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Understanding the Mechanisms through which Adverse Childhood Experiences Affect Lifetime Economic Outcomes

Stefanie Schurer
The University of Sydney & IZA

Kristian Trajkovski
The University of Sydney

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Children raised in material poverty are at a disproportionately higher risk of developmental delays, poorer educational and health outcomes, lifelong under- or unemployment, welfare dependency, and involvement in crime. The resulting economic cost of growing up poor to individuals, families and society is therefore sizable.

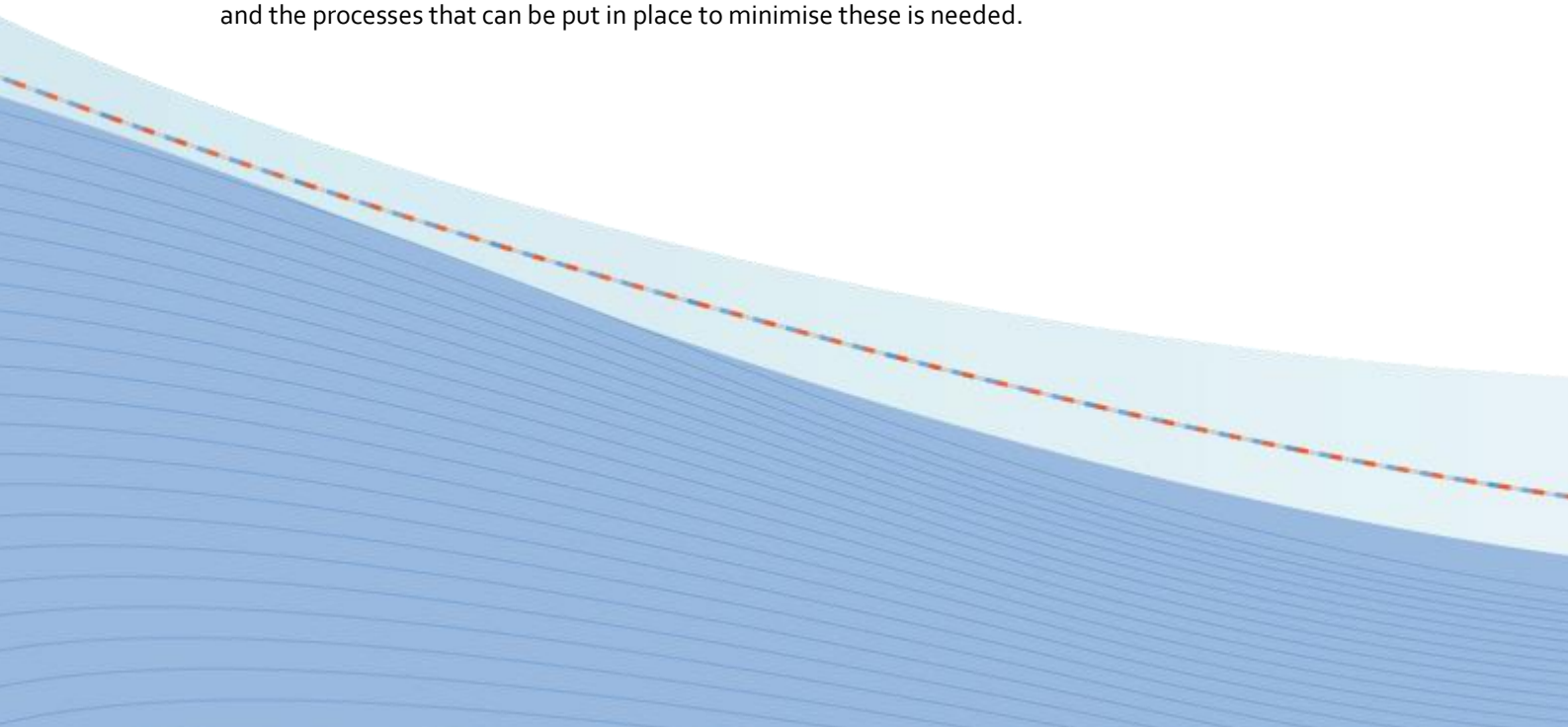
However, it is unclear whether it is early-childhood economic hardship per se that causes later-life socio-economic disadvantage, or whether it is the adverse childhood experiences to which children in economically disadvantaged households are disproportionately exposed (e.g. parental abuse and neglect, parental relationship instability, and parental mental health or substance abuse). Using high-quality cohort data from the United Kingdom (National Child Development Study), we examine how adverse childhood experiences between ages 7 and 16 affect individuals' lifetime economic outcomes (as captured by income, welfare dependency and subjective poverty). We also identify the channels through which this link takes place.

Our findings indicate that exposure to adverse childhood experiences is more common amongst children growing up in economically disadvantaged families, who are twice as likely as children in economically better-off families to experience at least one adverse life event. However, adverse childhood experiences affect children's developmental pathways negatively irrespective of parental socio-economic background.

We also find that adverse childhood experiences are strong predictors of economic outcomes at age 55, over and above the influence of other important early-life predictors (e.g. health at birth, parental education and parental occupation). One additional adverse childhood experience is associated with an earnings "penalty" of 7.3 percent, and a significant increase in the probability of welfare dependence and subjective poverty.

The experience of neglect, as assessed by the child's teacher when the child was age 7 to 11, is the driving factor in the association between adverse childhood experiences and economic outcomes. Differences in earnings by age 55 between those who experienced neglect and those who did not are almost entirely explained by differences in human and health capital accumulated by age 33.

