relationship between parenting and the family environment being particularly strong in KS2 and KS4 in MCS. The degree sample in both cohorts had few associations from parenting to education outcomes; however, in MCS parenting competency, school involvement, interparental conflict and mother-child interactions were worsened by an increase in substance use. This suggests that parental substance use and its relationship with both parenting and household conflict on education outcomes may be more important for children in lower socioeconomic conditions. Therefore, the unique contribution of both cohorts has highlighted some important similarities in parental substance use, and how this is related to their child's educational outcomes through parenting and the family environment.

Chapter 7 will feature a discussion of the findings from Chapter 4, 5 and 6 in relation wider literature, theory, and finalise with considerations for intervention development and further research recommendations.

Chapter 7 Discussion

The aim of this thesis was to examine the relationship between parental substance use and children's educational attainment using data from the UK. Two leading cohort studies of ALSPAC and MCS were used to explore five research questions. Latent class analysis was used to identify high substance use (Lowthian et al. 2020), and the probability of this was regressed on to educational outcomes; models were evaluated unadjusted and adjusted for demographic and environment aspects. Then, mediation analysis estimated if parenting and the family environment were associated with parental substance use, and if this was associated with lower educational attainment. As the results had some unexpected associations, further analysis was conducted to explore socioeconomic patterning. Through this analysis, it was found that lower socioeconomic groups had stronger associations in the mediation models compared to higher socioeconomic groups. Results of both cohorts were presented and compared, showing considerable similarity. This chapter summarises the findings for each research question, whilst simultaneously synthesising results from the scoping review and examining theoretical plausibility. The policy implications and application to intervention development are discussed, followed by recommendations for future research, and limitations.

7.1 Overview of findings

Previous studies found that 30% of children live with a binge, problem, hazardous or dependent alcohol user, and 11% lived with a parent who had used drugs (Manning et al. 2009). The scoping review identified around fifty studies which considered the effect of parental substance use on children's educational outcomes. It highlighted that there was a negative relationship and that the research field had some gaps. There was a limited number of studies exploring the impact of parental drug use on educational outcomes, and a lack of measures combining alcohol and drug use, despite that current research suggesting that a child's wellbeing is affected by both drug use (Barnard and Barlow 2003) and poly-use of substances (Raitasalo et al. 2015). Moreover, there was little research adjusting for confounders, such as socioeconomic status, and only one paper had tested mediators. Following this, literature on parental substance use, parenting and the family environment, and educational outcomes were synthesised to theorise mechanisms in a socioecological framework. From this, five research questions were developed to test the relationship, adjust for sociodemographic aspects, test for mediation, explore socioeconomic patterning, and consider the replicability of the findings across cohort studies.

7.2 Research question one: what is the relationship between parental substance use and children's educational outcomes?

High-quality research shows evidence for dose-respondent relationships. Mangiavacchi and Piccoli (2018) found that every additional gram of alcohol consumed decreased chances of tertiary education. Likewise, Berg et al's (2016) unadjusted estimates showed that alcohol-related admissions were negatively associated with school attainment which was also reflected in other studies (Díaz et al. 2008; Carbonneau et al. 2017; Evans et al. 2020; Raitasalo et al. 2020). However, this thesis found very mixed results. For ALSPAC, there was no significant relationship between heavy parental substance use and children's educational attainment. For MCS, the partner-heavy class, where only the partner used substances in higher amounts, did have a significant relationship with children's educational attainment. Likewise, households where the mother and their partner used alcohol and drugs in heavier amounts showed a positive association with educational attainment. For both cohorts, the increased probability of very low, and low uses of substances were associated with lower educational attainment, whereas moderate use increased the likelihood of higher attainment.

On further exploration, it was discovered that the classes in both cohorts had clear socioeconomic gradients. Wealthier, more educationally qualified parents were more likely to be in the moderate and heavy classes, whereas lower-income, and less qualified parents were more likely to be in the low, and very low classes. This gradient in substance use is documented in other studies, particularly regarding alcohol and physical health, often citing the 'J-shape' curve (Fillmore et al. 2006; Ng Fat and Shelton 2012); this study did not have a J-shape curve as it was a predicted probability, but problems surrounding bi-modality could be possible. In a commentary by Stockwell and Chikritzhs (2013) it is discussed that moderate drinking often acts a proxy for 'good health' as those that can afford regular alcohol often have the resources to afford healthier food, regular exercise at leisure facilities, and have greater access to healthcare systems.

Alongside socioeconomic patterning, the measure used to capture heavy substance use could also be limited. For instance, the heavy class in ALSPAC consumed around three glasses of alcohol a day, where one glass was equal to one unit. This compares to MCS which captures heavier to moderate alcohol consumption in the frequency questions and benefitted from high proportions of parents answering 'Yes' to problem behaviours on the CAGE screening tool. As a result, it is questionable to whether these classes capture heavy substance use. Moreover, it is difficult to compare to studies which use unidimensional measures; however, this research does not find that dual-parent alcohol use (Berg et al. 2016; Velleman and Templeton 2016) and poly-drug use (Raitasalo et al. 2015) have more significant risks for children's attainment in a regression analysis. Also, there is a concern of publishing bias. From this, research should define what heavy substance use is, with this being separate to dependent use.

7.3 Research question two: what is the relationship between parental substance use and children's educational attainment once environmental and demographic factors are adjusted for?

Consistent with the literature, maternal smoking in pregnancy was consistently associated with lower attainment in children; this was greater in effect size in ALSPAC compared to MCS, which may highlight the greater socioeconomic differences in this cohort. Some possible explanations include the link to low birthweight in new-borns (Mathews 2001; Ventura et al. 2003) which is later related to lower educational attainment (Agrawal et al. 2010), and the cost of tobacco use, which may place financial strain on the family. However, it is difficult to isolate the impacts of tobacco smoking as it has a strong correlation with socioeconomic conditions which often are co-determinants of educational attainment (Batty et al. 2006); although it was an independent effect in this research. Prenatal alcohol use and drug use was not consistently statistically associated with educational attainment, which is contradictory to some literature (Alati et al. 2013; Sayal et al. 2014; Ross et al. 2015). However, some of these models do not adjust for the same confounders and have not always adjusted for postnatal use as well as prenatal use; considerable development is required in the area of the effects of prenatal drug use (Ross et al. 2015).

Outside of individual predictors, the interpersonal relationships with family, peers and others are essential for development. A unique finding in this research showed that greater wellbeing among mothers was independently associated with a small increase in attainment. Most of the significant associations were when the child was aged seven years, suggesting that parental mental wellbeing does not endure over time, and has independent effects, perhaps when the mother-child bond is stronger, or when intragenerational transmission is clearer. Few studies have researched into parental mental health and children's educational attainment, so comparison is limited. Other family components included the mother's age, with children born to older mothers more likely to achieve the expected outcomes in attainment; this is likely to be related to greater resources via income, which often increases with age.

For socioeconomic status, both family income and the mother's qualifications were used as it is expected that they exert independent effects; the constructs were only moderately correlated in both cohorts. The mother's qualifications had a stronger association with their child's educational outcomes in both cohorts compared to family income. While family income is essential, the construct is likely to draw on resources such as homeownership in an affluent area, access to educational resources (books, computers, and the internet) and travel to improved educational settings. However, the mother's qualifications are linked to the knowledge of the educational system and how it operates; the exploitation of this knowledge by the mother is likely to be predictive of the child's success. As theorised by Bernstein (1960) and Bourdieu (1985), language and cultural capital is developed in the home and is directly related to school outcomes. As two social systems, they work together often transmitting ideology, values, and reproducing intergenerational inequality via access to resources (income), cultural practices and behaviours (visits to museums, values in education, prioritisation of schoolwork). Therefore, the family's income and qualifications work together in conjunction with each other, with no doubt that access to both is likely to be more advantageous rather just one.

The overarching finding was that adjustment for demographic aspects annulled any observed associations between parental substance use and child educational attainment. This was not so relevant for ALSPAC where no significant associations were seen for the heavy class, but more so in MCS where the dual-heavy class was significantly associated with a positive increase in attainment. This is similar to Berg et al. (2016) who found that parental alcohol hospital admissions were negatively associated with their children's educational attainment, but this effect was annulled once models were adjusted. However, this is not consistent, as other studies have adjusted for confounders and significant associations remain. For example, Mangiavacchi and Piccoli (2018) and Díaz et al. (2008). Nevertheless, how parental substance use operates to affect educational attainment in the context of other factors is still unclear. However, this research concludes that demographic and environmental factors could be stronger predictors of educational attainment compared to the measure of substance use in this study, and research which has not adjusted for this could present spurious findings.

7.4 Research question three: do parenting and the family environment mediate the relationship between parental substance use and children's educational attainment?

Chapter two explored parenting and the family environment as a mediator and potential mechanism in this relationship. As only one study was identified that tested this (Brook et al. 2010), literature was synthesised. First, literature which investigated how parental substance use was associated with parenting styles, behaviours, and values, and the family environment was explored (Holmes and Robins 1987; Kandel 1990; Baumrind 1991; Hogan 1997; Finzi et al. 2000; Davies et al. 2002; Gest et al. 2004; Edwards et al. 2009; Kachadourian et al. 2009; Gutman and Feinstein 2010; Arria et al. 2012; Finan et al. 2015). Following this, literature documenting the associations between parenting and the family environment and children's educational outcomes was explored. From this, it was theorised that parental substance use might change other behaviours and processes which result in poorer educational outcomes in their children (Bowlby 1969; Baumrind 1991; Mau 1997; Pianta 1999; Garcia-Reid et al. 2005; Sturge-Apple et al. 2008; Magdalena 2014; Castro et al. 2015; Masud et al. 2015). The models aimed to explore whether parental substance use interrupted parenting styles, behaviours, and values and the family environment, and whether this was indirectly associated with their children's educational attainment.

As the regressions did not show a negative association, indirect associations (termed as indirect effects in the SEM literature) were explored, despite the research question defining the parenting and family environment variables as mediators. Chapter 3 discussed this in more detail, but it was argued that the existence of a relationship between two variables can be cancelled out due to an opposite pathway of the positive and negative pathway, i.e., parental substance use increases interparental conflict, and this reduces educational attainment. As a result, indirect effect models were conducted to inspect whether parenting and family environment processes were occurring and whether they were consistent over cohorts.

Overall, the results showed some evidence that parenting behaviours and the family environment were modified by parental substance use, which was negatively associated with educational attainment. In terms of total sample results, ALSPAC showed larger effect sizes and more statistically significant associations compared to MCS. Following this, each parenting or family environment variable is discussed in turn in terms of findings and the wider literature.

7.4.1 Parent-child relationship

The parent-child relationship measured as either the mother or partner-child interaction showed variation depending on the parent. Mother-child interaction was negatively affected in ALSPAC and MCS when the probability of the heavy class increased; both cohorts showed significant associations with attainment. As found in the literature, this research affirms that the mother-child relationship is affected by substance use (Kandel 1990; Brook et al. 2010; Finan et al. 2015). For instance, Brook et al. (2010) found that the mother-child relationship was negatively associated with parental substance use, and the mother-child relationship was later associated with academic attainment. As this study included urban African Americans and Puerto Rican youth, this research offers further confirmation that these findings are transferable across some cultural backgrounds.

However, the size of the association was not consistent across both cohort studies as MCS' association between parental substance use and the mother/partner-child interaction was smaller. This may be due to ALSPAC having measures of warmth and parenting skills such as bedtime, cuddling and bathing the child, whereas MCS only measured creative factors such as drawing and painting. Perhaps, parental substance use may affect the warmth in parenting, such as cuddling, but creative play is altered less, or less crucial towards attainment. It also could be that the ALSPAC measure of parental substance use captures heavier consumption compared to MCS, reducing the strength in associations. Note, that this pathway was not a significant indirect effect in ALSPAC or MCS, which could be due to a lack of power in analysis. However, the partner-child interaction showed associations towards attainment for both types of substance use. Given the mother-child interaction was only decreased by substance use but not significant for attainment, the partner-interaction may be a proxy for overall family support and engagement in MCS. Furthermore, partner-heavy substance use increased mother-child interaction, suggesting that mothers were displaying potential over-functioning through the lens of family systems theory (Bowen 1974).

7.4.2 Mother-child closeness

Mother-child closeness had no relationship with parental substance use across all models. This finding does not support the literature, as Kandel (1990) found less closeness when maternal substance use increased, although the focus was on dependent, more high-risk levels of substance use compared to this research, which may explain the inconsistency. Likewise, Finan et al. (2015) found that family cohesion was affected by parental substance use, so this further inconsistency raises the question of whether the measure is capturing high-risk substance use. However, closeness was significantly associated with educational attainment and despite that this lessens in size over-time, this suggests that mother-child closeness is a key contributing factor towards educational attainment over the life course.

7.4.3 School involvement

In ALSPAC, parental substance use increased lower school interest by the mother, which resulted in a higher probability of the child not attaining the expected levels in education. In some models, this was a statistically significant indirect pathway, suggesting school interest could be an enduring mechanism. This corroborates Hogan's (1997) qualitative work, which found that parental substance use impacts overall engagement with the child's schooling. However, the findings do not show evidence for lower attendance at parents evening as this was not significantly associated with parental substance use in MCS. However, it was a significant predictor of attainment suggesting that a no attendance at parents evening is quite a rare occurrence, and perhaps only in circumstances where the parent is considerably affected by substance use as in Hogan (1997). Other forms of school involvement included homework help, which was negatively associated with both cohorts' heavy substance use classes probability. Again, Hogan (1997) found that teachers did not see any signs of homework help from parents who were dependent on substances. This corroborates with other studies that show that parental involvement, supervision, and monitoring practices are reduced when parental substance use is increased (Chassin et al. 1993; Windle 1996; Magdalena 2014).

An unexpected finding was that ALSPAC showed that mothers' help with homework was negatively associated with attainment; MCS did not show an association with attainment. Although this may seem surprising initially, it is useful to draw on the 'reactive hypothesis' (Epstein 1988; McNeal 1999; McNeal 2014) whereby adolescents struggle academically before exhibiting symptoms, which leads to parental involvement. Mau (1997) found that helping and controlling types of parental involvement were negatively associated with achievement. This type was largely found in white students rather than Asian students. Unlike Mau (1997), this study did not find evidence for increased negative relationships over-time due to the struggle for independence; instead, this relationship reduced in effect size over-time. Another unexpected finding was that partner help was consistently positively associated with education outcomes. This is likely again to be a proxy for household size, a more equal distribution of labour, and family support for the child's schooling.

7.4.4 Parenting competency

An increase in partner-heavy substance use was associated with better parenting competency in mothers which could allude to over-functioning in the household, or the mother comparing their parenting skills to their partners. At KS1, this was significantly associated with better attainment but not for KS2 and KS4, perhaps where parenting becomes less important over-time. In reverse, an increase in substance use in the dual-heavy class reduced overall parenting competency at every key stage; this was a statistically significant indirect effect for KS1. This aligns with other research, as Tan et al. (2017) found that parenting stress significantly mediated the relationship between ACEs and academic attainment. This suggests that confidence in parenting reduces when substance use increases, which could be related to feelings of guilt, parenting stress, or could be related to mental health illness which is bidirectionally associated with parental substance use.

7.4.5 Household routine

Both breakfast frequency and regular bedtime were unaffected by substance use; however, they were both significantly associated with most key stage outcomes across both cohorts. This supports literature which evidences that breakfast and sleep are essential factors in attainment (Dewald et al. 2010; O'Dea and Mugridge 2012; Littlecott et al. 2016). Conroy et al. (2015) found that children of alcoholics had fewer hours of sleep, and children often napped in the day. Likewise, Kelly and El-Sheikh (2016) found evidence for reduced sleep hours and efficiency in children whose parents had drinking problems; children were more likely to be from lower socioeconomic and Black backgrounds. This furthers the concern that the substance use captured in this research is conservative, as findings are not consistent with those which focused on dependent populations.

7.4.6 Interparental conflict

Findings were inconsistent across cohorts. ALSPAC showed evidence that interparental conflict was significantly increased by parental substance use; this measure included more abusive forms of conflict, e.g., physical violence, shouting and not talking to the partner. Likewise, MCS showed a significant increase in interparental conflict but the effect size was not as large; this may be due to the measure being focused more on relationship satisfaction rather than conflict. Both had a negative association with educational attainment, but this was only significant in MCS. As a result, this research aligns with other research whereby parental substance use increases negative interactions and marital tension in the household (Almeida et al. 1999; Keller et al. 2008; Kachadourian et al. 2009). In terms of educational attainment, the literature is quite limited. Harold et al. (2007) suggest that children are at risk for lower attainment, however, this may occur indirectly through externalising or internalising symptoms (Sturge-Apple et al. 2008). Furthermore, the small effect-sizes may be due to the bias in the self-reported nature of this questions, which may affect the power in analysis.

7.4.7 Summary

There is evidence for parenting and the family environment being mediators in the relationship between parental substance use and children's educational attainment, which is in line with other research (Brook et al. 2010; Tan et al. 2017). Warm and creative mother-child interactions were affected by parental substance use, and these were significantly and consistently associated with educational attainment in ALPSAC; in MCS, partner-child interactions were significant with attainment, but not substance use. Alongside this, the variables of school interest and parenting competency were key mediators, and potential mechanisms. Parental school involvement was also reduced when parental substance use increased; however, the relationship is complex as this variable could be capturing underlying controlling strategies in parents' method to help their child with their schoolwork, or overarching household support. Interparental conflict suggested some evidence of being a mediator, particularly in MCS. However, household routine, attendance at parents evening and mother-child closeness did not show evidence as mediators, but only as pathways towards attainment. Furthermore, these association sizes decreased over-time suggesting that other influences may take precedent, such as peers.

7.4.8 Understanding the unexpected findings

In the SEM mediation models, there was a positive relationship between parental substance use and educational attainment, this was consistent in ALSPAC and MCS. This was unexpected and not coherent with other literature. As a result, further analysis was conducted to investigate this. Cross-tabulations showed a socioeconomic gradient across the substance use classes; whereby lower socioeconomic groups were less likely to be in the high consumption classes. From this, a measurement invariance of the latent class analysis was conducted which showed invariance and model instability across degree educated and non-degree educated parents. Therefore, the sample was split by degree and non-degree groups and a replica analysis was conducted to explore socioeconomic patterning.

7.5 Research question four: Does the relationship between parental substance use and children's educational attainment differ across socioeconomic contexts?

Socioeconomic patterning was observed in both cohorts in the exposure variable. Over half of those from high-income households were in the dual-heavy class in both cohorts; this compared to near two-thirds of those in the partner-heavy class for MCS only. In terms of qualifications, near of half of the dual-heavy class in MCS was made up of degree-educated parents; in ALSPAC this was a fifth, but there were fewer degree-educated parents in this cohort due to time-variation in degree attainment so comparisons are limited. This is consistent with literature which shows that higher socioeconomic groups often use substances, particularly alcohol, in greater quantities (Patrick et al. 2012; Bonevski et al. 2014; Kendler et al. 2014). However, these groups are much less likely to experience alcohol-related harms compared to lower socioeconomic groups who use alcohol; research still is ongoing to why this exists, with some suggesting it is a combination of factors such as access to healthcare, and use of other substances, e.g. smoking (Katikireddi et al. 2017; Calling et al. 2019). Due to the socioeconomic patterning, separate latent class analysis models were conducted by parental education level; this was selected due to greater effect size of parental education on attainment; income is often associated with access to alcohol rather than cultural practices (Melotti et al. 2011) and this was somewhat found in the sensitivity analysis.