Altogether, our findings have important policy implications. Critically, they suggest that large gains in productivity could be attained by targeting household dysfunction as a way to alleviate childhood poverty. Further research into the factors leading to these forms of early life adversity, and the processes that can be put in place to minimise these is needed.



ABOUT THE AUTHORS

Stefanie Schurer is an Associate Professor and a SOAR Fellow in the School of Economics at The University of Sydney. Her main research interest is the Economics of Human Development. Most of her current research projects explore the evolution of skills, preferences, and health over the life course and the role that parents and the public sector play in determining these skills. From 2014 to 2017 she will be in a research-only position funded by an ARC Discovery Early Career Research Award (DECRA) titled "Exceptional upward mobility against all odds: Noncognitive skills and early-childhood disadvantage". Email: stefanie.schurer@sydney.edu.au

Kristian Trajkovski is an Honours student in the School of Economics at the University of Sydney. His Honours thesis alongside coauthor Associate Professor Stefanie Schurer focuses on adverse childhood experiences and later life economic outcomes, particularly what mechanisms drive these later life factors. He gained his Honours in Economics from the University of Sydney. Email: ktra8130@uni.sydney.edu.au

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(ARC Centre of Excellence for Children and Families over the Life Course)
Institute for Social Science Research, The University of Queensland (administration node)
UQ Long Pocket Precinct, Indooroopilly, Qld 4068, Telephone: +61 7 334 67477
Email: lcc@uq.edu.au, Web: www.lifecoursecentre.org.au

Abstract

The past two decades have witnessed an increased interest in the role of adverse childhood experiences (ACE) – children's exposure to maltreatment and household dysfunction – in shaping lifetime opportunities. This is the first study to quantify the economic penalties of ACE and identify their underlying mechanisms. We source data from the National Child Development Study to construct an ACE index based on prospective childhood information. We estimate an earnings penalty of 7.3 percent for each additional ACE, and a 53.1 (34.0) percent higher probability of being welfare dependent (subjectively poor) at age 55, controlling for economic background factors. The associations are driven by parental neglect, a component of the ACE index based on teacher assessments. Observed differences in earnings between children with and without neglect experiences can be fully explained by their observable differences in human and health capital accumulated by young adulthood. The productivity loss of an economy due to parental failures to adequately care for their children is likely to be high. Our findings contribute to a wider discussion on the multidimensionality and definitions of childhood poverty.

Keywords: childhood poverty; adverse childhood experiences; economic outcomes; welfare dependence; human capital

INTRODUCTION

Children raised in material poverty are undoubtedly at a disproportionately higher risk of cognitive and socioemotional developmental delays, poorer educational and health outcomes, lifelong under- or unemployment, welfare dependency, and involvement in crime (Bird 2013, Duncan et al. 2012, Duncan et al. 2010, Wiborg and Hansen 2009, Duncan et al. 1998). The resulting economic cost of growing up poor is sizable. Some studies estimate such cost to society to reach at least one percent of GDP in the UK (Blanden et al. 2010) and between one and four percent in the United States (Holzer et al 2007).

A wealth of literature has examined the impact of childhood poverty defining poverty as lack of access to financial or educational resources (e.g. Duncan et al., 2012, Cohen et al. 2010, Currie 2008, Case et al. 2001). The question however arises of whether it is early-childhood economic hardship that causes later-life socioeconomic disadvantage, or whether it is the type of adversities that children experience disproportionately in economically disadvantaged households. Children in poorer families are more likely to be exposed to parental abuse and neglect and instability in relationships, often caused by mental health or substance abuse problems that their carers experience. In short, poverty is more likely to expose a child to a toxic environment that compromises her developmental potential. We will refer to such toxic environments as adverse childhood experiences (ACE). Importantly, ACE may also occur in privileged families, and thus will put their children at risk of later-life disadvantage.

In a landmark study, Felitti et al. (1998) explored and documented the health consequences of ACE. A robust evidence base has amassed since the late 1990s linking ACE with adulthood physical and mental health problems, obesity, and substance abuse issues (see Section 2. for a literature review). The link between growing up with ACEs and numerous adulthood health problems and behaviours have been firmly established for various 20th century birth cohorts, suggesting that the effects of ACEs on health problems are unaffected by social or secular changes (Dube et al. 2003). Anda et al. (2006) explain that ACE is likely to cause chronic health problems later in life because of toxic stress exposure that manipulates neurological developments and may lead to brain dysfunction.

In this study, we adopt ACE as a new definition of childhood poverty. We hypothesise that if ACE altered brain functionality of children, then ACE should have long-term consequences on human capital accumulation and economic outcomes. To date, there is little empirical evidence on the lifetime economic penalties of ACE. There is no empirical evidence on the likely mechanisms through which this relationship may emerge. Exploring lifetime economic outcomes is important in two ways. First, economic outcomes are arguably the best proxies for overall opportunities in

life. Second, knowledge of the economic penalty of ACE allows to quantify the social cost of early-childhood trauma.

Our study seeks to fill this gap in the literature using high-quality cohort data from the National Child Development Study (NCDS) (Power and Elliott 2006). The NCDS followed a birth cohort of children born within one week in the United Kingdom in 1958 from birth up until age 55 today. The study is rich in detailed information that was collected about the child and their parents at birth, age 7, age 11, and age 16. Such wealth of data allows us to construct an objective measure of ACE based on negative-event data that were recorded between ages 7 and 16. Thus, we neither rely on self-reports of trauma nor on retrospective information. Because follow up data were collected on the children in young adulthood up until age 55 today, we can link earlier-life ACE with lifetime economic outcomes and identify the channels through which a link is observed. To quantify the underlying mechanisms, we use a variance-decomposition approach that was suggested in Heckman and Pinto (2015) and applied in Heckman et al (2013). We calculate the contribution of differences in observable characteristics, measured at a time when cohort members enter adulthood, to the observed differences in income, welfare dependency and subjective poverty between cohort members with doses of ACE and cohort members without.

We motivate our analysis by the assumption that ACE affects children's developmental pathways irrespective of parental socioeconomic background. Empirically, we are able to demonstrate that this is indeed the case. Although ACE are disproportionately more common in economically disadvantaged families, they are twice as likely to experience at least one adverse event, ACE also occur in more privileged families. We furthermore find that ACE are strong predictors of age 55 economic outcomes, over and above the influence of standard early-life predictors including health at birth, parental education and occupation, and other background factors. One additional ACE – on a scale that is bound between 0 and 6 – is associated with an earnings penalty of 7.3 percent, and a significant increase in the probability of welfare dependence and subjective poverty. These findings are robust to alternative definitions of ACE, for instance excluding separation from parents due to absence of a parent from the index, and allowing for nonlinearities in the relationship between ACE and economic outcomes. The experience of neglect, an assessment made by the cohort member's teacher between ages 7 and 11, is the driving factor in the association between ACE and economic outcomes.

Observed differences in net earnings by age 55 between those who experienced neglect, and those who did not, are almost entirely explained by differences in human and health capital accumulated by age 33. This finding has critical implications for the way public policy views childhood poverty. It suggests that if public policy were to target more directly household

dysfunction as a new way to alleviate childhood poverty, large gains in productivity could be expected.

This paper will proceed as follows. In Section I we review the existing literature on the association between ACE and lifetime economic and health outcomes. In Section II we explain the data used for the empirical analysis. Section III outlines our empirical modelling strategy. In Section IV we present the estimation results. Section V discusses the limitations of our study design and the policy implications of our findings. Supplementary material is provided in an appendix.

I. LITERATURE REVIEW

The origins of the ACE debate

Adverse childhood experiences (ACE) are defined as "potentially traumatic events that can have negative, lasting effects on health and well-being" (Felitti et al. 1998). There is no unique definition of ACE, but ACE refer usually to child maltreatment, household dysfunction, exposure to mental health or substance abuse problems by a carer, or contact of a family member with the criminal justice system. Most of the early work focused exclusively on the role of child maltreatment, encompassing physical, sexual, and emotional abuse and neglect.

The seminal work by Felitti et al. (1998) demonstrated a significant relationship between exposure to ACE (defined by child maltreatment) and risky health behaviours and disease in middle age using a sample of employed adults covered by Kaiser Permanente, a US private health insurer. The study found that individuals who reported four or more categories of childhood maltreatment, compared to those who experienced none, were four to 12 times more likely to suffer from alcoholism, drug abuse, depression, and suicidal thoughts; they were two to four times more likely to smoke, and up to 1.6 times more likely to be obese.

Brooks (2012) has described these results as "striking" (p.1), as they revolutionised the way how researchers and health professionals perceived childhood maltreatment. The ACE study showed that ACE could not only be seen as the root cause of mental and social problems in victims, but that it could also be one of the leading causes of adult morbidity in developed nations. The ACE Study had however some limitations. The authors controlled only for the confounding effects of age, sex, race and own educational attainment, and fully disregarded the impact of childhood socioeconomic status. This is problematic because many studies show a strong association between household poverty and the probability of child maltreatment (Goldberg et al. 2013; Cancian et al. 2010). Similarly, a strong link exists between childhood poverty and adulthood health problems (Magnuson and Votruba-Drzal 2008). The ACE study did not disentangle these pathways, which Clark et al. (2010) consider to be its "major methodological limitation" (p.386).

Palusci (2013) notes that since the original ACE study almost 60 papers have followed more or less its methodological approach, corroborating and extending its findings. Dong et al. (2003), Dong et al. (2004), Danese (2009), and Brown et al. (2009) have assessed the impact of ACE – measured by maltreatment factors only - on liver disease, ischemic heart disease, cardiovascular disease, and premature mortality, respectively. Kelly et al. (2013a), Kelly et al. (2013b) and Solis et al (2015) using data from the NCDS and an extended measure of ACE find significant relationships between high-dose ACE and cancer, mortality, and general wear-and-tear, controlling for a rich set of early-life background factors. Isohookana et al. (2016) and Thomas et al. (2009) find a significant link between early childhood abuse and obesity and unhealthy weight control behaviours; however such a finding could not be replicated by Hariharan and Schurer (2017) using NCDS data. Schilling et al. (2007) find a significant relationship between ACE and depressive symptoms, drug use, and antisocial behaviour. Danese (2009) shows for a sample of children from New Zealand that those who were exposed to ACE were more likely at risk of depression later in life. Mersky et al (2013) show a robust association between ACE greater usage of tobacco, alcohol and marijuana. More recently, Merrick et al (2017) demonstrate that the link between childhood adversity and adult mental health service use is driven by an increasing risk of depression, suicidal thoughts, drug use and alcoholism.

The relationship between ACE and skills, education, and crime

Some studies document a link between maltreatment experiences and cognitive and non-cognitive skill development. Fletcher and Schurer (2017) use sibling fixed effects models on a US cohort to study the causal impact of maltreatment experiences on non-cognitive skill development in young adulthood. The authors find that sexual abuse experiences resulted in higher levels of neuroticism, while parental neglect resulted in lower levels of conscientiousness and higher levels of neuroticism. Richards and Wadsworth (2004) show a long-term penalty of maltreatment on cognitive function, memory and concentration, and educational attainment. The latter finding has been replicated by Boden et al. (2007) using data from the Christchurch birth cohort. Their findings show that cohort members who have experienced either sexual or physical abuse were significantly less likely to complete secondary schooling or to enroll at university.