The separate latent class analysis showed similarities across cohorts, with the non-degree sample showing greater use of illicit drugs, whereas the degree-educated sample showed greater alcohol consumption. Both cohorts still showed the same classes of dual-heavy use and partner-heavy use across education samples, but the values did differ in alcohol and illicit drug use. Interestingly, the direct effects observed in MCS between heavy parental substance use and educational outcomes were somewhat annulled by this adjustment, with only KS1 in the non-degree sample, and KS1 and 2 in the degree sample being significant for the partner-heavy class; these could be issues relating to multiple testing.

Socioeconomic differences in indirect effect SEM models were clear. The key finding was that the non-degree sample had more associations for pathways from parental substance use to parenting and the family environment, and even greater from this to educational attainment compared to the degree sample. This was evident for both cohorts, but ALSPAC showed more robust evidence for this finding, whereas this pattern in MCS was more prevalent after KS1 outcomes suggesting some temporal explanations in associations; this finding may be due to the fact that ALSPAC was split by mother qualifications only, and MCS was split using both parents due to response rate differences in the cohorts.

In ALSPAC, the variables of school interest, cruelty, homework help, and interparental conflict were associated with parental substance use for the non-degree sample only. Only interparental conflict was increased by parental substance use in the degree-educated sample in ALSPAC. For pathways from parenting and the family environment to educational attainment, the non-degree sample showed all variables excluding interparental conflict and cruelty had significant relationships with attainment. In contrast, the degree-educated sample only showed a significant association for sleep in KS2 and 4. Despite this research not finding a relationship between interparental conflict, cruelty and educational outcomes, this still may affect other domains of wellbeing such as mental wellbeing (Cosgaya et al. 2008; Sturge-Apple et al. 2008). This may indirectly impact educational attainment, as increased emotional distress could be associated with attention difficulties at school and by proxy, attainment. A similar pattern was observed for MCS, but this pattern is stronger in KS2 and KS4 and is more the case for dual-parent substance use, rather than partner-heavy use.

In MCS, partner-heavy substance use was associated only with increased mother-child interactions in non-degree samples. Conversely, in degree samples there was an increase in mother-child closeness, parents evening, breakfast, parenting competency and reduced inter-parental conflict in the presence of partner-heavy substance use. As a result, there is evidence that higher socioeconomic families are able to support their children in the circumstance of partner-heavy substance use. Perhaps, mothers are more available to 'over-function' in a family systems theory lens, and the associations are capturing parenting comparisons from mother to partner. Therefore, in these circumstances, over-functioning (Bowen 1974) is available among higher socioeconomic families whereby the partner's substance use does not cause conflict; this over-functioning may not be available to lower socioeconomic mothers, or is likely not a response to their partner's use of substances.

In terms of pathways from parenting and the family environment to attainment, MCS was similar to ALSPAC for KS2 and KS4 only. For both socioeconomic samples, most variables were associated with KS1 outcomes, excluding homework help and mother-child interaction; the degree sample also included no associations for interparental conflict and partner child-interaction for only the degree sample. Variables showed relationships in the expected directions whereby parenting and family environment improved attainment. However, at KS2 and KS4, only sleep and breakfast were associated with attainment in the higher socioeconomic samples (degree educated), and no associations were found by KS4 in MCS. This compares to non-degree educated samples, where the associations between parents evening, breakfast, sleep and parenting competency were still prevalent. Hence, for the partner-heavy class, it is evident that socioeconomic differences exist for families and their children's educational attainment, however there were no clear indirect pathways for partner-heavy substance use.

For the dual-heavy use of substances in MCS, both samples observed a negative association between parental substance use and the variables of parenting competency, mother-child interaction, time spent on homework, and inter-parental conflict for KS1 - 4. This suggests that the use of substances to certain points reduces confidence in parenting skills, time spent with children, and increases conflict across socioeconomic contexts. However, the higher socioeconomic group had fewer indirect pathways that endured over-time, only inter-parental conflict in KS1 was significant. This suggests that while higher socioeconomic groups have some buffer to the impact of parental substance use via structural, material, or cultural resources, some behaviours may still permeate this. Notably, the findings point to this buffer becoming a stronger influence over-time as few effects were observed at KS2 and KS4. Very much like ALSPAC, only sleep and breakfast were associated with attainment at KS2, and none with KS4. This finding is in opposition to the non-degree educated group, as again many parenting and family environment variables were still associated with attainment at KS2 and 4, and inter-parental conflict and parenting competency were indirect pathways. Therefore, across cohorts there is evidence for effects that withstand socioeconomic conditions however, the main finding is that the indirect effects of parenting and the family environment are more prevalent in lower socioeconomic contexts.

This finding offers a new perspective on the mechanisms in the relationship of parental substance use and their child's educational attainment across socioeconomic contexts. Little research has been conducted in this area, with Font and Maguire-Jack's (2016) work being a unique addition to this. While no negative direct effects were found between parental substance use and educational attainment, the process of parenting and the family environment differed across socioeconomic contexts. The most notable finding was that the degree educated sample had fewer associations between parenting and family environment and attainment, and overall indirect effects compared to non-degree educated families. A possible explanation for this can be found in the reasons why parents use substances. In higher socioeconomic contexts, parents may use substances in a social manner, as an accompaniment to a meal, or to relax in the evenings. However, in lower socioeconomic contexts, it may be used to cope with the other stress and strains in life, such as the lack of resources this is associated with, e.g., health, or neighbourhood violence. Perhaps, it is *why* parents use substances rather than quantity or frequency – to an extent. Very little research has been conducted in this area; however, it may be a potential avenue for further, more qualitative research.

Other explanations include the reduced access to cultural, structural, and material resources lower socioeconomic families have. As discussed in Chapter 2, Bourdieu (1985) discusses the forms of capital more educated parents are likely to possess, and how they are transmitted to their children, which in turn is valued by the education system. This harmony among structures in society leads to the reproduction of inequality, whereby higher socioeconomic families continue to transmit cultural practices intergenerationally. In this research, there was little evidence that parenting, and the family environment was associated with attainment in higher socioeconomic families. These processes were often only observed in less educated families, with most of the indirect effects through parental substance use observed among this group. As a result, higher socioeconomic families appear to have a buffer, whereby parenting practices and the family environment is not a strong predictor of their children's attainment.

In terms of potential buffers, it may be that children with more educated parents are attending less deprived schools, and these consistently attain higher in comparison to more deprived schools. This is mainly due to the higher intake of more academically able children which again, is related to socioeconomic status, thus highlighting more of the reproduction of inequality in society. In addition, children from more educated families will be more likely to reside in settings where educational attainment is a crucial focus, being the main goal throughout childhood and adolescence. Not only this, but more educated, and therefore most likely wealthier, families are able to capitalise on activities that benefit the educational needs of the child, such as visiting museums, or galleries. Alongside this, they often have more capital to purchase books or any extra tuition that is required for the child to succeed. Perhaps, only dependent substance use is likely to alter parenting and the family environment in high socioeconomic families, and as a result, there is a threshold of resilience in these groups.

On the other hand, lower socioeconomic families are deprived of access to the cultural capital required for universal educational success (Lee and Bowen 2006), and they often experience some, or all, types of deprivation, including material and neighbourhood deprivation. Material deprivation often compromises of overcrowding, housing tenure, benefit receipt, lack of amenities for basic requirements such as hygiene or cooking, but also work and play (Sacker et al. 2002). In a longitudinal study, it was found that material deprivation (which included most aspects in the last sentence) was negatively associated with academic achievement. They also found that material deprivation was increasingly associated with lower educational achievement over age 7 (-0.09), 11 (-0.11) and 16 years (-0.24) whereas associations of parental involvement lessened over-time; however, material deprivation was associated with parental involvement over-time too. A more recent systematic review by Pillas et al. (2014) found that household level of deprivation was associated with school readiness. Within this systematic review, a study by Kelly et al. (2011) examined family income and school readiness, while adjusting for demographics, the parent-child relationship and parenting behaviours. They found that despite adjusting for all of these aspects, the poorest quintile had the lowest school readiness, and a gradient was observed. In short, it is possible that material deprivation can lead to families being unable to participate in activities or outings which place further strain on parents' emotional and physical resources for parent-child or parent-teacher interactions (Roberts 1980 cited in Sacker et al. 2002); this in turn can allow for negative parent-child interactions which can further impact achievement.

Alongside material deprivation, children residing in lower socioeconomic conditions may also experience neighbourhood deprivation. This can compromise of increased violence, anti-social behaviours and less cohesion in the community, particularly as neighbours have to compete for resources (Barnes et al. 2006). Barnes et al. (2006) discusses how collective socialisation models highlight the importance of adult role models, and how if they are not available to socialise children towards acceptable success children may be socialised towards anti-social behaviour – which links to anomie and strain theory. Moreover, they discuss the role of competition theory and how neighbours have to challenge each other for scarce resources, which relates to relative deprivation and how poorer neighbours may feel demoralised against more affluent groups; particularly if subjected to negative labelling. These theories were supported in Barnes et al. (2006) who found that neighbourhood deprivation was heavily related to school disorder, which later was associated with school achievement; this was also supported by Sacker et al. (2002).

In addition to this, they noted that school-level deprivation was an improved predictor of school achievement; this was the percentage of children who had free school meals (FSM) or with special educational needs. School-level deprivation often compromises of lower resources, high pupil-teacher ratio and expenditure per pupil (Steele et al. 2007). In Steele et al. (2007), they note that if expenditure per pupil increased by £1,000 and teacher-pupil resourced increased lower socioeconomic children would improve their levels of maths and science by 0.5 a year; however, English would have less of an improvement due to language development being closely related to the home environment. Given that all levels of deprivation are strongly related to one another, lower socioeconomic families face multiple disadvantage and exclusion from the education system at a material, social, neighbourhood and school level.

Not only do these families experience multiple levels of deprivation, but they often use language that is also not valued by education systems, known as the 'restricted code' (Bernstein 1960). Moreover, other explanations include the added stress and strain that lower socioeconomic families face, and the increased risk of developing a common mental health disorder, or serious mental illness, with family stress being a particularly strong link to anxiety and depression (Santiago et al. 2011). Given that mental illness has a strong link to substance use, with both being more prevalent in low socioeconomic communities (Jane-Llopis and Matytsina 2006) it could be that some variation in substance use is confounded with mental health illness. This is noteworthy given the relationship between parental mental health and parenting (Smith 2004). As a result, given that children residing in lower socioeconomic contexts face multiple disadvantage through material, parental, neighbourhood and educational means, it is possible to conclude that the interventions are better placed to tackle both poverty and parenting as focusing on parenting alone may not overcome systematic exclusion from multiple levels of society, particularly if this persists overtime.

7.6 Research question five: how do the findings compare across cohort studies in terms of replicability?

The rationale for the cross-cohort research was to establish whether the findings were replicable and generalisable. Gage et al. (2016) argue that if two studies (or more) have different confounding structures, it can improve causal statement. However, causality is not possible in this research, it can only make associations. Nevertheless, the use of two cohorts improves the robustness of the findings in that we can be more confident that these associations are not a result of chance. In reference to Critical Realism (CR), the use of two cohort studies allows us to identify the generative mechanisms across time and space contexts. That is, the more information we have on the empirical, the more we develop our understanding of the real (Bhaskar 1979; Bhaskar 1989). Moreover, as this research has attempted to identify the indirect effects between parental substance use and children's educational attainment, the testing of mechanisms is the development of detecting the demi-regularities. However, we are limited in our understanding that parental substance use has the tendency to reduce educational outcomes given the presence of parenting and the family environment, as factors that were not measured in this research are also operating. Hence, our understanding of the real is only partially developed by this research.

Moreover, the use of two cohorts has allowed us to understand whether the risk differs across cohorts as in Sellers et al. (2019), who also compared educational outcomes across these two cohorts. This research did not find much difference in risk across the two cohorts. To summarise what is discussed in Chapter 6, the main difference between the latent class analyses were that ALSPAC seemed to capture higher consumption compared to MCS, but MCS found two types of familial settings which had high substance consumption. Both cohort's parental substance use had few direct effects with educational outcomes, and any significant effects were annulled when adjusted for demographic and environmental aspects. ALSPAC showed greater evidence for socioeconomic patterning compared to MCS, and this may be partly due to the more conservative political climate observed in the early 1990s. This confounding structure has been primarily discussed in Chapter 3, and in Sellers et al. (2019).

In terms of the mechanisms, both cohorts found that school interest and involvement was reduced when parental substance use increased. Moreover, mother-child interactions, particularly in terms of warmth, were indirect effects; the effect sizes in MCS were less compared to ALSPAC. Homework help showed a negative pathway for mothers in ALSPAC, whereas partner help in ALSPAC was positive, and MCS had no clear association. Aspects of interparental conflict and cruelty often were increased by substance use but were not associated with educational outcomes in ALSPAC, only MCS. In a similar vein, both cohorts showed that breakfast and sleep routine was consistently associated with better educational outcomes in line with Littlecott et al. (2016) and Dewald et al. (2010).

Alongside total sample findings, both cohort studies showed that degree educated parents used substances, specifically alcohol, in more significant quantities. These parents were more likely to be in the moderate and heavy latent classes. The opposite was observed for lower socioeconomic status groups, which were more likely to be in the very low, or low classes. Splitting these samples showed that degree educated parents used greater quantities of alcohol, whereas non-degree educated parents used greater quantities of drugs. Both cohorts showed moderate evidence that the risks of parental substance use via parenting and the family environment were greater for lower socioeconomic families. Therefore, as the cohorts show resemblances in findings, we can begin to consider that parental school involvement and interest, the parental engagement and warmth with children, and inter-parental conflict are potential mechanisms in the relationship between parental substance use and child educational attainment in lower socioeconomic groups. From this, it is useful to consider these findings in the context of policy and intervention development.

7.7 The relevance of this work for policy and intervention development

Despite decades of research evidencing a relationship between parental substance use and children's wellbeing, there was no mention of the secondary effects of alcohol use on others in the 2012 Alcohol Strategy, nor any strategy to tackle this (Great Britain and Parliament 2012; Houses of Parliament 2018). Shortly after, Public Health England and the Department of Education acknowledged the secondary effects of parental alcohol misuse (Houses of Parliament 2018). The secondary effects of parental drug use were approached earlier in the Hidden Harms report in 2003 (Advisory Council on the Misuse of Drugs 2003). In more recent years, there has been a considerable recognition of the secondary effects of alcohol and drug use. For instance, the Drug Strategy (HM Government 2017) recognised the impact of both alcohol and drug misuse on children and families. Within the Welsh Government's (2019) substance outlook, considerable recognition was given to the impact on children and young people, both prenatal and postnatal. They pledge to keep working with families until 2022 in their 'Substance Misuse Delivery Plan 2019-2022'. In Scotland, the 2008 strategy recognised the risks to children and asked for evidence to support the development of programmes (Scotland and Scottish Government 2008).

This research not only contributes to that knowledge base, but also to the policy area in several ways. Firstly, it highlights and corroborates the notion that considerable numbers of the population are using alcohol in greater quantities than recommended; albeit the estimates are dated. Second, it evidences that alcohol and drug use is correlated, with 20 – 18% of the population who use alcohol in heavier amounts being more likely to poly-use. This evidences that treatment services should work together to support those experiencing substance use rather than being separate (Lowthian et al. 2020). Third, this research shows some evidence that parental substance use alters parenting and the family environment, evidencing that programmes to support parental substance use must offer support not only for substances but for parenting also. Lastly, it shows that these pathways are more likely to operate under lower socioeconomic conditions, suggesting that disadvantaged children are at higher risk in circumstances of adversity.

In some programmes, families have been supported for substance use and parenting skills. The Troubled Families Programme (2015 – 2020) attempted to intervene in circumstances where children were in need of help. This included parents on benefits and who had health problems, which included alcohol or drug problems (Department for Communities and Local Government 2017). This programme allocated money to local authorities to intervene with families in need; keyworkers were supplied to help families who had 'multiple issues'. In the first phase, it was estimated that around £4,000 was spent on each family (Great Britain and Ministry of Housing 2019), and initial results showed some positive findings as 99% of families had self-reportedly 'turned around'. However, in the most recent phase, little has been disclosed; 15% of families in this programme are dependent on alcohol on drugs, (Department for Communities and Local Government 2017). However, the evaluation does not address child educational outcomes in households where the parent has problems with alcohol or drugs (Great Britain and Ministry of Housing 2019; Loft 2020). Overall, the programme showed an increase of around 20% regarding children's educational attendance. However, this seems to be a modest change given this is a significant intervention via key workers.

Despite that this intervention claims to have economic benefits of £2.28 for every £1.00 spent, it does not go far enough for educational attendance, which is strongly linked to attainment. This programme does align with this research in that 78% of all families expressed a need for help with parenting issues, hence recognising the importance of parenting in child wellbeing. However, this report does not outline what 'parenting skills' were, which families required them, and for what social problem. It also assumes that families can identify what they need when they may be unaware given the multiple societal strains they experience. This programme would benefit by first, analysing data on parental substance use and child attendance. Also, a more tailored approach is required. For educational outcomes, some of the indirect effects of parental substance use are shown to be through school interest and involvement, mother-child interactions, parenting competency and inter-parental conflict. It seems that this programme has assumed 'families with societal problems' require the same parenting skills without considering what individual needs they have, and the mechanisms which contribute to educational attendance, or attainment. Hence, this research argues for a more tailored approach to parental substance use in terms of parenting skills.

The devolved nations Wales and Scotland also have parental substance use programmes. In Wales, over the ten years, there have been multiple strategies to support families affected by substance use. The NSPCC in 2015 offered 'FED UP' a family environment: drug-using parents' programme. This programme not only works with children to build their self-esteem and offer a space to discuss issues, but also supports parents to develop parenting skills, while getting treatment for substance use. The evaluation showed positive outcomes, particularly in terms of parental confidence and happiness; however, the differences in child wellbeing were small – but statistically significant (NSPCC Cymru 2017). The strength and difficulties questionnaire was used for wellbeing, and shifts were seen for children presenting non-clinical needs, but less useful for those who already met clinical thresholds (NSPCC Cymru 2017). Better outcomes were seen for parents in terms of their happiness, confidence, and parenting skills. In Scotland, similar programmes have been conducted, with £3 million pounds recently being announced to support families experiencing significant adversity (Scotland and Scottish Government 2019). Alongside this, both countries have ACEs hubs or centres, which include supporting children whose parents use substances (NHS Health Scotland 2017; CymruWellWales 2019).