The impact of maltreatment on educational attainment is likely to operate through suboptimal school performance. Wodarski et al. (1990) show that students who experienced earlier life abuse and/or neglect score lower on standardised language tests and are twice as likely to repeat a grade. Slade and Wissow (2007), also using siblings-fixed-effects models, show that children with maltreatment experiences score significantly lower grade point averages. In line with previous

evidence, the authors explain poor school performance with impaired cognitive skill development that results from maltreatment experiences.

Currie and Tekin (2012) highlight furthermore the potential impact of maltreatment on the propensity to participate in criminal activity. Using siblings- and twin-fixed-effects models, the authors show that experiences of child abuse and neglect double the likelihood of committing a crime in young adulthood. Interestingly, the authors find this relationship for both boys and girls.

The relationship between ACE and economic outcomes

Despite this broad empirical evidence base supporting a significant link between ACE and health, education, and skill development, little empirical evidence exists on its impact on lifetime economic outcomes. There are important exceptions. Using Canadian survey data, Metzler et al. (2017) demonstrate that children with ACE were significantly more likely to be unemployed and to live below the poverty line in adulthood. Sansone et al. (2012) and Covey et al. (2013) find similar impacts on adulthood employment status. Currie and Widom (2010) find a 14 percent gap in age 40 employment probabilities between adults with and without court-substantiated histories of abuse/neglect, controlling for background characteristics. Liu et al (2013) show that men who had experienced one to three ACE were almost twice more likely to be unemployed than men with no ACE. The authors suggest that the link between ACE and unemployment is likely to result from worse cognitive outcomes. Font and Maguire-Jack (2016) find that individuals who experienced ACE earned 10 percent lower salaries than individuals who did not. Using also data from the NCDS (among other data sources), Conti et al. (2017) find no link between child maltreatment – defined by retrospective, self-assessed measures – employment and earnings using data from the NCDS and other British cohort data.

We contribute to this emerging literature by (i) providing a rigorous analysis of the later-life economic penalty of ACE for one major OECD country, (ii) identifying the mechanisms underlying this relationship, and (iii) improving upon previous study designs. Many previous studies were not able to adequately control for childhood socioeconomic status and relied on later-life retrospective self-evaluations of maltreatment and household-dysfunction experiences. We discuss the limitations of retrospective ACE measures in the next section.

Measurement issues

When it comes to testing the impact of ACE, one obstacle is that childhood adversity is difficult to measure. At the time of occurrence during childhood, it is hard for anyone outside a child's immediate environment to truly know whether they are suffering from familial instability or

parental maltreatment. Existing studies have tackled this problem in a variety of ways, revealing that all measures of ACE present certain benefits and limitations.

Most previous studies discussed above use retrospective, self-reported data on parental maltreatment, although their reliability is questionable. Some authors argue that retrospective reports of ACE are always invalid for two reasons. First, people may forget (or choose to forget) past maltreatment as they grow older. Secondly, individuals with severe health or employment problems may perceive their childhood experiences more negatively than their healthier or more successful peers (Brown and Harris 1978; Clark et al. 2010).

For instance, previous literature confirms the existence of recall bias, where the accuracy of self-reported maltreatment is a function of current health status (Widom et al. 2004; Hardt and Rutter 2004). The phenomenon of 'effort after meaning' explains such behaviour, where unhealthy individuals search for an explanation for their state of bad health, and thus assign more meaning to negative past events. If this is true, the model will overestimate the effect of ACE on health outcomes. Widom et al. (2004) conclude that whilst 'it is tempting to be convinced by the volume of retrospective studies which link child abuse to certain outcomes ... the studies may all suffer from the same potential biases' (p. 721).

Conversely, Currie and Tekin (2012) assert that 'several researchers have studied the validity of self-reported data on child maltreatment and have concluded that, if collected properly, this data is valid' (p.514). Data validity is improved if respondents can listen to prerecorded questions through earphones, and enter their answers directly on laptops in order to maintain confidentiality and minimise the potential for interviewer influence. In order to obtain accurate responses about the timing of events, subjects should also be prompted with a calendar of important events. Currie and Tekin (2012), who use cohort data from Add Health which explicitly followed these protocols, showed that older cohort members were not less likely to report ACE than younger cohort members. They also demonstrated that twins who differed in their self-reports of maltreatment did not differ in their self-reports of family information where no difference was expected. Thus, the authors concluded that the maltreated twin did not systematically suffer from recall bias or effort after meaning, reinforcing the validity of the ACE data.

To mitigate concerns regarding the unreliability of retrospective ACE measures, some studies opt for administrative data such as court-substantiated cases of child abuse, or cases of maltreatment which are reported to government agencies. For example, Currie and Widom (2010) and Young and Widom (2014) use court-substantiated abuses to estimate the effect of ACE on economic-wellbeing and emotional processing in adulthood. The benefit of court-substantiated data is that it is objective. However, Currie and Tekin (2012) argue that it captures only a small

fraction of all ACE because of severe underreporting and low conviction rates. Further, convicted cases are unlikely to be representative of all cases of maltreatment. Official records of abuse are likely to pertain to households that come to the attention of official agencies for other reasons, such as unemployment or ill-health. As such, reliance on administrative data is likely to produce a small and unrepresentative sample of families in which ACE occurs.

In the past decade, more studies have exploited prospective longitudinal data to construct an ACE measure. Prospective longitudinal studies collect information on cohort members at several stages during childhood, where reports are often obtained from family members, doctors, or teachers. This information can be used to construct a more reliable ACE measure, since it captures objective evidence of adversity at the time of its occurrence. Danese et al. (2007) for instance use data from the Dunedin Multidisciplinary Health and Development Study to assess the effect of ACE on adult inflammation. They construct their ACE measure from a combination of behavioural observations and parental reports during childhood, and retrospective reports by study members once they have reached adulthood. The authors manage to avoid using self-reports for all ACE indicators except outright abuse (physical and sexual abuse).

Kelly-Irving et al. (2013a) and Solis et al (2015) are two of the few studies which use an ACE index that does not rely on retrospective reports. Although available in their data,[1] their ACE index does not incorporate physical or sexual abuse. We follow these two studies to construct an ACE index exclusively from prospective data that does not rely on self-reports and was collected decades before economic outcomes were recorded. Unfortunately, we cannot identify exogenous variation in ACE which we could exploit to identify the causal impact of ACE on economic outcomes, similar as in Currie and Tekin (2012), Fletcher and Schurer (2017), or Slade and Wissow (2007) who control for family fixed effects by using siblings or twin samples. However, we will carefully control for childhood socioeconomic status (parental education, occupation, and region of residence), and other relevant pre-treatment conditions, so that our findings can be interpreted as the influence of ACE on economic outcomes over and above childhood socioeconomic status, family composition, and at-birth health outcomes.

II. NATIONAL CHILD DEVELOPMENT STUDY (NCDS)

The analysis will be conducted with data from the National Child Development Study (NCDS), a British cohort study which collected information at birth on 18,558 children born within a single week in the United Kingdom (UK) in 1958 (Power and Elliott 2006). This study provides longitudinal data on each child's birth outcomes, physical and educational development into young

adulthood, economic outcomes, family situation, employment, health, wellbeing, social status and behavioral attitudes. The dataset is carried out at different stages of the cohort members' lives through interviews of the prime caretaker (predominantly the mother), assessments of the cohort members' ability through the interview team, and teacher assessments. In later sweeps, data was collected directly from the cohort members through interviews.

Information on the children was collected in ten sweeps at ages 0, 7, 11, 16, 23, 33, 42, 46, 50 and 55, with age 0 being sweep 0, age 7 being sweep 1 and so on. The earlier sweeps collected comprehensive information on both the children's cognitive and non-cognitive abilities as well as information on parental background such as: (i) Family background and financial situation from birth to age 16; (ii) Cohort member physical and mental health outcomes from birth to current age 55; (iii) Household composition and structure in terms of family composition within household and also considering the type of house and tenure of the family; (iv) Education covering information from primary school right through to secondary education and tertiary education. Here we consider school participation and activity as well as later life course qualifications of the children as well as educational information about the mother and father; (v) Cognitive and non-cognitive skills covering the child's early life test scores of reading, writing, mathematics as well as personality traits test scores; (v) Employment and financial situation during adult years age 17 onwards.

ACE Components

To construct a measure of adverse childhood experiences (ACE), we use prospective information provided through the earlier sweep surveys and teacher assessments. Following Kelly-Irving et al (2013a) and Solis et al (2015), we construct an index of experiences that captures traumatic and stressful events that are out of the child's control and tend to occur and persist over time. This index is constructed from the following items:

1. Child in care: Child has ever been either in public or voluntary foster care services at ages 7, 11 or 16.
2. Physical Neglect: Whether the child appears undernourished or dirty at ages 7 or 11, information collected from the response from child's teacher to the Bristol Social Adjustment Guide.
3. Offenders: The child has lived in a household where any given family member (who also lives in the same household as the child) was either in prison or on probation at age 11, or a household member was in contact with probation services at age 7 or 11.

4. Parental Separation: Child has ever been separated from their mother or father due to either death, divorce or separation at age 7, 11 or 16.
5. Mental Illness: Household has been in contact or is still in contact with mental health services at age 7 or 11. Alternatively, any family member has mental illness at age 7, 11 or 16.
6. Alcohol Abuse: Family member suffers from alcohol problems at age 7.

We sum all items with equal weighting to construct an ACE index, bounding the index between 0 (no adversity) and 6 for maximum possible adversity. The index is increasing in the frequency of ACE. In additional analyses, we use a binary measure of ACE that takes the value 1 if the individuals experienced a high dose of ACE (ACE>1), and 0 otherwise (see Kelly et al. 2013b). In a robustness check, we use each individual component of ACE as a measure of adversity.

Outcome variables

The main outcomes of interest are net individual earnings, welfare dependency and subjective poverty recorded at age 55. Net earnings are measured as net monthly pay reported in 2011 British pounds. Respondents in the survey were asked about their net monthly income in their main job/occupation after tax and other deductions. As is common in the literature, we logarithmatise this measure to be able to allow for nonlinearities at the top end of the distribution and to interpret marginal effects of interest in terms of (log) percentage changes.