Outside of policy and government programmes, interventions are also relevant to this work. Many interventions focus on substance use only, with no other aspects such as mental health, or deprivation, or unemployment. However, interventions which address the substance use, parenting and family environment seem to have more significant benefits for both parents and child wellbeing (Niccols et al. 2012); although there are not many (Itäpuisto 2014). Both Arria et al. (2012) and Neger and Prinz (2015) argue that parental substance use is related to deficits in parenting skills, emotional regulation and decreased pleasure from the parenting role – which could be attributed to other stressors. Moreover, these parents have difficulty in practising warmth, discipline and a healthy parent-child relationship (Arria et al. 2012). This research supports Arria et al. (2012) as mother-child interactions were a significant indirect effect for KS1 outcomes in ALSPAC and MCS. However, parenting competency was a significant indirect effect for only lower socioeconomic groups when split, suggesting this is a potential mechanism that may operate in specific circumstances. Furthermore, this study did not find evidence for mother-child closeness being an indirect effect despite being theorised in Arria et al. (2012).

In other interventions, there has been a focus on expectation, empathy, physical punishment, role reversal (Camp and Finkelstein 1997) and parenting stress (McLaughlin et al. 2016). The cohorts used did not capture data on these elements; however, ALSPAC did estimate a positive association between substance use and emotional and physical cruelty, but not with educational attainment. Also, MCS captured parenting competency, which showed indirect associations for only lower socioeconomic samples. The socioeconomic contexts of interventions are essential, as Suchman and Luthar (2000) argue that low socioeconomic status parents have restricted autonomy; they attribute this to environments where there is greater violence, crime, and health hazards. A critical link from that study to this research is parental involvement, of which was low. For instance, parental substance use across both cohorts reduced homework help, mother-child interactions and school interest. Hence, this finding corroborates interventions which argue that parental involvement is key (Suchman and Luthar 2000; Suchman et al. 2007).

Together with previous studies, this research shows some similarity with the mediators and mechanisms identified across studies (Camp and Finkelstein 1997; Suchman and Luthar 2000; Suchman et al. 2007; Arria et al. 2012; McLaughlin et al. 2016). While no interventions have focused on educational attainment, they have seen improvements in both parenting and child wellbeing; suggesting parenting is a crucial component of this relationship. However, this research did not consider discipline strategies, empathy, and role-reversal (or young carers). Nevertheless, this research can support the theorised additional needs lower socioeconomic families may have, as associations in both directions were greater. However, targeted approaches would need to be considered carefully, as inter-parental conflict was similar across socioeconomic contexts, highlighting some mechanisms resistant to inequality. Therefore, interventions which consider parental substance use and child educational attainment should consider the building parental warmth, school involvement, parenting competency and reducing inter-parental conflict as mechanisms for change. While universal interventions are useful, they may need adaptation for lower socioeconomic status families, who face additional challenges associated with poverty and strain. Given this research has filled multiple research gaps and provided evidence for interventions it has a number of recommendations.

7.8 Recommendations for policy and intervention development

Given the policy-relevance of this research, it has a number of policy and intervention recommendations for government. First, the documents published by governments and policymakers often neglect the educational domains of wellbeing for children who experience adversity. This thesis provides evidence that those who use substances may have parenting behaviours or family environments that do not positively support children's educational development. While this is exists more for lower socioeconomic groups, and some targeting may be required, higher socioeconomic groups are not exempt from familial problems arising from substance use. As a result, there is a need for stakeholders to assess and consider the educational disadvantage children face when parents use substances. However, given that parental substance use is also related to other adversity, such as domestic violence, mental health, criminal behaviour there must also be considerations for the clustering of adversity, such as the toxic trio and beyond (Hood et al. 2021), and how these clusters effect educational outcomes specifically, but wider health and wellbeing and support needs.

As shown in this thesis, providing support to improve the home learning environment would be a valuable place to begin to support children experiencing parental substance use. Stakeholders and specifically interventions should consider elements of school involvement and support, parent-child interactions, and inter-parental conflict to support child development. However, parent-centred programmes may ignore how families are multiply disadvantaged. While encouraging and improving the home learning environment provides children with a good foundation, it cannot replace a violent neighbourhood, or inaccessibility to healthy food (both geographically and financially), or alleviate the strain felt by parents to not only financially support their children, but find the emotional availability and patience to support their child's development in the home. The government and policymakers must move towards a national model which removes the burden and expectations for disadvantaged families to provide a home learning environment equivalent to their non-disadvantaged counterparts; this problem has been highlighted in the COVID-19 pandemic. This is implausible given that lower socioeconomic contexts were much more likely to endure negative associations across parenting and family environment pathways in circumstances of parental substance use – despite that substance consumption was lower than higher socioeconomic groups. As a result, providing lower socioeconomic families with support to alleviate the burden and strain that poverty causes may support children further. However, this is not simply providing families with financial help. Considerable social problems are very likely to require even larger solutions.

Given that children residing in lower socioeconomic families may face multiple levels of deprivation, there is a need to tackle these (Tan et al. 2014). First, this research finds that families need more support for parenting, the family environment and the home learning environment. However, other research by Evans (2006) builds on this and outlines that children also require environments which are quiet, not overcrowded, and have access to the internet and learning devices. Moreover, Evans (2006) discusses how housing type, quality and predictability of daily routines are important for development. Notably, a neighbourhood that is characterised by high police involvement, crime and violent behaviours may feel unstable, unsafe and insecure. Subsequently, the findings in this thesis can be situated in wider understandings of child development and socioeconomic barriers to provide recommendations. In addition to the home environment, wider literature suggests that the education system requires funding to support and provide resources for children, which includes reducing the teacher-pupil ratio (Steele et al. 2007). Alongside this, Lupton and Thrupp (2013) argue that the removal of market and performative pressures, contextualised funding mechanisms and policies, and additional support staff to help with child emotional needs would improve learning outcomes and allow for child autonomy in learning which more advantaged groups afford. In short, this thesis has built on wider evidence to develop an understanding of how policies and practice need to become more integrative in terms of parental and socioeconomic support to fully overcome the effects of childhood adversity.

7.9 Further research recommendations

This thesis has highlighted several avenues for future research. First, it has shown that the current measures of parental substance use are limited as most measures do not account for both alcohol and illicit drug use, and that parental substance use is often examined as maternal vs. paternal. This ignores the increased proportion of drug use that comes with both high consumption alcohol use as seen in both cohort studies, and also household dynamics, particularly how similar the behaviours are between parents (Lowthian et al. 2020). With research suggesting that dual-parent substance use puts children at greater risk for poorer wellbeing (Raitasalo et al. 2015), future research must further consider the limitations of measuring single parents or substances and attempt to account for poly-use and parental dynamics.

In addition to measurement, little research has considered the array of pathways towards wellbeing. While this research has shown some functional pathways from parental substance use and educational attainment, it only was able to test parenting and the family environment. For instance, pathways through mental illness should be explored as it has been shown to mediate educational outcomes in adverse family settings (Sturge-Apple et al. 2008; Porche et al. 2016). Moreover, parenting stress or discipline should be explored as mechanisms as they are often discussed as key in the literature (McLaughlin et al. 2016; Tan et al. 2017). Furthermore, other traumatic experiences often exist in tandem with parental substance use. Most commonly, parents who are experiencing addiction often present mental health issues, such as depression, which could also affect parenting and the family environment. Moreover, substance use is related to other adversities such as victimisation, parental conflict, separation (Tan et al. 2017) and neglect. Future research must find a way to explore the web of adversity and deprivation for a fuller understanding of the pathways; this could be through the linkage of routine data (Paranjothy et al. 2018).

Alongside the use of secondary data, the collection of primary data (particularly cohort studies) should consider alternative methodology. First, much of the available data provides information on hetero-sexual families, with same-sex families being underrepresented. Therefore, a focus on the inclusion of more diverse family settings would be welcomed.

Second, the female (often the natural mother) is considered the main household respondent in most studies, but reflects more traditional circumstances, and therefore can only represent traditional settings. A shift towards fathers, or other caregivers considered equal to the main respondent would be a method of tackling this mother-centric collection method, which is a particular problem in ALSPAC. Future cohort studies must find ways of representing the diversity of families that exist in society, and in doing this, must be accessible to data users. Moreover, the variables included at each wave must consider repeated questions to build validity over-time, and aid the non-response associated with single time-point questions. Furthermore, using measures which harmonise well across other studies can improve the validity and replicability of research.

Further research should also better adjust for the potential bias in missing data. Multiple imputation is a standard method to adjust for this, however as the predicted probability of the classes could not be estimated using this, it was not conducted. Research that does not face these restrictions should consequently compare results across complete-case, imputation and FIML for a fuller understanding. However, categorical dependent variables present significant challenges, and research does somewhat depend on the capability of software's in the future. In addition to quantitative research, qualitative research should also consider the mechanisms, and the reasons behind substances being used by parents to deepen our understanding of this relationship. Perhaps, there are fundamental differences between stress-related use and social use in terms of child outcomes. Lastly, research should also consider whether the school is a protective factor; for example, teacher-child relationships, peer support and academic self-concept.

7.10 Limitations

Despite having several strengths, such as a large sample size, adjusting demographic and environmental aspects, and utilising advanced quantitative methods to answer complex public health questions, this research has some limitations. Perhaps the most important is the bias in the missing data. Although this research made efforts to use FIML, some models could not be conducted with this. The latent class analysis and some of the regression models were able to run with FIML. However, the maximum likelihood estimator (needed for FIML) was unable to converge models where dependent variables are categorical or binary; to combat this, all SEM models were conducted with the WLSMV. The problem with this estimator is that it uses pairwise techniques to manage missing data, which is very limited. However, this method is superior to complete-case analysis. Ideally, this research would have used multiple imputation, however, it was not possible to use the predicted probabilities from the latent class analysis if imputation methods were used in Mplus. Moreover, the computational cost of models was already high, with some models taking more than 16 hours to converge. Therefore, there could be missing data bias in the regression and SEM models, but perhaps as statistical methods improve, imputation methods can be used alongside predicted probabilities.

The latent class analysis technique also has some limitations. While it was an excellent tool for identifying poly-use of alcohol and illicit drugs and parental dynamics, it had some shortcomings. The technique was unable to accurately identify groups that were using substances in very high amounts; although the 5-class solutions identified them, the models were not stable. As a result, the high consumption groups were likely conservative estimates of alcohol and drug use, and the more severe groups were included in these groups, muddying the interpretation of results. However, ALSPAC was able to determine higher consumption than MCS, due to the variables used. In MCS, the CAGE was used, but this captures problem drinking, and this in combination with the limited consumption measures led to difficulty in capturing high consumption groups. As a result, variables which adequately capture heavy substance use should be used, and perhaps the CAGE tool is limited in LCA. Other research have compared cluster analysis to latent class analysis to explore usability (DiStefano and Kamphaus 2006). They found that latent class analysis found three broad classes, whereas cluster analysis found seven clusters; as a result, cluster analysis may be a better method for work which is somewhat theoretically driven and requires nuance rather than breadth. Consequently, the heavy classes identified are likely to be a conservative estimate of parental substance use and may account for the unexpected, positive associations with children's educational attainment.

Alongside statistical problems, there were limitations with the cohort studies in terms of attrition, data collection, variable availability and the harmonisation of variables. First, both cohort studies experienced attrition which have led to whiter, wealthier groups being overrepresented. However, this limitation is much more pronounced in ALSPAC than MCS, due to the sampling differences which are outlined in Chapter 3. This attrition and patterning in missing responses would have limited the generalisability of results, particularly in ALSPAC, as these findings are unable to explore cultural differences in parenting or partially represent them. Notably, the ALSPAC findings will provide an understanding of how parental substance use, parenting and child educational attainment operates in communities which are affluent and largely White. Whereas, MCS oversamples disadvantaged and ethnic minorities meaning that this dataset provides an improved, perhaps more representative account of the relationship studied. Both cohort studies do however have the same disadvantage that they only collect certain variables on substance use, parenting and the family environment. For instance, both cohorts did not capture meaningful measures of parental discipline, monitoring (before age seven), and supervision. In addition, both cohorts did not ask questions using validated scales on parenting or the family environment which would have been advantageous for identifying warmth or parenting style; they also would have provided some validity in measurement. As later mentioned, the use of public-patient involvement and engagement (PPIE) may have been useful for identifying the most relevant variables, or sense-checking their use.

The measures used also were self-reported, which has the common problem of social desirability bias. For instance, parents have been known to over-report their child's number of vaccinations as discussed in Morsbach and Prinz (2006). In contrast, parents are much less likely to report victimisation, abuse or cruelty as the mismatch between officially recognised maltreatment and child self-report maltreatment is high (Pinto and Maia 2013). However, both cohorts use self-reported questionnaires regarding sensitive topics which is likely due to the increased social desirability bias associated with interviewers rather than self-complete questionnaires (Morsbach and Prinz 2006). Although, in both cohorts there is an overreliance of maternal reporting; this is particularly the case for ALSPAC. Research suggests that there are consistencies in maternal and paternal reports but this is less so for negative behaviours than positive (Lovejoy et al. 1999). This overreliance leads this research to become very mother-centric rather than parental or paternal focused. While this research devised the data to be mothers and their partners (as a very low number were same-sex couples in ALSPAC but not in MCS) this is a challenge often experienced when using cohort studies, as mothers are often the main respondent; this could be improved if all household members responses were strived for, even in situations which may prove challenging. As a result, the framing of this research is rather nuclear, assuming that the respondent(s) are a two-parent heterosexual household. Further research should extend to other family types, such as kinship care, grandparents, looked after children; although these groups are rare in incidence so this may prove challenging.

This study also benefits from linked routine education data, offering a nationally comparative measure of educational attainment. However, while educational attainment is related to considerable health outcomes (Marmot 2005; Cohen and Syme 2013), other measures of wellbeing such as mental health, or cognitive development would also have been insightful for this research. For instance, cognitive development is considerably related to, and somewhat predicts educational attainment (Schulz et al. 2017). Moreover, it is related to both adult physical and mental health (Deary 2011); a study by Calvin et al. (2011) found that a one standard deviation advantage in intelligence lowered the risk of death by 24% over a follow-up time of 17 – 69 years. Schulz et al. (2017) pose concerns that sociological research may overemphasise socioeconomic resources in relation to educational attainment, and argue that parental and child cognitive ability have a more important role for educational outcomes than previously shown in research. As a result, the lack of recognition for cognitive development (both for parents and their child) may risk overstating associations via socioeconomic means.

In addition, this research did not adjust for educational confounders, such as school size, teacher-pupil ratio, special educational needs, or FSM. Moreover, it did not adjust for perinatal confounders which are related to attainment such as small for gestational age, multiple births, breastfeeding, or congenital abnormalities. Adjusting for children in the same household (<1%) was only conducted in the exploratory analysis for ALSPAC and some MCS models; MCS SEM mediation models could not use clustering due to older Mplus versions in the Secure Lab. However, household clustering seemed to make no differences. For school clustering, the school ID that was offered in ALSPAC was limited if the pupil had moved school. Moreover, other measures of educational outcomes could have been explored, including behaviour, adjustment, attendance, and exclusions; further research can do this as NPD collects data on this. Also, this research did not adjust for controls in the SEM models, aside for socioeconomic patterning. As this field is developing, future research would benefit from using control variables in SEM models, such as causal mediation.

Alongside statistical methods, this research would have benefitted from qualitative research and Public-Patient Involvement and Engagement (PPIE). First, qualitative research with parents who have experienced using substances could have elicited parenting practices, or family environment aspects which they felt were particularly positive or negative (as in Hogan and Higgins 2001) for educational outcomes, along with other outcomes e.g. mental health. Likewise, the children of parents who used substances would be useful to reflect on their lived-experience, particularly in terms of parental behaviours, and their educational or school experience (as in Hill 2015). These deeper understandings could have guided the quantitative research, or provided some depth to the models, perhaps an element of 'sense-checking'. Second, this research would have benefitted from PPIE, particularly in terms of parents with lived-experience of substance use treatment, or children whose parents used substances. Both parents and children would have been able to reflect on their experiences to better define and measure parenting, family environment aspects, or educational outcomes which may have improved the quantitative modelling in terms of sense-checking and interpretation of models. This in turn may have resulted in research which was more nuanced, and provided a less complex, broad narrative. Furthermore, it may have allowed an understanding that educational outcomes go beyond attainment, identifying other key aspects which children felt were important to their development.

A final acknowledgement is the theoretical framing used in this thesis. First, this thesis used Brofenbrenner's socioecological theory to underpin this work, and while useful in terms of theorising how different levels of society influence educational outcomes it has limitations. Perhaps most notably is the theory's assumption that the child is influenced by multiple aspects, without recognising that children are participatory individuals across multiple social systems (Elliott and Davis 2018). This is where family systems theory might have offered different insights as it would have been able to explore how children reside and participate in the family system, particularly in terms of parental substance use and over-functioning. Furthermore, it might have provided an account, or basis of how children navigate in a situation when their parents are under pressure, providing more of a child-centred approach rather than viewing them as beings with a lack of agency.

Second, this thesis has reflected white, middle-class ideals of parenting, the family environment and key stage outcomes. As explained in Gillies (2005), much of this research uses measures which derive from socially included, advantaged families, and does not account for the structural barriers or social exclusion groups encounter in their parenting practices. Moreover, many of the parenting measures are women focused, hence the responsibility of parenting, and thus the outcomes from it, are invariability unequally put upon mothers (Gillies 2005). In addition, the focus on key stage outcomes, and the assumption that they lead to health promoting behaviours is problematic. Key stage outcomes are largely influenced by a child's socioeconomic status, and thus opportunities to be socially mobile are limited by this (Croll and Attwood 2013). In essence, the opportunities for children who are from a lower socioeconomic status are multiply disadvantaged before substance use and parenting processes have begun. As a result, this research recognises the barriers to attainment and social mobility via family socioeconomic status.

7.11 Conclusion

This thesis has developed knowledge of parental substance use, and its relationship with children's educational outcomes in several ways. The scoping review in Chapter 1 highlighted that around fifty studies exist on this topic, and most found a negative relationship between parental substance use and educational outcomes. A challenge was that substances were measured differently across studies, e.g., dependence, problem, hazardous, and educational outcomes included attainment, adjustment, attendance and more. Furthermore, many of the studies were dated or had significant methodological shortcomings. The scoping review highlighted low methodological quality among studies, and little knowledge of the mechanisms in this relationship. Chapter 2 synthesised two bodies of literature to develop an understanding of what mechanisms could exist, and it was identified that parenting and the family environment were potential mechanisms; these were theorised in a socioecological framework. From this, five research questions were developed.

Chapter 3 provided a methodological discussion and approach towards answering the research questions. Both ALSPAC and MCS were used to understand the relationship between parental substance use and educational outcomes, the mechanisms, and in what socioeconomic conditions; the methodologies, ethics, and measures for both datasets were outlined. Chapter 4 included the findings from ALSPAC. This chapter identified a heavy parental substance use class, but this had no direct relationship with educational outcomes. When adjusted for confounders the effect size decreased, and effects were not statistically significant. SEM mediation models showed evidence for indirect effects, with school involvement, mother-child interactions and homework help being significant mediators in the relationship.

Chapter 5 provided the MCS findings. Two heavy substance using groups were identified in the latent class analysis, one being where only the partner uses substances in heavy amounts, and the other where both parents use substances in heavy amounts. A positive relationship was found for both substance use classes – partner-heavy and dual-heavy households; however, once adjusted, these effects were annulled. There were indirect pathways through parenting competency, interparental conflict, and the mother-child interaction. Chapter 6 included further exploratory analysis to understand socioeconomic patterning. When split by socioeconomic status, it was found that greater associations existed in models where families were not degree educated, suggesting that higher socioeconomic status was a protective factor in this relationship. This was prevalent across both cohorts, but the evidence was weaker in MCS compared to ALSPAC. Chapter 6 also provided a synthesis of the evidence from both ALSPAC and MCS, and the findings were similar, providing evidence of replicability and generalisability. As a result, this improves our understanding of the demi-regularities in a CR sense.

This Chapter has considered the empirical findings in Chapters 4, 5 and 6 and synthesised it with the evidence from Chapters 1 and 2. The findings of the bivariate associations between parental substance use and educational attainment were not consistent with the scoping review. However, the methodological quality is improved in this research, and the measurement of parental substance use are not focused on dependent populations. In line with Berg et al. (2016), significant associations were annulled once adjusted for confounders. In terms of mediators, it was concluded that inter-parental conflict, parenting competency, school interest and the mother-child interaction were key for lower socioeconomic groups. However, inter-parental conflict also spans across the socioeconomic spectrum as a more universal mediator, and potential mechanism. As a result, intervention programmes and policy development should consider the mechanisms of parenting, the family environment, and the family-school relationship within socioeconomic contexts when developing strategies to tackle parental substance use and its complex relationship with children's educational outcomes.

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Appendix

A. Scoping Review Checklist

Item	Section	PRISMA-ScR Checklist Item	Y/N
1	Title	Identify the report as a scoping review	Yes
2	Abstract	Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Yes
3	Rationale	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Yes
4	Objectives	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Yes
5	Protocol and registration	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Yes
6	Eligibility criteria	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Yes
7	Information sources	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Yes
8	Search	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	No
9	Selection of sources of evidence	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Yes
10	Data charting process	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Yes
11	Data items	List and define all variables for which data were sought and any assumptions and simplifications made	Yes

12	Critical appraisal of individual sources of evidence	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Yes
13	Summary measures	Not applicable for scoping reviews.	N/A
14	Synthesis of results	Describe the methods of handling and summarizing the data that were charted.	Yes
15	Risk of bias across studies	Not applicable for scoping reviews.	N/A
16	Additional analyses	Not applicable for scoping reviews.	N/A
17	Selection of sources of evidence	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	No
18	Characteristics of sources of evidence	For each source of evidence, present characteristics for which data were charted and provide the citations.	Yes
19	Critical appraisal within sources of evidence	If done, present data on critical appraisal of included sources of evidence (see item 12).	Yes
20	Results of individual sources of evidence	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Yes
21	Synthesis of results	Summarize and/or present the charting results as they relate to the review questions and objectives.	Yes
22	Risk of bias across studies	Not applicable for scoping reviews.	N/A
23	Additional analyses	Not applicable for scoping reviews.	N/A
24	Summary of evidence	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Yes
25	Limitations	Discuss the limitations of the scoping review process.	Yes
26	Conclusions	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Yes
27	Funding	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	No

B. Ethical approval

i. ALSPAC Ethical Approval Letter

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18 April 2018

Our ref: SREC/2733

Emily Lowthian
PhD Programme
SOCSI

Dear Emily,

Your project entitled *'Understanding the secondary harms of parental substance misuse on children's school outcomes'* has now been approved by the School of Social Sciences Research Ethics Committee of Cardiff University and you can now commence the project should all necessary forms of approval been received.

If you make any substantial changes with ethical implications to the project as it progresses you need to inform the SREC about the nature of these changes. Such changes could be: 1) changes in the type of participants recruited (e.g. inclusion of a group of potentially vulnerable participants), 2) changes to questionnaires, interview guides etc. (e.g. including new questions on sensitive issues), 3) changes to the way data are handled (e.g. sharing of non-anonymised data with other researchers).

In addition, if anything occurs in your project from which you think the SREC might usefully learn, then please do share this information with us.

All ongoing projects will be monitored and you will be obliged periodically to complete and return a SREC monitoring form.

Please inform the SREC when the project has ended.

Please use the SREC's project reference number above in any future correspondence.

Yours sincerely

A J Bullock

Professor Alison Bullock
Chair of School of Social Sciences Research Ethics Committee
Cc: Graham Moore, Simon Moore, Corinda Perkins

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ii. MCS Ethical Approval Letter

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21 December 2018

Our ref: SREC/3172

Emily Lowthian
PhD Programme
SOCSI

Dear Emily,

Your project entitled *'Understanding the Secondary Harms of Parental Substance Use on Children's School Outcomes'* has now been approved by the School of Social Sciences Research Ethics Committee of Cardiff University and you can now commence the project should all necessary forms of approval been received.

If you make any substantial changes with ethical implications to the project as it progresses you need to inform the SREC about the nature of these changes. Such changes could be: 1) changes in the type of participants recruited (e.g. inclusion of a group of potentially vulnerable participants), 2) changes to questionnaires, interview guides etc. (e.g. including new questions on sensitive issues), 3) changes to the way data are handled (e.g. sharing of non-anonymised data with other researchers).

In addition, if anything occurs in your project from which you think the SREC might usefully learn, then please do share this information with us.

All ongoing projects will be monitored and you will be obliged periodically to complete and return a SREC monitoring form.

Please inform the SREC when the project has ended.

Please use the SREC's project reference number above in any future correspondence.

Yours sincerely

E. Renold

Professor Emma Renold
Chair of School of Social Sciences Research Ethics Committee

C. ALSPAC: Exploratory Factor Analysis

i. Interparental conflict correlation matrix

	Mother irritated with partner	**Partner irritated with mother**	**Hitting or slapping**	**Arguments**	**Not talking**	**Shouting names**	**Throwing /breaking**
Partner irritated with mother	0.73	1.00					
Hitting or slapping	0.16	0.14	1.00				
Arguments	0.59	0.57	0.19	1.00			
Not talking	0.28	0.27	0.13	0.38	1.00		
Shouting names	0.35	0.35	0.22	0.48	0.29	1.00	
Throwing/ breaking	0.19	0.17	0.33	0.22	0.15	0.23	1.00
Walked out	0.25	0.23	0.25	0.31	0.28	0.29	0.28

ii. Interparental conflict EFA model solution tables

Model	**Parameters**	χ^2	***Df***	***P***	**Eigenvalues**
1-factor	7.00	601.99	14.00	<0.05	4.09
2-factor	13.00	87.89	8.00	<0.05	0.84
3-factor	18.00	13.71	3.00	<0.05	0.69

iii. Mother-child interaction correlation matrix

	Bath	**Make things**	**Sing**	**Read**	**Play**	**Cuddle**	**Active play**	**Playground**	**Bed**	**Swim**	**Draw/paint**
Bath	1.00										
Make things	0.31	1.00									
Sing	0.28	0.43	1.00								
Read	0.39	0.38	0.40	1.00							
Play	0.28	0.56	0.46	0.46	1.00						
Cuddle	0.39	0.32	0.34	0.59	0.36	1.00					
Active play	0.25	0.47	0.42	0.36	0.58	0.33	1.00				
Playground	0.24	0.38	0.28	0.29	0.39	0.29	0.46	1.00			
Bed	0.46	0.28	0.29	0.52	0.30	0.60	0.29	0.26	1.00		
Swim	0.23	0.22	0.18	0.26	0.21	0.26	0.24	0.27	0.25	1.00	
Draw/paint	0.24	0.55	0.40	0.35	0.54	0.29	0.49	0.38	0.26	0.24	1.00
Food	0.35	0.27	0.27	0.50	0.29	0.71	0.25	0.24	0.53	0.23	0.24
Classes	0.18	0.18	0.17	0.23	0.19	0.25	0.16	0.16	0.23	0.24	0.15

Shopping	0.17	0.29	0.25	0.23	0.29	0.30	0.29	0.31	0.25	0.12	0.29
Sport	0.11	0.19	0.12	0.11	0.16	0.09	0.24	0.21	0.12	0.23	0.18
Homework	0.26	0.27	0.24	0.43	0.29	0.32	0.25	0.20	0.29	0.20	0.25
Conversations	0.38	0.31	0.31	0.57	0.32	0.85	0.29	0.27	0.58	0.24	0.27
Prepare school	0.31	0.31	0.30	0.43	0.33	0.53	0.29	0.24	0.40	0.19	0.29

	Food	Classes	Shopping	Sport	Homework	Conversations	Prepare school
Food	1.00						
Classes	0.26	1.00					
Shopping	0.27	0.21	1.00				
Sport	0.09	0.16	0.19	1.00			
Homework	0.30	0.20	0.19	0.16	1.00		
Conversations	0.75	0.26	0.31	0.09	0.34	1.00	
Prepare school	0.49	0.25	0.29	0.13	0.38	0.57	1.00

iv. Mother-child interaction EFA model solution tables

Model	Parameters	χ^2	*Df*	*P*	Eigenvalues
1-factor	15	7705.93	90	<0.05	6.20
2-factor	29	2664.26	76	<0.05	1.43
3-factor	42	1438.53	63	<0.05	1.12
4-factor	54	1032.03	51	<0.05	0.90
5-factor	65	597.86	40	<0.05	0.77
6-factor	75	231.86	30	<0.05	0.69

v. Partner-child interaction correlation matrix

	Bath	Make things	Sing	Read	Play	Cuddle	Active play	Playground	Bed	Swim	Draw/paint
Bath	1.00										
Make things	0.40	1.00									
Sing	0.30	0.42	1.00								
Read	0.52	0.52	0.44	1.00							
Play	0.42	0.64	0.46	0.60	1.00						
Cuddle	0.43	0.44	0.41	0.62	0.53	1.00					
Active play	0.38	0.49	0.40	0.51	0.62	0.57	1.00				
Playground	0.33	0.45	0.33	0.41	0.47	0.40	0.50	1.00			
Bed	0.61	0.42	0.33	0.65	0.49	0.60	0.45	0.37	1.00		
Swim	0.32	0.33	0.28	0.37	0.35	0.35	0.39	0.41	0.34	1.00	
Draw/paint	0.32	0.64	0.43	0.46	0.55	0.36	0.44	0.42	0.35	0.32	1.00
Food	0.41	0.38	0.28	0.42	0.37	0.43	0.35	0.33	0.45	0.27	0.33
Classes	0.29	0.28	0.24	0.30	0.28	0.28	0.26	0.26	0.29	0.30	0.25
Shopping	0.25	0.34	0.26	0.30	0.33	0.33	0.29	0.34	0.29	0.24	0.31
Sport	0.20	0.24	0.19	0.20	0.26	0.19	0.31	0.29	0.19	0.35	0.21
Homework	0.42	0.46	0.33	0.62	0.48	0.44	0.41	0.33	0.50	0.31	0.43
Conversations	0.41	0.43	0.35	0.60	0.51	0.84	0.57	0.40	0.58	0.35	0.34
Prepare school	0.37	0.47	0.34	0.49	0.46	0.39	0.38	0.33	0.43	0.28	0.41

	Food	Classes	Shopping	Sport	Homework	Conversations	Prepare school
Food	1.00						
Classes	0.37	1.00					
Shopping	0.44	0.32	1.00				
Sport	0.17	0.23	0.20	1.00			
Homework	0.38	0.32	0.28	0.25	1.00		
Conversations	0.44	0.29	0.33	0.20	0.44	1.00	
Prepare school	0.47	0.43	0.36	0.23	0.52	0.38	1.00

vi. Partner-child interaction EFA model solution tables

Model	Parameters	χ^2	*Df*	*P*	Eigenvalues
1-factor	16	11660.13	104	<0.05	8.02
2-factor	31	6603.19	89	<0.05	1.19
3-factor	45	4430.55	75	<0.05	1.07
4-factor	58	2359.09	62	<0.05	0.10
5-factor	70	799.23	50	<0.05	0.68
6-factor	81	364.37	39	<0.05	0.64
7-factor	91	218.42	29	<0.05	0.56
8-factor	100	92.32	20	<0.05	0.53

vii. School involvement correlation matrix

	Mothers interest	Mother prepares school	Partner prepares school	Mother helps with homework	Partner helps with homework
Mothers interest	1.00				
Mother prepares school	-0.09	1.00			
Partner prepares school	-0.06	0.08	1.00		
Mother helps with homework	-0.11	0.30	0.06	1.00	
Partner helps with homework	-0.07	0.10	0.53	0.32	1.00

viii. School involvement factor models solutions

Model	Parameters	χ^2	*Df*	*P*	Eigenvalues
1-factor	5.00	1475.23	5.00	<0.05	2.05

ix. School involvement factor loadings – without mother's interest

1-factor model solutions (without mother's interest)

	School involvement
Mother's homework help	0.46
Fathers homework help	0.93
Mother prepares child for school	0.38
Father prepares child for school	0.59

D. ALSPAC: Regression analysis for KS3

i. *Direct regression of the predicted probability of each class on KS3*

	KS3	
	n=8034	
	OR	**CI**
Very low	0.55	0.48 - 0.63
Low	1.38	1.17 - 1.62
Moderate	1.53	1.28 - 1.83
Heavy	1.36	0.78 - 2.07

ii. *Very low class on KS3 adjusted for confounders*

	KS3	
	n=5670	
	OR	**CI**
Very low class	0.76	0.63 - 0.92
Prenatal smoking	0.93	0.87 - 1.00
Prenatal alcohol use	0.99	0.88 - 1.11
Prenatal drug use	1.42	0.66 - 3.03
Mothers age at delivery	1.04	1.02 - 1.06
Child sex	1.65	1.41 - 1.94
Child ethnicity	0.70	0.46 - 1.09
Family income	1.32	1.22 - 1.42
Mother's qualification	1.52	1.42 - 1.62
Mother's wellbeing	1.02	1.00 - 1.04

iii. Low class on KS3 adjusted for confounders

	KS3	
	n=5670	
	OR	**CI**
Low class	1.21	0.98 - 1.49
Prenatal smoking	0.93	0.87 - 1.00
Prenatal alcohol use	1.03	0.92 - 1.15
Prenatal drug use	1.44	0.68 - 3.08
Mothers age at delivery	1.04	1.02 - 1.06
Child sex	1.66	1.41 - 1.94
Child ethnicity	0.69	0.45 - 1.08
Family income	1.32	1.23 - 1.42
Mother's qualification	1.53	1.43 - 1.63
Mother's wellbeing	1.02	1.00 - 1.04

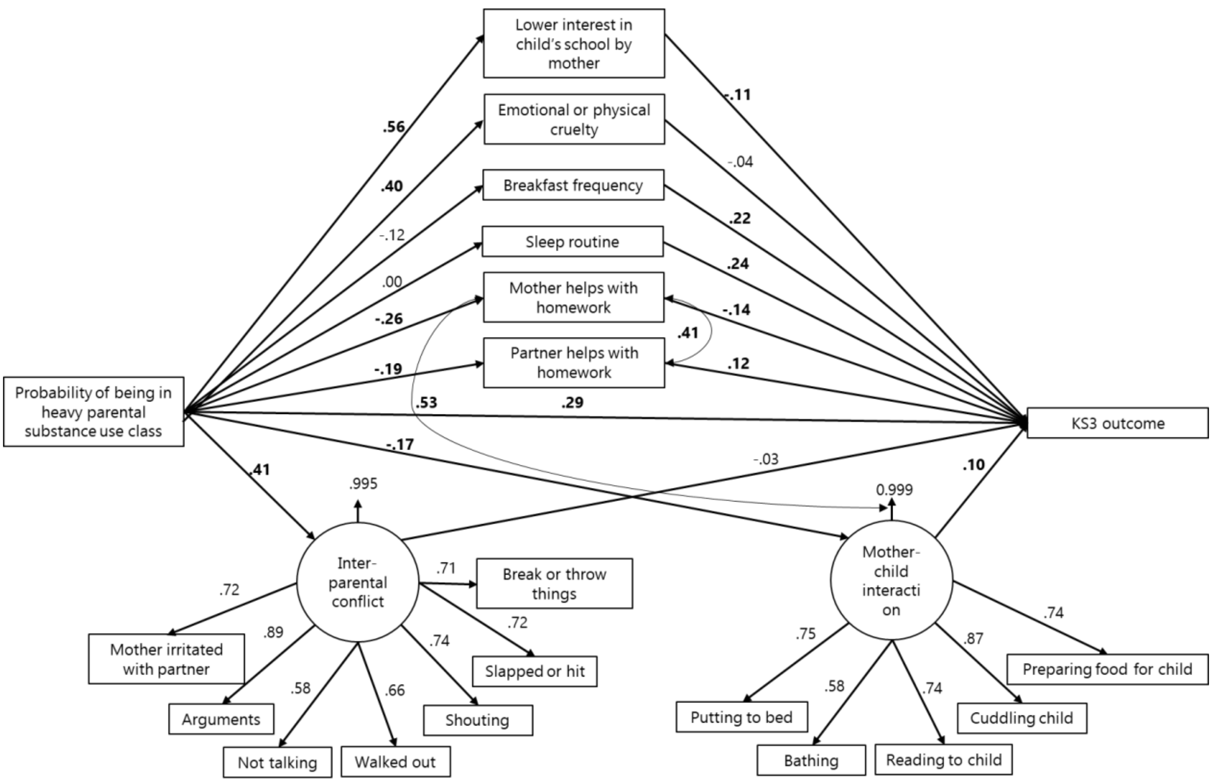
iv. Moderate class on KS3 adjusted for confounders

	KS3	
	n=5670	
	OR	**CI**
Moderate class	1.11	0.87 - 1.40
Prenatal smoking	0.93	0.87 - 0.99
Prenatal alcohol use	1.01	0.90 - 1.14
Prenatal drug use	1.43	0.67 - 3.06
Mothers age at delivery	1.04	1.02 - 1.06
Child sex	1.66	1.41 - 1.94
Child ethnicity	0.69	0.44 - 1.07
Family income	1.33	1.23 - 1.43
Mother's qualification	1.53	1.43 - 1.63
Mother's wellbeing	1.02	1.00 - 1.04

v. Heavy class on KS3 adjusted for confounders

	KS3	
	n=5670	
	OR	**CI**
Heavy class	1.34	0.76 – 2.37
Prenatal smoking	0.93	0.87 – 0.99
Prenatal alcohol use	1.02	0.91 - 1.14
Prenatal drug use	1.42	0.66 - 3.04
Mothers age at delivery	1.04	1.02 - 1.06
Child sex	1.66	1.42 - 1.95
Child ethnicity	0.69	0.44 - 1.06
Family income	1.33	1.23 - 1.43
Mother's qualification	1.53	1.43 - 1.64
Mother's wellbeing	1.02	1.00 - 1.04