Welfare dependency is based on a question in which respondents were asked "do you or your partner/husband/wife currently receive a regular payment from any of the following sources" which includes government transfers, tax credits, and benefits as possible answers. Those who do receive any combination of government transfers, benefits or tax credits would be classified as welfare dependent and those who do not receive any of these benefits would be classified as not welfare dependent.[2]

A measure of subjective poverty experiences is constructed from a question that asked participants at age 55 whether they consider themselves financially struggling. Respondents were asked "how well would you say you personally are managing financially these days". Those who responded as finding it quite difficult or very difficult are classified as living in subjective poverty, while those who responded as just about getting by or able to get by comfortably are classified as not living in subjective poverty. This measure is used instead of a more objective measure of poverty, which requires information on income of all household members. Such data are not available in the NCDS.

Control variables

To control for potential confounders, we control for various other factors which arguably occurred before the exposure to ACE and which were out of the cohort member's control. These variables include sex, whether the child was born premature (less than 37 weeks of gestation) or with low birth weight (less than 2500 gram).[3] Similarly, we control for the age of the mother when she gave birth to the child (whether a teenager, young adult mother or mature aged mother) as well as the number of siblings in the family and birth order, as these factors are likely to have an impact on availability of parental resources to invest in the cohort member's development.[4] Careful attention is paid to controlling adequately for childhood socioeconomic status of the family. To proxy for parental attitudes toward education, access to education-relevant information, and parenting skills, we use parents' level of education as measured by the age at which the father and the mother left full-time education. To capture parental income potential, we control for father's occupation (if father is present) and the geographic location where the family resides.

III. EMPIRICAL FRAMEWORK

Estimating the relationship between ACE and economic outcomes

First, we estimate a linear regression model to test for a statistical relationship between ACE and later-life economic outcomes. The dependent variable is either log net earnings, welfare dependence or living in poverty, which are all measured at age 55, and the main independent variable is ACE.

$$Y_i = \beta_0 + \beta_1 ACE_i + \varepsilon_i, \qquad (1)$$

ACE_i is a continuous measure of the number of adverse experiences a cohort member experienced during childhood (approximately by age 11). We also consider a binary measure of ACE_i^B that takes the value 1 if the individual experienced two or more ACE, and zero otherwise to indicate high-dose ACE (see Kelly-Irving et al. 2013a, Kelly-Irving et al. 2013b). Of main interest is the parameter β_1. In the case of a continuous ACE measure, β_1 captures the association of one additional adverse event with economic outcomes. In the case of a binary measure of ACE, this coefficient captures the differences in economic outcomes between those with one or no ACE and those with high-dose ACE.

It is important to emphasise that ACE is an endogenous variable; some children are more likely to experience ACE than others, and are more likely to have poor lifetime economic outcomes

independent of ACE. This could occur for instance because children with ACE are more likely to be living in low income- or education-poor families, and childhood poverty is also likely to affect life-time economic opportunities (see Fletcher and Schurer, 2017 for a discussion). Not controlling for this selection is likely to overstate the estimated relationship of interest. Thus, we estimate subsequent models that include controls for X_i to capture the aforementioned confounding factors.

$$Y_i = \propto_0 + \propto_1 ACE_i + \propto_2 X_i + \varepsilon_i. \qquad (2)$$

We identify $\propto_1$ on the assumption of conditional independence between the error term ε_i and ACE_i. A statistically significant parameter $\propto_1$ will be interpreted as a robust association between ACE and lifetime economic outcomes $\mathrm{Y_i}$, over and above the influence of $\mathrm{X_i}$.

To better understand which components of ACE drive the relationship, we further explore the association between each individual component of ACE and economic outcomes. We highlight the important role of child neglect, a key measure of child maltreatment that is relatively easy to observe (here: teacher assessment). In a robustness check, we furthermore explore an ACE measure which excludes parental separation as a possible category of negative experiences. The literature on parental separation has produced mixed results on whether it is associated with positive or negative economic or education outcomes of children (Amato 1988, Amato 2000). This alternative ACE index varies between 0 (no adversity) and 5 (maximum adversity).

Decomposition analysis

In a second step, we explore the underlying mechanisms through which ACE is likely to impact upon later-life economic outcomes. To identify the likely channels, we use the same decomposition method proposed in Heckman and Pinto (2015) and applied in Heckman et al. (2013). This method decomposes the "treatment effect" of high-dose ACE into observable and unobservable components that explain the difference in outcomes between treatment and control groups. In a robustness check, we conduct the decomposition analysis using child neglect as treatment indicator Figure 1 illustrates the possible channels through which ACE may affect lifetime economic outcomes.

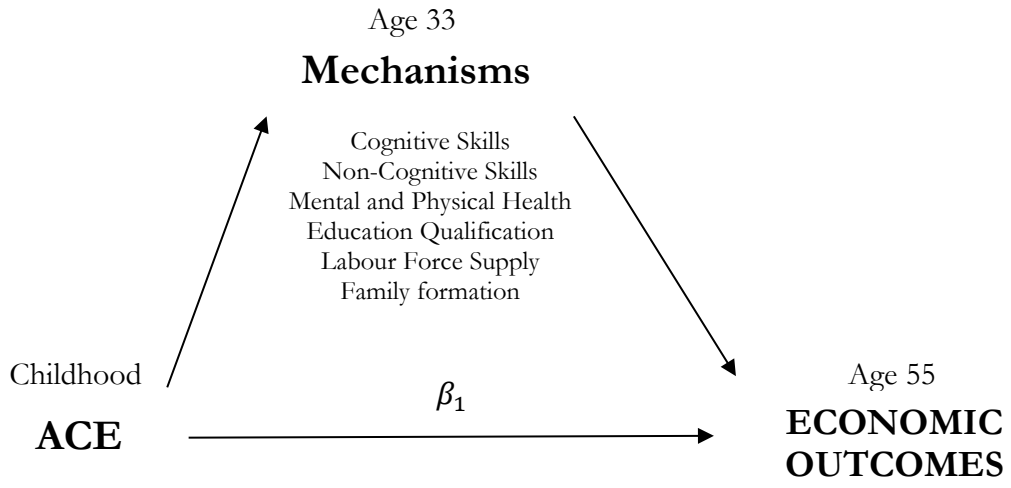


Figure 1: Channels through which ACE may affect lifetime economic outcomes

The starting point of the mediation analysis is the following equation of economic outcomes:

$$Y_d = k_d + \propto_d \theta_d + B_d X + \varepsilon_d, \qquad (3)$$

where Y_d is the outcome of interest. Let Y_1 and Y_0 be the counterfactual outcomes when ACE=1 (high dose) and ACE=0 (no or mild dose), respectively. The subscript *d* can take values 0 and 1 to indicate whether the variable is `fixed' at treatment; to flag those - at a given point in time - who had experienced ACE compared against those who had not experienced ACE.[5] k_d is an intercept, and θ_d captures all variables that are likely to mediate the relationship between ACE and later-life economic outcomes as described in Figure 1. We assume that there are specific young-adulthood outcomes θ_d that are changed by ACE, and that produce the treatment effect. Therefore, the term $\theta_d = D\theta_1 + (1 - D)\theta_0$ represents the counterfactual outcomes in young-adulthood between treatment and control group. *X* contains all variables that are not affected by ACE because they occur before exposure. We assume that the outcomes are independent across participants conditional on observed characteristics *X*. ε_d is a zero-mean error term assumed to be independent of both *X* and θ_d.

Although the NCDS collected a large array of young adulthood measures, we may not be able to capture all relevant outcomes in young adulthood that are affected by ACE. These outcomes are summarised as unobservable characteristics. We therefore classify the potential mediating factors captured in θ_d into observable characteristics and unobservable characteristics as follows:

$$Y_d = k_d + \underbrace{\sum_{j \epsilon J_p} \propto_d^j \theta_d^j}_{\text{Observed}} + \underbrace{\sum_{j \epsilon J \setminus J_p} \propto_d^j \theta_d^j}_{\text{Not observed}} + \beta_d X + \tilde{\epsilon_d}\,, \qquad (4)$$

$$Y_d = \tau_d + \sum_{j \epsilon J_p} \propto_d^j \theta_d^j + \beta_d X + \tilde{\epsilon_d}\,, \qquad (5)$$

where $\tau_d = k_d + \sum_{j \epsilon J \setminus J_p} \propto_d^j \theta_d^j$ and $j \in J_p$ denotes a given mediating factor *j* within a set of factors J_P; $\sum_{j \epsilon J_p} \propto_d^j \theta_d^j$ are all factors for which we have measurements, and $\sum_{j \epsilon J \setminus J_p} \propto_d^j \theta_d^j$ are all mediating factors for which we do not have measurements. Under the assumption that the ACE `treatment' affects young-adulthood outcomes, but not the impact of such outcomes and pretreatment variables *X* on later-life outcomes, we can further simplify this equation with the result that *X* drops out.

With this further simplification, the treatment effect can be decomposed simply as follows:

$$E(Y_1 - Y_0) = (\tau_1 - \tau_0) + \sum_{j \epsilon J_p} \propto_d^j E(\theta_1^j - \theta_0^j), \qquad (6)$$

so that we can interpret observed differences in later-life outcomes between treatment and control group in terms of differences in mediating factors $E(\theta_1^j - \theta_0^j)$ and differences in unobservable factors $(\tau_1 - \tau_0)$ as captured by differences in the intercept. This method is analogous to a standard Blinder-Oaxaca decomposition analysis (Fortin, Lemieux and Firpo 2011).

We assume that ACE is likely to impact later-life economic outcomes indirectly by influencing a child's skill development, health, human capital accumulation, labor supply, and marital decisions over the life course. Adapting a similar analysis from Fletcher and Schurer (2017), there are various potential mechanisms we can examine, given the available data:

1. Age 16 Cognitive Skills: ACE may impair cognitive development and thus intelligence. We use age 16 mathematics and reading test scores to proxy cognitive ability, the last measurement available after childhood.
2. Age 33 Non-Cognitive Skills: ACE may impair socioemotional abilities. We proxy these abilities with age 33 internal locus of control tendencies (self-efficacy).
3. Age 33 Health Outcomes: ACE may impact health trajectories through psychological developmental problems and immune health problems. We proxy health outcomes at age 33 with a self-assessed measure counting physical health problems and the Rutter Malaise Inventory.

4. Age 33 Education Outcomes: ACE may directly impact educational attainment, because children may not be able to focus on school and fall behind. We proxy educational attainment at age 33 with completed education levels.
5. Age 33 Family Composition: ACE may impact the decision to form a family. Maltreatment experiences are characterized by a breakdown in trust between carer and child. Thus, a victim of maltreatment may have difficulty in building trusting relationships in adulthood. We proxy family formation with marital status and the number of children by age 33.
6. Age 33 Employment Status: ACE may impact upon early-adulthood labour supply and instability in regular employment. We proxy labour-supply decisions with working part-time or full-time employment at age 33.

All remaining channels are captures by τ_d, and thus are termed as the contribution of unobservable factors.