E. ALSPAC: SEM mediation model for KS3



F. MCS: Exploratory Factor Analysis

i. Interparental conflict correlation matrix

	Sensitive	Listen	Lonely	Separate	Disagree ment	Go out	Happy
Listen	0.57	1.00					
Lonely	0.51	0.59	1.00				
Separate	0.43	0.45	0.52	1.00			
Disagreement	0.26	0.28	0.27	0.25	1.00		
Go out	0.19	0.16	0.19	0.15	0.08	1.00	
Happy	0.45	0.40	0.47	0.49	0.24	0.15	1.00
Force	0.17	0.16	0.19	0.22	0.11	0.06	0.17

ii. Interparental conflict model solution

Model	Parameters	χ^2	*Df*	*P*	Eigenvalues
1-factor	7	923.36	14	<0.05	3.83
2-factor	13	138.54	8	<0.05	0.81
3-factor	18	9.68	3	<0.05	0.74

iii. Mother-child interaction correlation matrix

	Read	Stories	Music	Draw/Paint	Toy
Stories	0.19	1.00			
Music	0.21	0.27	1.00		
Draw/Paint	0.28	0.29	0.30	1.00	
Toys	0.31	0.26	0.30	0.41	1.00
Playground	0.18	0.17	0.15	0.23	0.22

iv. Mother-child interaction factor solutions

Model	Parameters	χ^2	*Df*	*P*	Eigenvalues
1-factor	5	166.48	5	<0.05	2.27
2-factor	9	4.72	1	<0.05	0.82

vi. Partner-child interaction correlation matrix

	Read	Stories	Music	Draw/Paint	Toy
Stories	0.27	1.00			
Music	0.26	0.31	1.00		
Draw/Paint	0.35	0.33	0.33	1.00	
Toys	0.34	0.29	0.31	0.40	1.00
Playground	0.23	0.21	0.18	0.26	0.27

vii. Partner-child interaction model solutions

Model	Parameters	χ^2	*df*	*P*	Eigenvalues
1-factor	6	109.83	9	<0.05	2.59
2-factor	11	11.08	4	<0.05	0.83

viii. School involvement correlation matrix

	Read	Write	Maths
Write	0.37	1.00	
Maths	0.33	0.48	1.00
Parents evening	0.08	0.03	0.05

G. MCS: Parenting regression models

i. Parenting variables predicting KS1 - 4

	KS1		KS2		KS4	
	n=14211		n=14211		n=14,11	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Interparental conflict	0.80	0.64 – 1.00	0.73	0.51 – 1.06	0.85	0.70 – 1.05
Mother-child interaction	**0.00**	0.00 – 0.04	**0.00**	0.00 – 0.00	**0.00**	0.00 – 0.14
Partner-child interaction	**67.81**	5.12 – 898.79	**1065.03**	18.14 – 62538.83	**40.50**	3.06 – 536.52
School involvement	**194.57**	4.23 – 8953.07	**6355.05**	14.51 – *	**94.15**	2.29 – 3872.07
Mother-child closeness	**1.52**	1.25 – 1.84	**1.81**	1.30 – 2.51	1.16	0.98 – 1.36
Parenting competency	**1.19**	1.06 – 1.34	1.18	0.98 – 1.43	**1.23**	1.11 – 1.36
Breakfast	**1.26**	1.16 – 1.38	**1.36**	1.17 – 1.58	**1.27**	1.17 – 1.39
Sleep routine	**1.49**	1.32 – 1.68	**1.68**	1.36 – 2.08	**1.27**	1.14 – 1.42

ii. Parenting variables predicting KS1 – 4 adjusted for partner-heavy class and confounders

	KS1		KS2		KS4	
	n=9052		n=9052		n=9052	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Partner-heavy users	**1.69**	1.09 – 2.63	**2.61**	1.20 – 5.68	1.26	0.91 – 1.73
Interparental conflict	0.94	0.79 – 1.11	0.86	0.64 – 1.17	0.96	0.84 – 1.09
Mother-child interaction	**0.00**	0.00 – 20.55	**0.00**	0.00 – 514.04	0.01	0.00 – 43.46
Partner-child interaction	**18.75**	1.88 – 187.00	**199.83**	1.91 – 20916.60	**10.04**	1.09 – 92.43
School involvement	**40.78**	1.64 – 1015.93	**893.51**	1.38 – 578311.56	16.44	0.84 – 323.33
Mother-child closeness	**1.36**	1.08 -1.72	**1.69**	1.12 – 2.54	1.07	0.88 – 1.29
Parenting competency	**1.17**	1.01 – 1.36	1.12	0.87 – 1.45	**1.19**	1.06 – 1.34
Breakfast	1.12	0.99 – 1.26	1.06	0.88 – 1.29	1.09	0.98 – 1.20
Sleep routine	**1.42**	1.22 – 1.67	**1.60**	1.21 – 2.13	**1.18**	1.03 – 1.34
Prenatal smoking	**0.95**	0.93 – 0.97	**0.94**	0.90 – 0.98	**0.93**	0.91 – 0.95

Prenatal alcohol use	1.07	0.95 – 1.21	1.11	0.90 – 1.36	0.97	0.89 – 1.06
Mothers age at delivery	1.01	0.99 – 1.03	**1.05**	1.00 – 1.10	**1.05**	1.03 – 1.08
Child sex	**3.14**	2.42 – 4.07	**2.06**	1.31 – 3.25	**2.15**	1.73 – 2.68
Child ethnicity	**0.53**	0.36 – 0.80	1.11	0.52 – 2.32	0.98	0.71 – 1.36
Family income	**1.33**	1.17 – 1.51	**1.32**	1.05 – 1.67	1.09	0.99 – 1.20
Mother's qualification	**1.55**	1.38 – 1.73	**1.77**	1.45 – 2.16	**1.43**	1.31 – 1.55
Mother's distress	0.97	0.94 – 1.00	0.97	0.92 – 1.04	0.98	0.95 - 1.01

iii. Parenting variables predicting KS1 – 4 adjusted for dual-heavy class and confounders

	KS1		**KS2**		**KS4**	
	n=9052		n=9052		n=9052	
	OR	**CI**	**OR**	**CI**	**OR**	**CI**
Dual-heavy users	0.86	0.55 – 1.35	0.91	0.43 – 1.91	1.06	0.75 – 1.50
Interparental conflict	0.94	0.80 – 1.11	0.87	0.65 – 1.17	0.96	0.84 – 1.09
Mother-child interaction	**<0.01**	0.00 – 0.21	**<0.01**	0.00 – 0.25	**0.01**	0.00 – 0.85
Partner-child interaction	**18.15**	2.16 – 152.95	**171.14**	2.17 - 13528.14	**9.69**	1.21 – 77.47
School involvement	**40.13**	1.98 – 811.74	**770.24**	1.66 - 356655.25	16.04	0.97 – 265.86
Mother-child closeness	**1.37**	1.08 – 1.73	**1.68**	1.12 – 2.52	1.07	0.88 – 1.29
Parenting competency	**1.18**	1.02 – 1.37	1.14	0.88 – 1.47	**1.20**	1.06 – 1.35
Breakfast	**1.12**	1.00 – 1.26	1.06	0.88 – 1.28	1.09	0.98 – 1.20
Sleep routine	**1.43**	1.23 – 1.67	**1.60**	1.21 – 2.13	**1.18**	1.03 – 1.34
Prenatal smoking	**0.95**	0.93 – 0.97	**0.94**	0.90 – 0.97	**0.93**	0.91 – 0.95
Prenatal alcohol use	1.09	0.96 – 1.23	1.11	0.91 – 1.36	0.97	0.88 – 1.06
Mothers age at delivery	1.01	0.99 – 1.03	**1.05**	1.01 – 1.09	**1.05**	1.03 – 1.08
Child sex	**3.12**	2.52 – 4.06	**2.03**	1.30 – 3.18	**2.15**	1.73 – 2.66
Child ethnicity	**0.51**	0.36 – 0.77	1.01	0.48 – 2.12	0.97	0.70 – 1.34
Family income	**1.33**	1.17 – 1.51	**1.31**	1.04 – 1.65	1.09	0.99 – 1.20
Mother's qualification	**1.55**	1.39 – 1.74	**1.77**	1.46 – 2.16	**1.43**	1.31 – 1.55
Mother's distress	0.97	0.94 – 1.00	0.97	0.92 – 1.03	0.98	0.95 – 1.01

H. ALSPAC: Further exploratory analysis

i. *Clustering of household ID in LCA statistical solution*

	2-class	3-class	4-class	5-class	6-class
AIC	164704.97	161985.65	161304.85	161243.84	161229.55
BIC	164948.59	162286.59	161663.11	161659.42	161702.45
Adjusted BIC	164840.54	162153.12	161504.22	161475.11	161492.72
Proportions	52%	50%	38%	32%	32%
	48%	29%	30%	27%	27%
		21%	27%	27%	25%
			4%	11%	13%
				1%	3%
					<1%
Entropy	0.78	0.77	0.74	0.68	0.69
Probability of most likely latent class membership	94%	91%	82%	78%	77%
	94%	99%	80%	100%	100%
		81%	100%	70%	65%
			70%	59%	57%
				65%	61%
					72%
VLMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.30$
LMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.30$

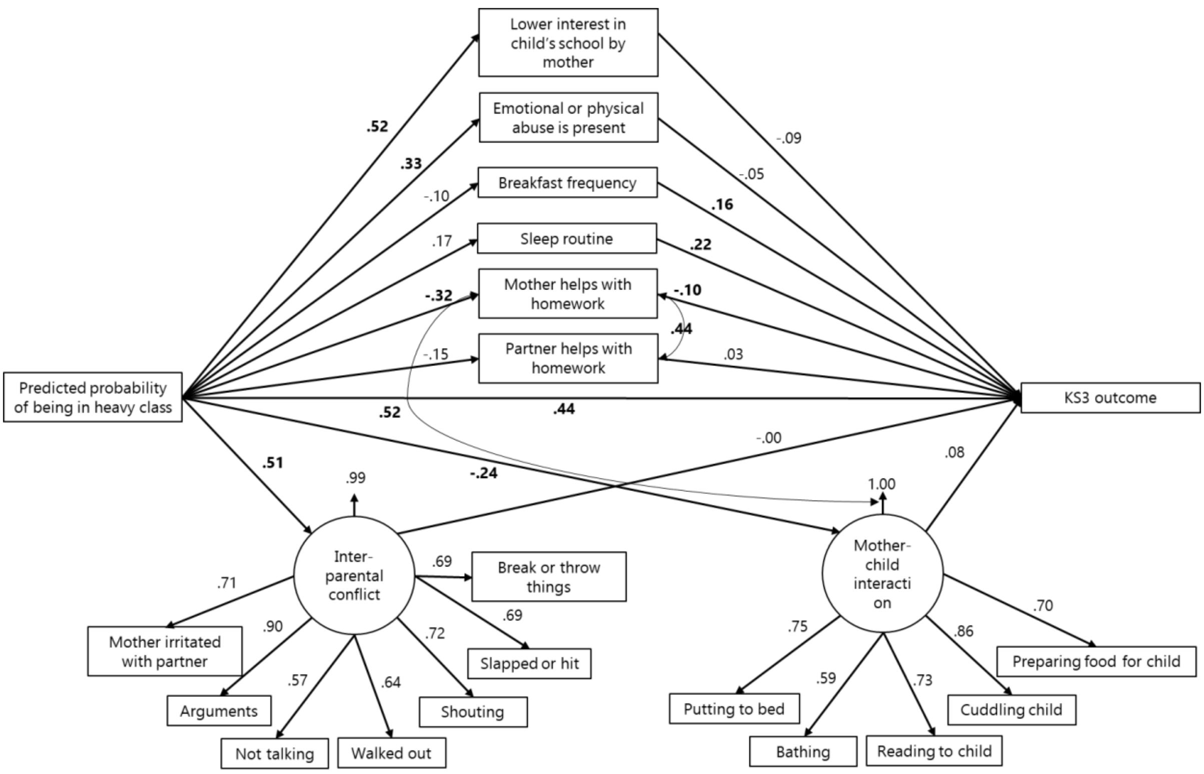
ii. *Unadjusted regression KS3 outcomes – degree sample*

	KS3	
	n=1074	
	OR	**CI**
Very low	1.07	0.34 – 3.34
Low	1.45	0.62 – 3.40
Moderate	0.51	0.21 – 1.22
Heavy	169.34	0.16 – 177729.23

iii. *Adjusted regression KS3 outcomes – degree sample*

	KS3	
	n=995	
	OR	**CI**
Heavy class	616.28	0.24 – *
Prenatal smoking	0.53	0.35 – 0.79
Prenatal alcohol use	1.11	0.59 – 2.08
Prenatal drug use	0.90	0.18 – 4.10
Mothers age at delivery	0.99	0.90 - 1.11
Child sex	1.51	0.70 – 3.26
Child ethnicity	0.51	0.09 – 1.05
Mother's depression	0.94	0.84 - 1.05

iv. *SEM mediation model KS3 outcomes – degree sample*



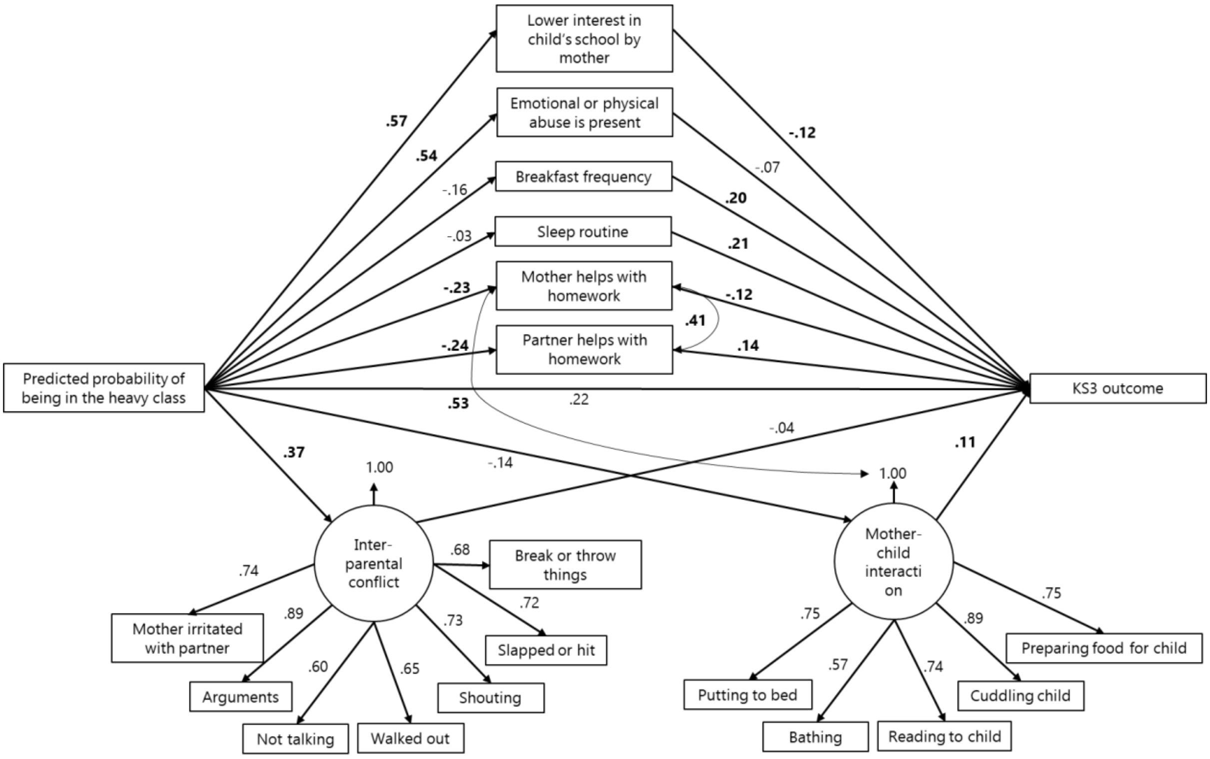
v. *Unadjusted regression KS3 outcomes – non-degree sample*

	KS3	
	n = 6355	
	OR	**CI**
Very low	0.62	0.53 – 0.72
Low	1.33	1.12 – 1.59
Moderate	1.40	1.15 – 1.69
Heavy	1.09	0.71 – 1.66

vi. *Adjusted regression KS3 outcomes – Non-degree sample*

	KS3	
	n=5226	
	OR	**CI**
Heavy class	1.07	0.64 – 1.77
Prenatal smoking	0.85	0.80 – 0.91
Prenatal alcohol use	1.08	0.97 – 1.21
Prenatal drug use	1.36	0.69 – 2.69
Mothers age at delivery	1.05	1.03 – 1.07
Child sex	1.61	1.38 – 1.86
Child ethnicity	0.71	0.47 – 1.07
Mother's depression	1.04	1.02 – 1.06

vii. *SEM mediation model KS3 outcomes – non-degree sample*



I. ALSPAC: Sensitivity analysis of Income

i. Low-income sample latent class analysis solution

	2-class	3-class	4-class
AIC	29693.73	29303.38	29270.86
BIC	29884.42	29538.93	29551.28
Adjusted BIC	29776.40	29405.49	29392.43
Proportions	55%	46%	42%
	45%	38%	38%
		16%	19%
			2%
Entropy	0.81	0.75	0.75
Probability of most likely latent class membership	94%	87%	85%
	97%	100%	100%
		75%	71%
			50%
VLMR LRT	$p<0.05$	$p<0.05$	$p=0.81$
LMR LRT	$p<0.05$	$p<0.05$	$p=0.81$
Bootstrap LRT	N/A	N/A	N/A

ii. Low-income sample latent class analysis means and proportions

	Very low class	Low-moderate class	Moderate-heavy class
Monday	0.00	0.22	1.79
Tuesday	0.00	0.23	1.76
Wednesday	0.00	0.38	1.72
Thursday	0.00	0.42	1.63
Friday	0.00	0.85	2.59
Saturday	0.00	1.41	3.08
Sunday	0.00	0.54	2.01

		Very low class	Low-moderate class	Moderate-heavy class
Partners binge drinking (>4 units)	**None**	37%	18%	5%
	1 - 2 days	20%	23%	3%
	3 - 4 days	17%	23%	10%
	5 - 10 days	11%	23%	23%
	> 10 days	9%	9%	40%
	Everyday	6%	4%	21%
Mothers' drug use	**Yes**	8%	9%	27%
	No	93%	91%	73%

iii. High-income sample latent class analysis solution

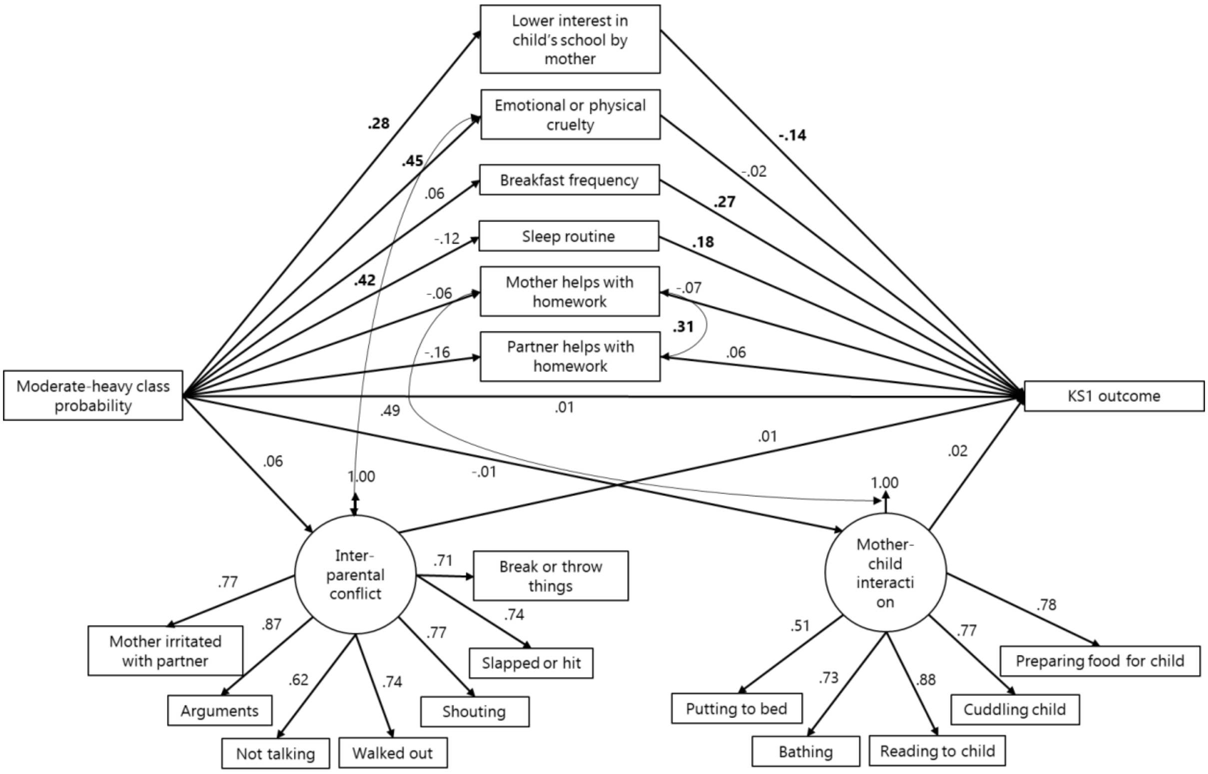
	2-class	3-class	4-class	5-class	6-class
AIC	118847.32	116963.64	116404.01	116356.22	116354.52
BIC	119078.21	117248.85	116743.57	116750.09	116802.71
Adjusted BIC	118970.17	117115.39	116584.67	116565.78	116592.98
Proportions	51%	52%	40%	34%	33%
	49%	26%	31%	28%	27%
		22%	23%	23%	23%
			5%	12%	13%
				2%	3%
					<1%
Entropy	0.76	0.77	0.75	0.68	0.69
Probability of most likely latent class membership	94%	91%	84%	79%	78%
	92%	96%	81%	71%	68%
		82%	100%	100%	100%
			72%	61%	59%
				68%	64%
					65%
VLMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.72$
LMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p<0.05$	$p=0.72$

iv. High-income sample latent class analysis means and proportions

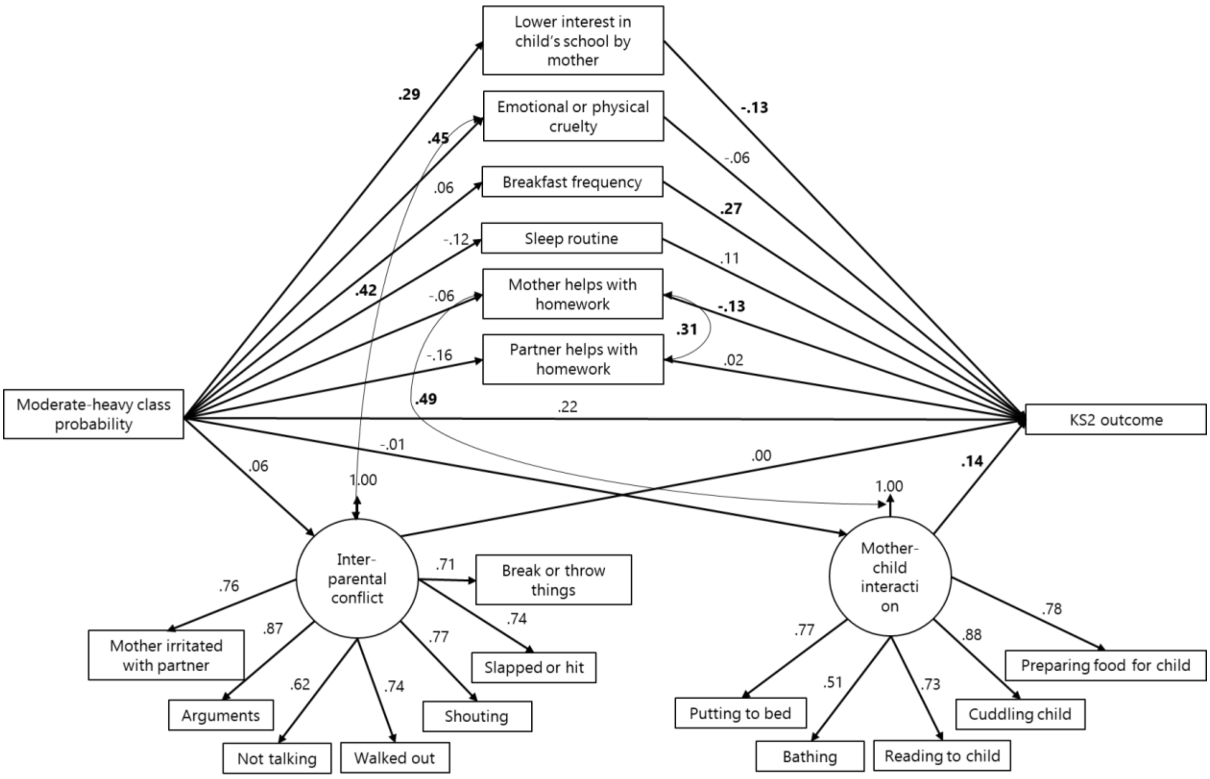
	Very low class	Low class	Moderate class	Heavy class
Monday	0.00	0.13	0.83	3.05
Tuesday	0.00	0.14	0.89	2.79
Wednesday	0.00	0.20	0.99	2.82
Thursday	0.00	0.19	1.02	2.93
Friday	0.00	0.61	1.61	3.41
Saturday	0.00	1.23	2.15	3.76
Sunday	0.00	0.61	1.36	2.97

		Very low class	Low class	Moderate class	Heavy class
Partners binge drinking (>4 units)	**None**	29%	16%	<10%	<10%
	1 - 2 days	23%	21%	12%	<10%
	3 - 4 days	17%	24%	18%	11%
	5 - 10 days	17%	25%	35%	15%
	> 10 days	<10%	11%	23%	32%
	Everyday	<10%	<10%	<10%	36%
Mothers drug use	**Yes**	<10%	<10%	<10%	15%
	No	>90%	>90%	>90%	85%

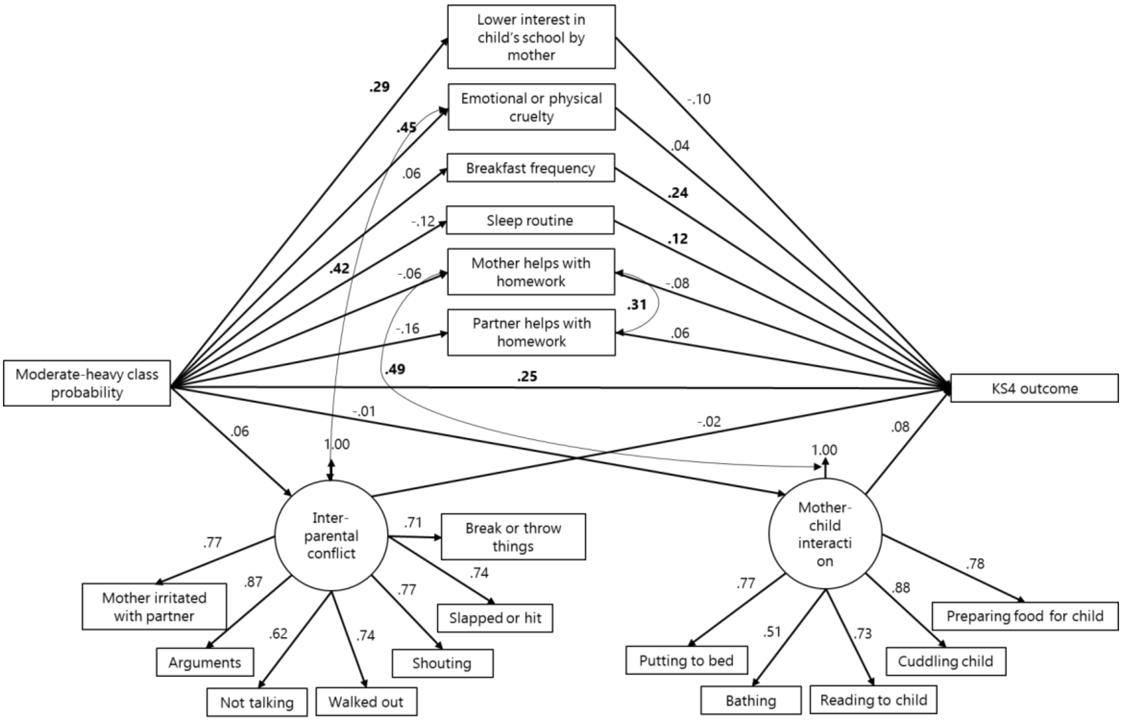
v. Low-income: heavy class and KS1



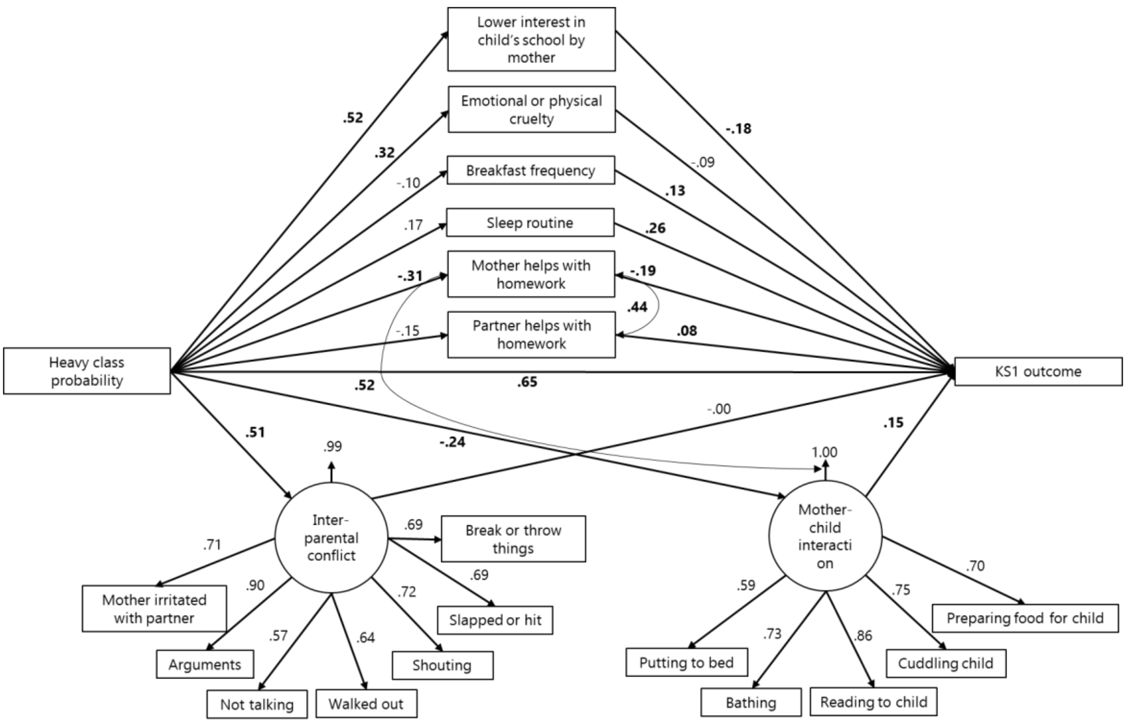
vi. Low-income: heavy class and KS2



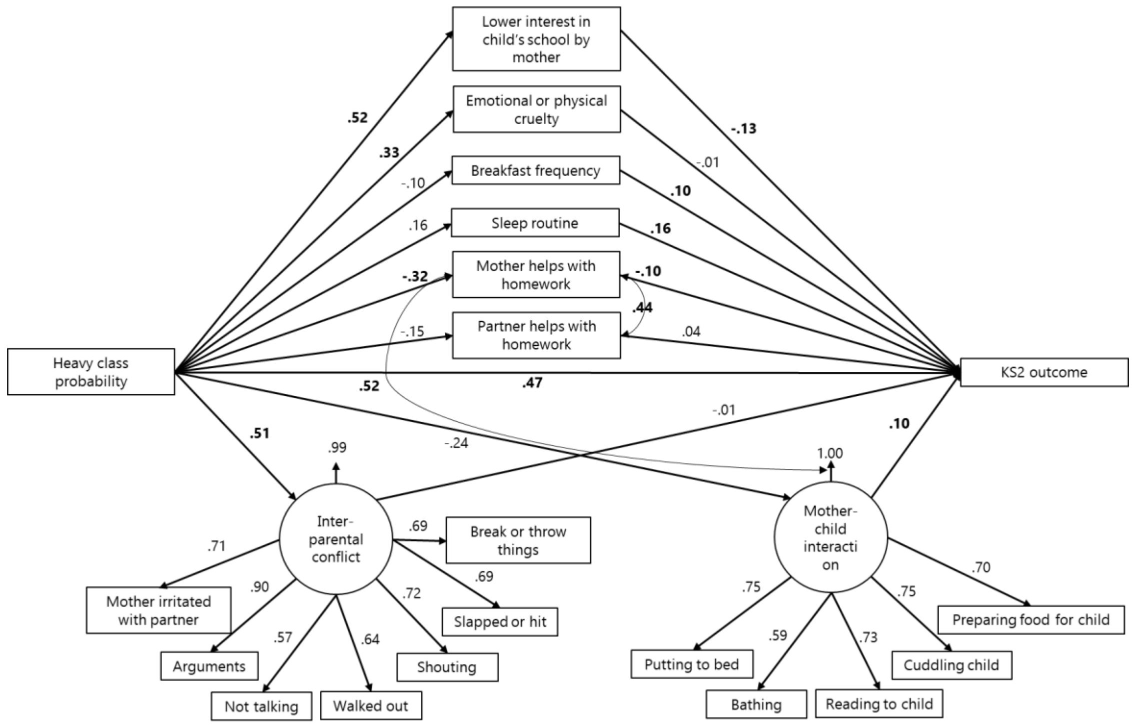
vii. Low-income: heavy class and KS4



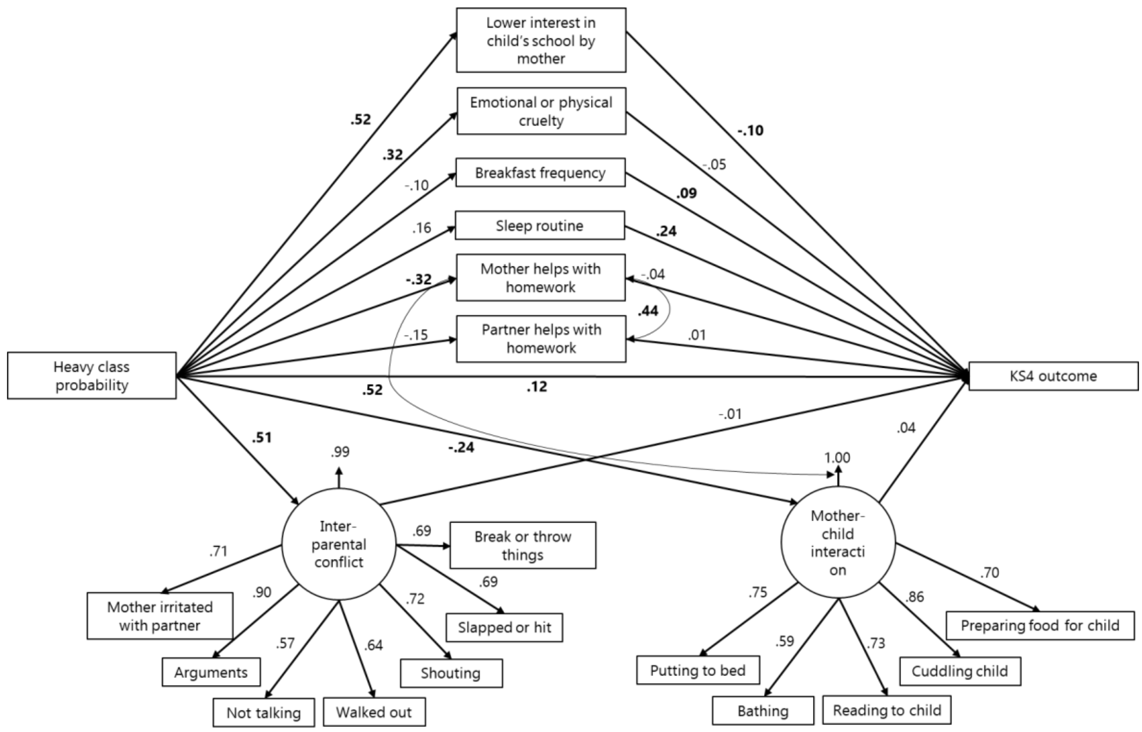
viii. High-income: heavy class and KS1



ix. High-income: heavy class and KS2



x. High-income: heavy class and KS4



J. MCS: Further exploratory analysis

i. Latent class proportions for measurement invariance for the non-degree sample

Measure	Class 1 – Dual-Heavy		Class 2 – Moderate		Class 3 – Partner-heavy		Class 4 – Low	
	Mother	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**
Usual drinking								
Never	<5%	5%	<5%	<5%	18%	<5%	84%	58%
Less than once month	5%	<5%	29%	15%	20%	<5%	14%	16%
1 – 2 times a month	<5%	7%	31%	23%	22%	5%	<5%	11%
1 – 2 times per week	36%	26%	35%	44%	31%	34%	<5%	11%
3 – 4 times a week	30%	29%	5%	10%	6%	31%	<5%	<5%
5 – 6 times a week	11%	16%	<5%	<5%	<5%	10%	<5%	<5%
Everyday	12%	14%	<5%	<5%	<5%	17%	<5%	<5%
Cut down								
No	18%	53%	>95%	>95%	>95%	17%	>95%	>95%
Yes	82%	47%	<5%	<5%	<5%	83%	<5%	<5%
Criticise								
No	76%	87%	>95%	>95%	>95%	68%	>95%	>95%
Yes	24%	13%	<5%	<5%	<5%	32%	<5%	<5%
Guilty								
No	57%	80%	>95%	>95%	>95%	59%	>95%	>95%
Yes	43%	20%	<5%	<5%	<5%	41%	<5%	<5%
First thing								
No	92%	94%	>95%	>95%	>95%	86%	>95%	>95%
Yes	8%	6%	<5%	<5%	<5%	14%	<5%	<5%
Drug use								
No	84%	82%	>95%	93%	>95%	84%	>95%	95%
Yes	16%	19%	<5%	7%	<5%	16%	<5%	5%

ii. Latent class proportions for measurement invariance for the degree sample

Measure	**Class 1 – Dual-heavy**		**Class 2 – Partner-heavy**		**Class 3 – Low**		**Class 4 – Moderate**	
	Mother	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**
Usual drinking								
Never	<5%	<5%	10%	<5%	44%	34%	7%	<5%
Less than once month	<5%	<5%	14%	<5%	30%	29%	11%	<5%
1 – 2 times a month	<5%	12%	13%	<5%	21%	29%	20%	12%
1 – 2 times per week	19%	20%	35%	23%	<5%	8%	43%	52%
3 – 4 times a week	36%	30%	20%	40%	<5%	<5%	15%	24%
5 – 6 times a week	25%	23%	<5%	16%	<5%	<5%	<5%	6%
Everyday	17%	22%	<5%	16%	<5%	<5%	<5%	<5%
Cut down								
No	15%	48%	>95%	8%	>95%	>95%	>95%	92%
Yes	85%	52%	<5%	92%	<5%	<5%	<5%	9%
Criticise								
No	85%	94%	>95%	73%	>95%	>95%	>95%	>95%
Yes	15%	6%	<5%	27%	<5%	<5%	<5%	<5%
Guilty								
No	62%	85%	>95%	53%	>95%	>95%	>95%	>95%
Yes	38%	15%	<5%	47%	<5%	<5%	<5%	<5%
First thing								
No	>95%	>95%	>95%	>95%	>95%	>95%	>95%	95%
Yes	<5%	<5%	<5%	<5%	<5%	<5%	<5%	5%
Drug use								
No	90%	86%	>95%	90%	>95%	>95%	>95%	95%
Yes	11%	14%	<5%	11%	<5%	<5%	<5%	5%

K. MCS: Sensitivity analysis income

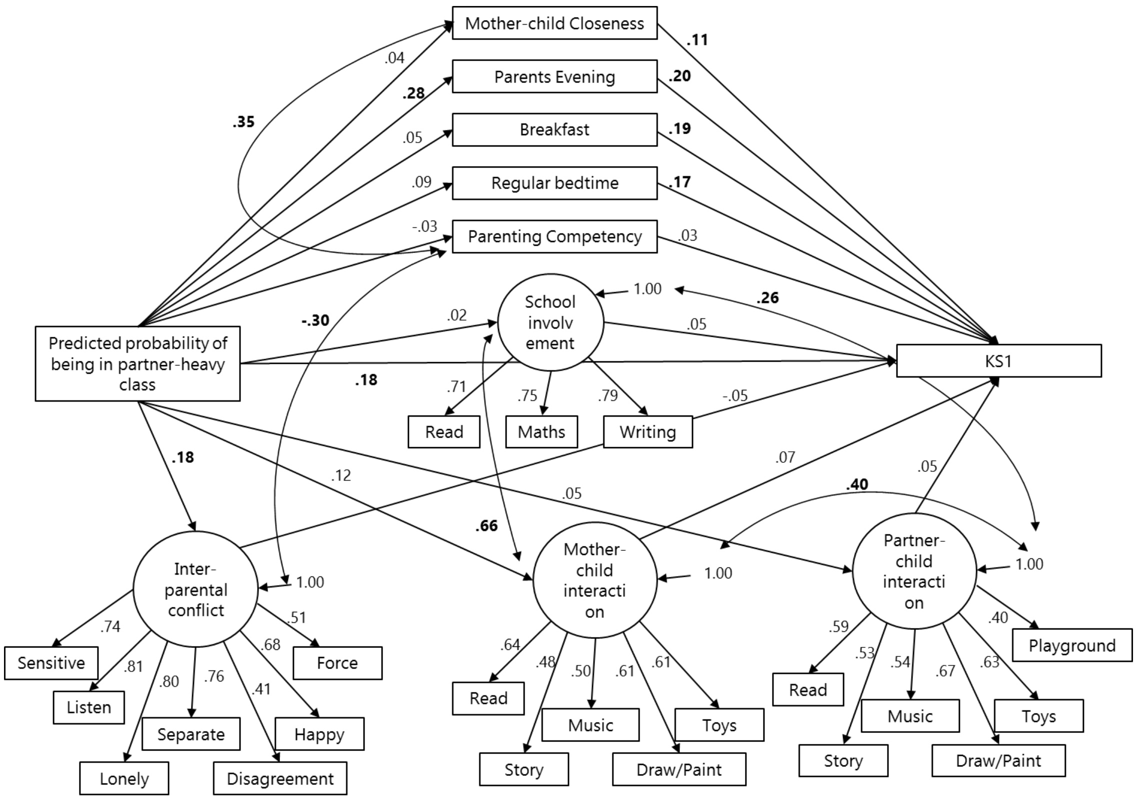
i. Low-income: LCA statistical criteria

	2-class	3-class	4-class	5-class
AIC	55421.89	54268.85	53220.20	52895.79
BIC	55730.40	54735.05	53844.08	53677.35
Adjusted BIC	55587.40	54518.96	53554.91	53315.08
Proportions	71%	63%	~	29%
	29%	27%	~	27%
		10%	~	23%
			~	12%
				9%
Entropy	0.66	0.66	0.70	0.61
Probability of most likely latent class membership	91%	82%	78%	72%
	91%	86%	93%	68%
		89%	88%	83%
			89%	89%
				89%
VLMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p<0.05$
LMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	$p<0.05$

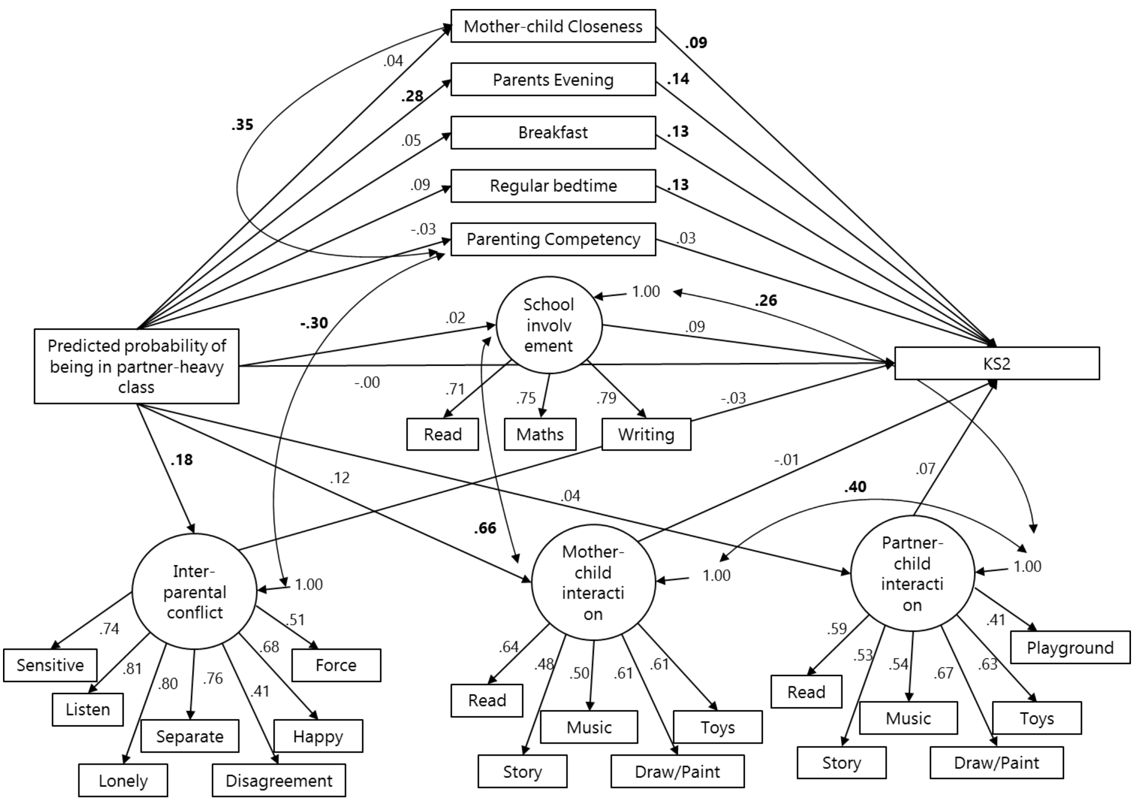
ii. Low-income LCA proportions for 4-class model

Measure	Class 1 - Moderate		Class 2 – Partner-Heavy		Class 3 – Moderate		Class 4 – Low	
	Mother	Partner	Mother	Partner	Mother	Partner	Mother	Partner
Usual drinking								
Never	<5%	<5%	19%	<5%	83%	62%	<5%	6%
Less than once month	30%	17%	18%	<5%	15%	16%	7%	7%
1 – 2 times a month	33%	24%	19%	6%	<5%	10%	7%	8%
1 – 2 times per week	32%	42%	33%	33%	<5%	9%	41%	30%
3 – 4 times a week	<5%	9%	8%	32%	<5%	<5%	26%	23%
5 – 6 times a week	<5%	<5%	<5%	10%	<5%	<5%	10%	14%
Everyday	<5%	<5%	<5%	16%	<5%	<5%	10%	13%
Cut down								
No	>95%	16%	>95%	20%	>95%	>95%	17%	60%
Yes	<5%	84%	<5%	80%	<5%	<5%	83%	40%
Criticise								
No	>95%	62%	>95%	65%	>95%	>95%	71%	88%
Yes	<5%	38%	<5%	35%	<5%	<5%	29%	12%
Guilty								
No	>95%	54%	>95%	59%	>95%	>95%	522%	80%
Yes	<5%	46%	<5%	41%	<5%	<5%	48%	20%
First thing								
No	>95%	84%	>95%	85%	>95%	>95%	92%	94%
Yes	<5%	16%	<5%	15%	<5%	<5%	9%	6%
Drug use								
No	>95%	92%	>95%	81%	>95%	94%	80%	79%
Yes	<5%	8%	<5%	19%	<5%	6%	20%	22%

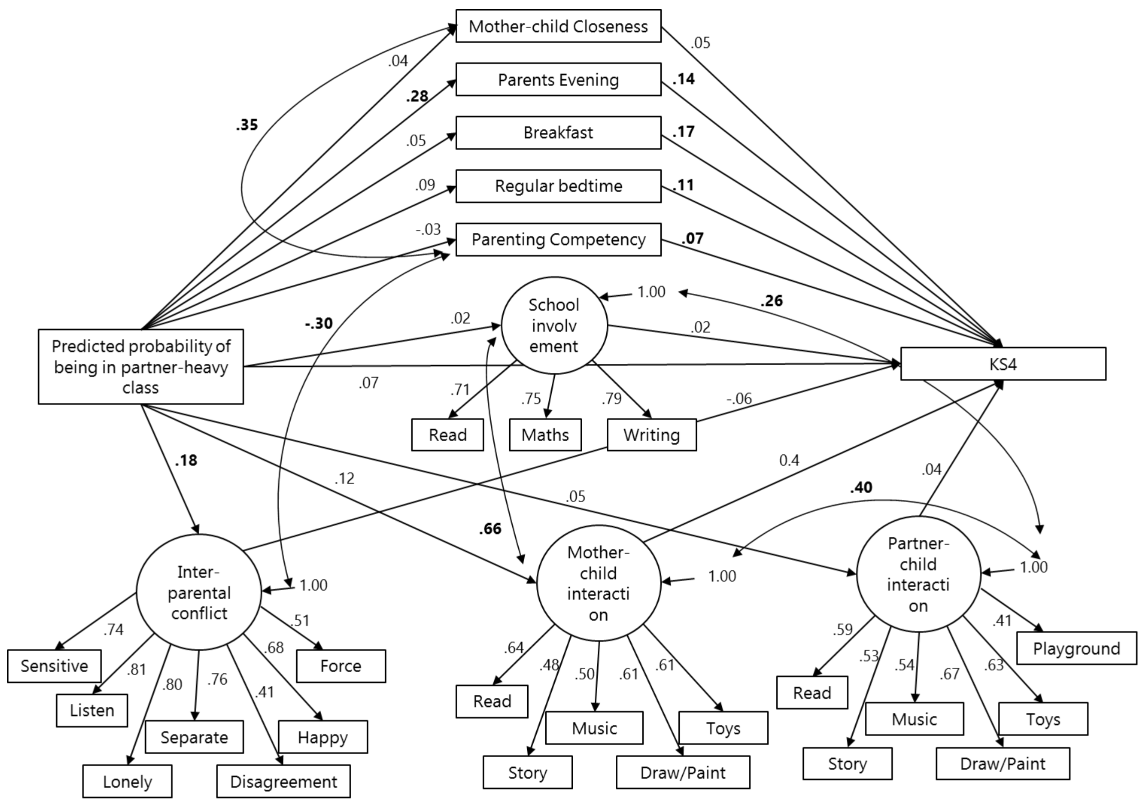
iii. Low-income: partner-heavy class and KS1



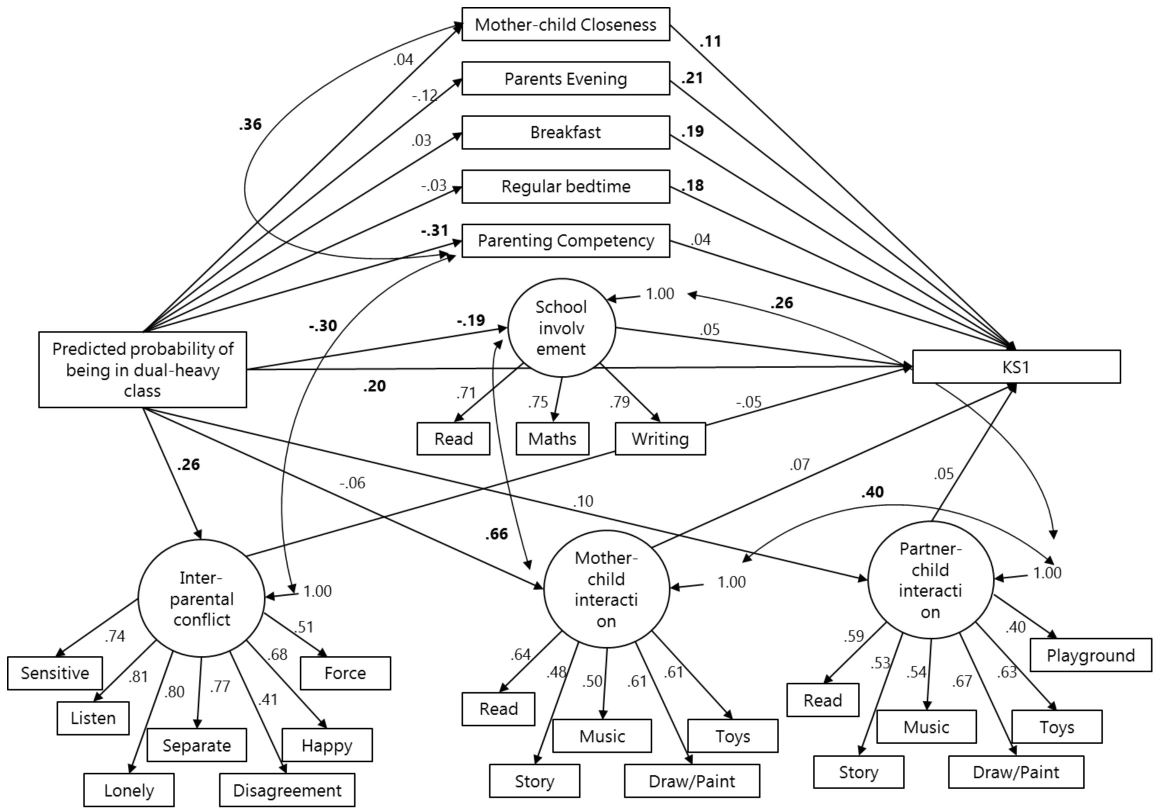
iv. Low-income: partner-heavy class and KS2



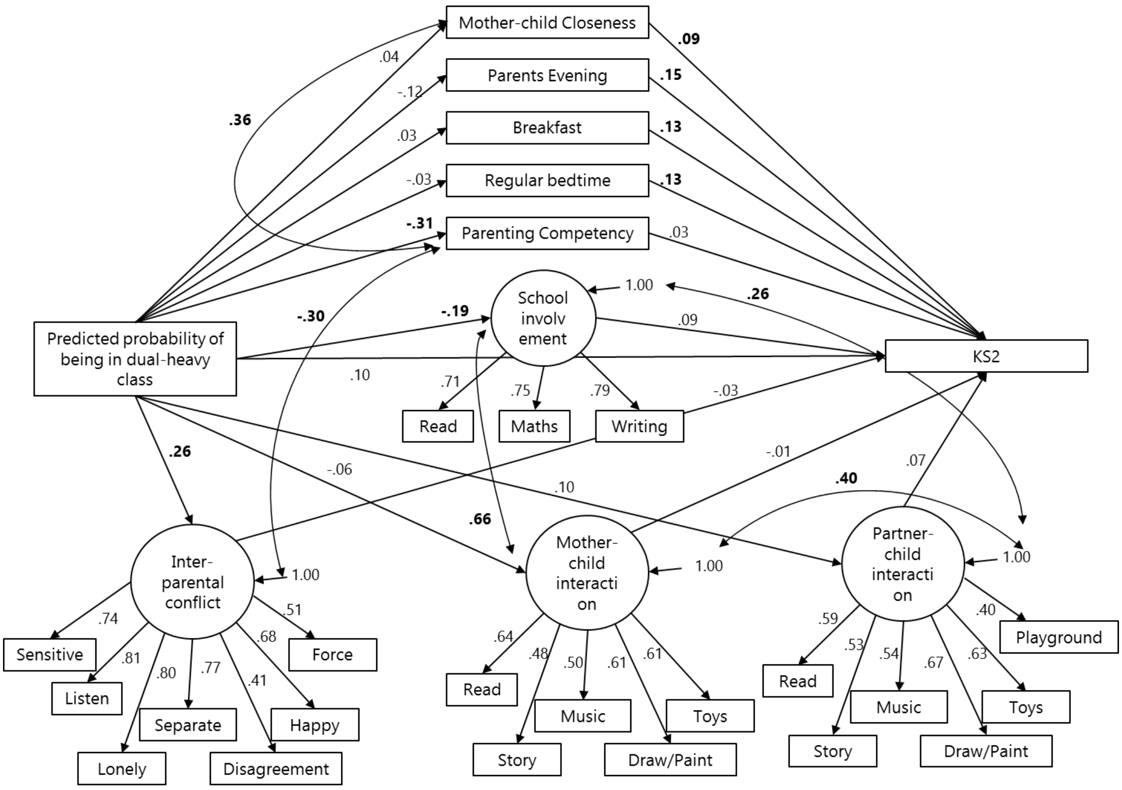
v. *Low-income: partner-heavy class and KS4*



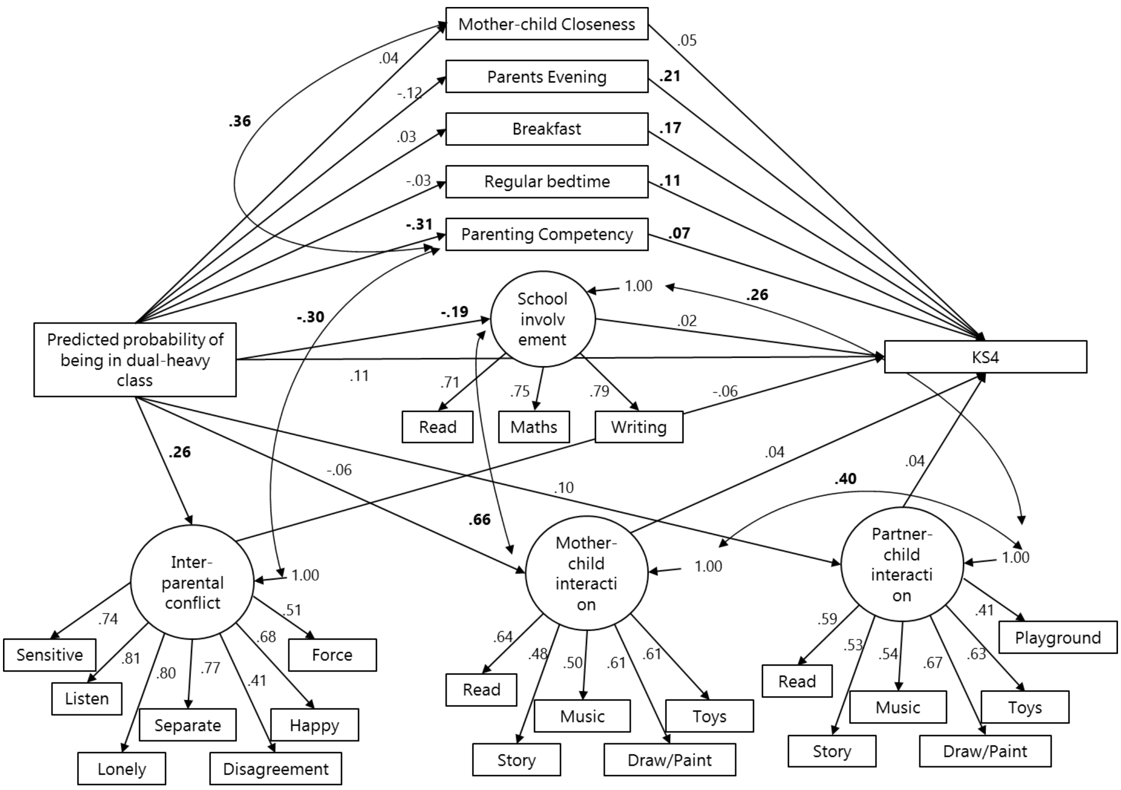
vi. *Low-income: dual-heavy class and KS1*



vii. Low-income: dual-heavy class and KS2



viii. Low-income: dual-heavy class and KS4



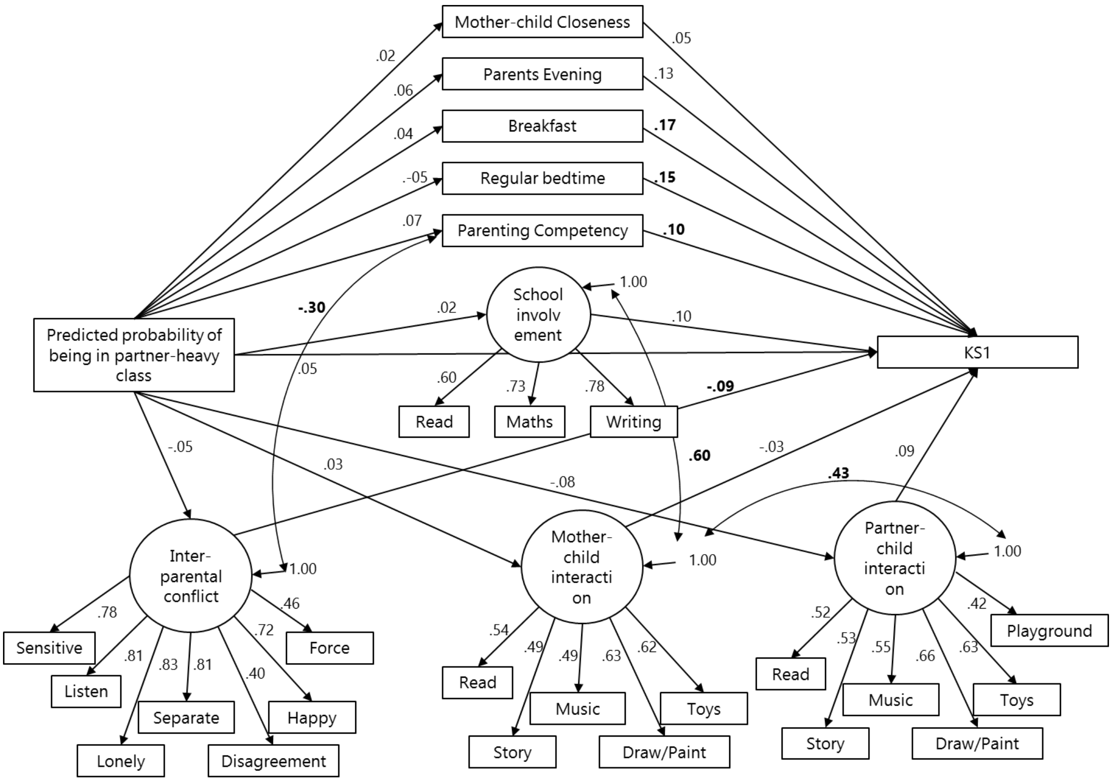
ix. High-income LCA statistical criteria

	2-class	3-class	4-class	5-class
AIC	62262.36	60961.32	60257.41	-
BIC	62565.76	61419.79	60870.95	-
Adjusted BIC	62422.76	61203.71	60581.78	-
Proportions	61%	62%	~	44%
	39%	20%	~	20%
		18%	~	14%
			~	13%
				10%
Entropy	0.67	0.75	0.68	0.72
Probability of most likely latent class membership	92%	91%	79%	86%
	89%	86%	81%	76%
		88%	80%	70%
			90%	88%
				83%
VLMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	-
LMR LRT	$p<0.05$	$p<0.05$	$p<0.05$	-

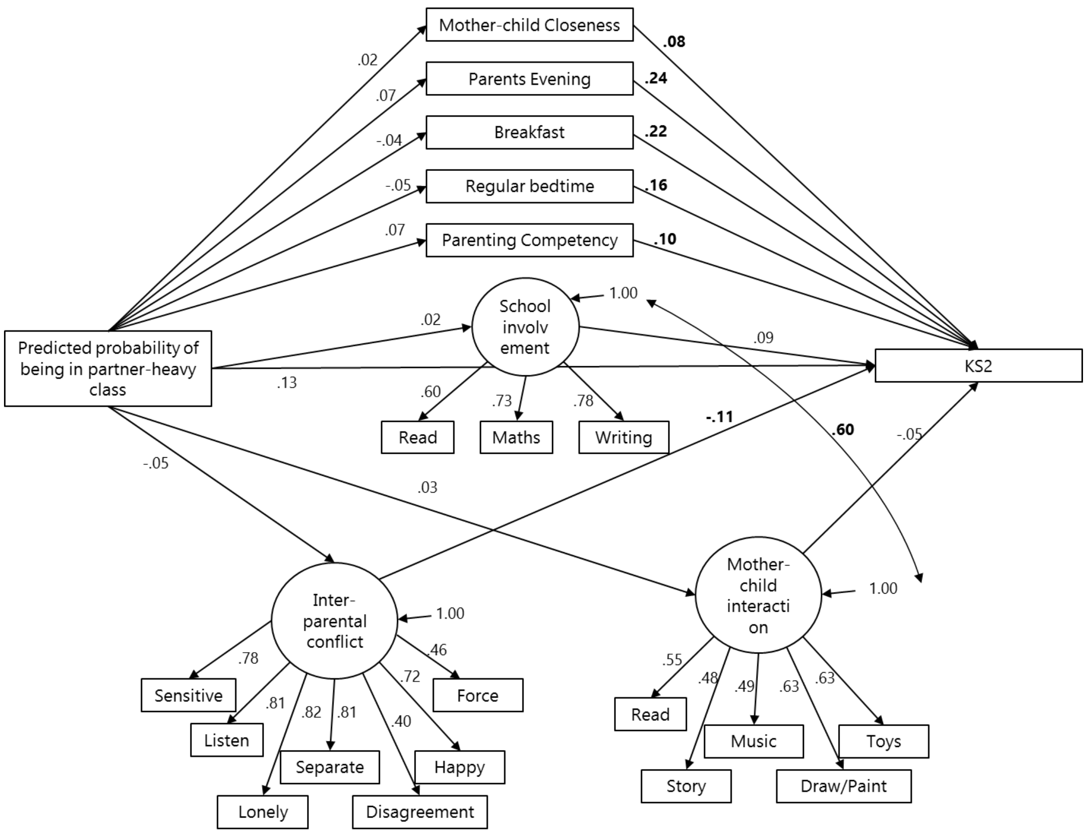
x. High-income LCA proportions

Measure	Class 1 – Partner-heavy		Class 2 – Moderate		Class 3 – Dual-heavy		Class 4 – Low	
	Mother	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**	**Mother**	**Partner**
Usual drinking								
Never	10%	<5%	6%	<5%	<5%	<5%	28%	18%
Less than once month	17%	<5%	8%	<5%	<5%	<5%	33%	26%
1 – 2 times a month	17%	<5%	17%	7%	<5%	<5%	26%	32%
1 – 2 times per week	32%	27%	47%	52%	16%	19%	11%	22%
3 – 4 times a week	18%	35%	18%	28%	39%	32%	<5%	<5%
5 – 6 times a week	<5%	15%	<5%	8%	25%	22%	<5%	<5%
Everyday	<5%	18%	<5%	<5%	18%	21%	<5%	<5%
Cut down								
No	>95%	8%	>95%	87%	18%	46%	>95%	>95%
Yes	<5%	93%	<5%	13%	82%	54%	<5%	<5%
Criticise								
No	>95%	71%	>95%	>95%	87%	92%	>95%	>95%
Yes	<5%	29%	<5%	<5%	13%	8%	<5%	<5%
Guilty								
No	>95%	49%	>95%	>95%	65%	84%	>95%	>95%
Yes	<5%	51%	<5%	<5%	35%	16%	<5%	<5%
First thing								
No	>95%	94%	>95%	>95%	>95%	>95%	>95%	>95%
Yes	<5%	6%	<5%	<5%	<5%	<5%	<5%	<5%
Drug use								
No	>95%	90%	>95%	94%	91%	85%	>95%	95%
Yes	<5%	10%	<5%	6%	9%	15%	<5%	5%

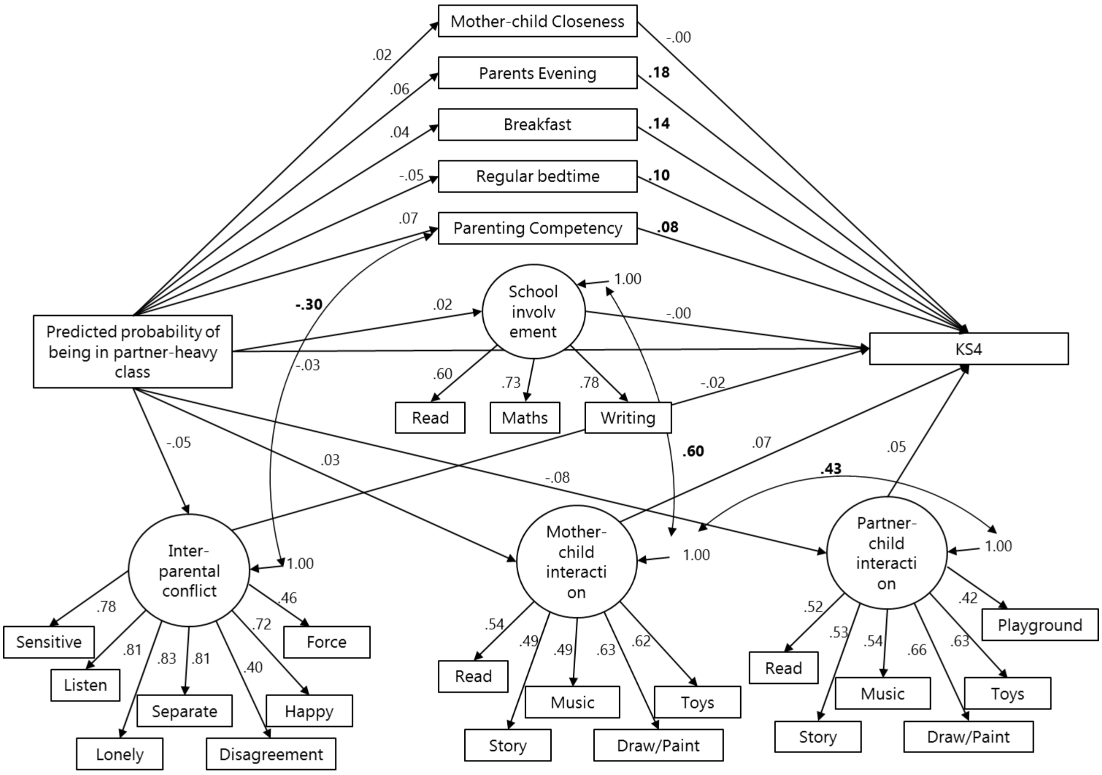
xi. *High-income: partner-heavy class and KS1*



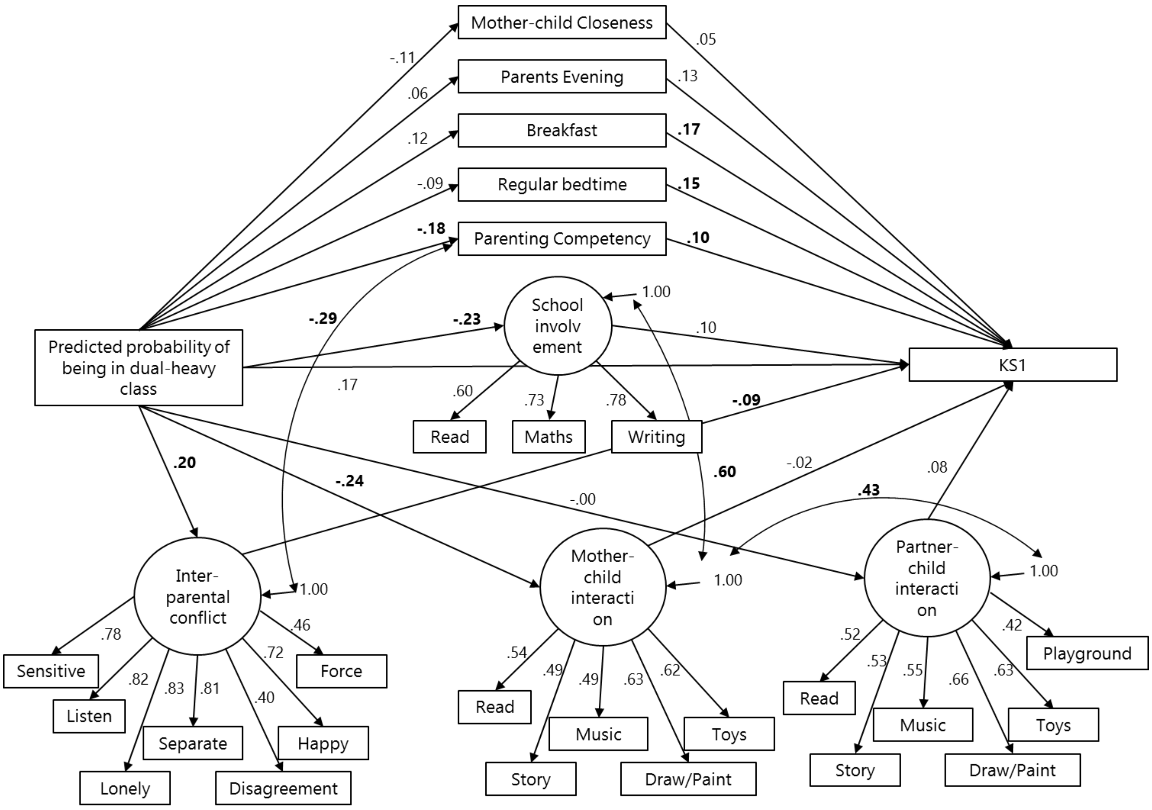
xii. *High-income: partner-heavy class and KS2*



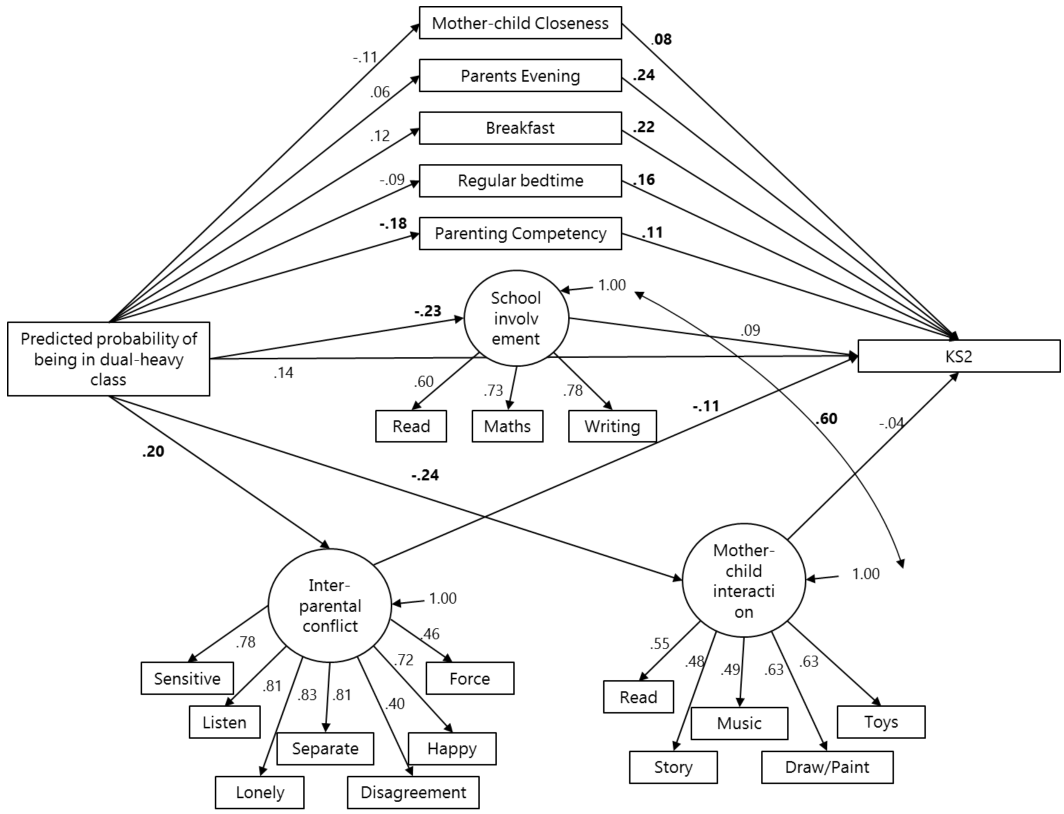
xiii. *High-income: partner-heavy class and KS4*



xiv. *High-income: dual-heavy class and KS1*



xv. High-income: dual-heavy class and KS2



xvi. High-income: dual-heavy class and KS4