IV. ESTIMATION RESULTS

Descriptive Analysis

Before discussing our estimation results, we present summary statistics (mean, standard deviation, minimum and maximum values) of key variables used in the analysis. Table 1 provides an overview of the three economic outcome measures recorded at age 55 – net monthly earnings (logarithmatised), the proportion of individuals receiving welfare payments, and the proportion of individuals stating that it is (very) hard for them to get by with their financial resources – all ACE components, and all control variables.[6]

The average net monthly income in the sample is log of 7.12 which translates into a net monthly salary of 1,236 pounds or 14,834 pounds per annum. Around 10% of the cohort members are classified as living in material poverty according to self-assessments and 17% are dependent on welfare payments. The average ACE is almost 0.4, which implies that two in five Brits born in 1958 experience at least one ACE. The maximum number of adverse events that a cohort member experienced is 5. Of the full sample, five percent experienced at least two adverse experiences. Excluding separation as one of our ACE components, only two percent of cohort members experienced at least two ACE, suggesting that the most common ACE is separation from the parents. In fact, 25% of the cohort members experienced separation from their parents up until age 16. In stark contrast, only four percent of cohort members experienced neglect (teacher assessed) by age 11.

Table 1: Summary Statistics

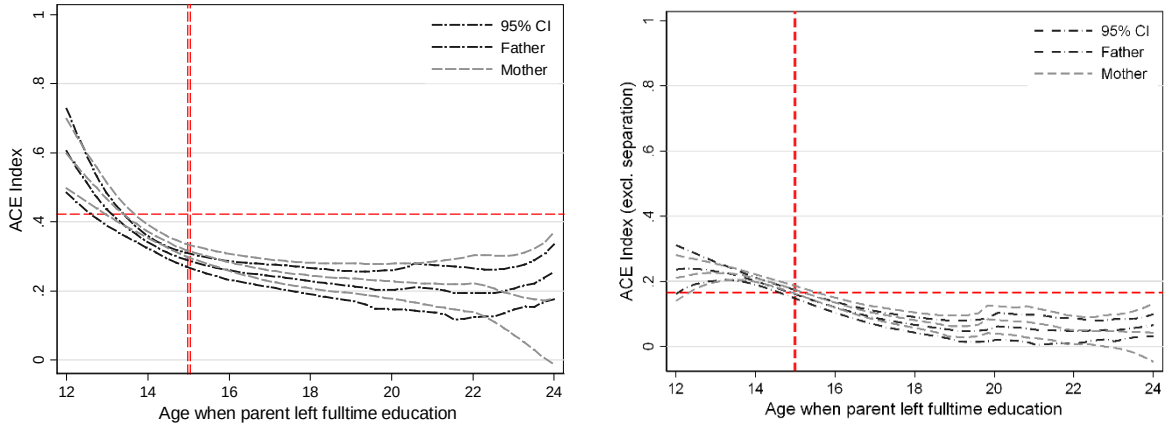
	Mean	Std. Dev.	Min	Max	N
Economic outcomes age 55					
Log Net Earnings Age 55	7.12	0.89	0	10	3784
Subjective poverty Age 55	0.10	0.30	0	1	5627
Welfare Dependence Age 55	0.17	0.38	0	1	5694
Pre-treatment control variables					
Female	0.54	0.50	0	1	5760
Low Birthweight	0.07	0.26	0	1	5760
Premature Birth	0.02	0.15	0	1	5005
Number Siblings Age 7	3.71	0.96	2	5	5095
Mother Age when child born	2.08	0.41	1	3	5487
Father SES	4.75	1.64	1	8	5074
Father age when left FT education	15.13	2.10	12	24	4228
Mother age when left FT education	15.06	1.67	12	24	4347
Geographical Location	5.86	3.07	1	11	5492
Cognitive Skills Age 7	61.98	12.69	17	98	4987
Non-Cognitive Skills Age 7	7.36	8.01	0	59	5163
Mechanisms – Young adulthood outcomes					
Cognitive Math Score Age16	14.19	7.00	0	31	4487
Cognitive Read Score Age16	26.97	6.09	1	35	4501
Non Cognitive Skill Age 33	2.48	0.90	0	3	5760
Physical Health Age 33	0.40	0.49	0	1	5760
Malaise Inventory A33	2.29	2.86	0	22	5760
Self-Assessed Health Age 33	0.03	0.16	0	1	5760
Chronic Health Problem Age 33	0.28	0.45	0	1	5760
Overall Health Age 33	1.37	1.04	0	4	5760
Education Outcome Age 33	2.65	1.48	0	5	5658
Number Children Age 33	1.44	1.10	0	8	5287
Marriage Status Age 33	0.92	0.36	0	2	4078
Employment: Part Time Age 33	0.28	0.45	0	1	5760
Employment: Full Time Age 33	0.13	0.34	0	1	5760
Adverse Child Experiences (ACE)					
ACE Dummy	0.05	0.22	0	1	5760
ACE Index	0.38	0.62	0	5	5760
Robust ACE Dummy (excl. separat.)	0.02	0.13	0	1	5760
Robust ACE Index (excl. separation)	0.12	0.40	0	4	5760
Child in care Age 7-16	0.03	0.17	0	1	5748
Child neglected Age 7-11 (teacher)	0.04	0.20	0	1	5183
Separation from parents Age 7-16	0.25	0.43	0	1	5745
Mental Illness in family Age 7-16	0.03	0.18	0	1	5570
Alcohol Abuse in family Age 7	0.01	0.08	0	1	4880
Offender in family Age 7-11 (0,1)	0.02	0.13	0	1	5570

Note: Descriptive statistics are based on NCDS information collected at different sweeps throughout the birth cohort's lifetime

An important question is whether ACE is just an alternative proxy for socioeconomic disadvantage. Figure 2a demonstrates indeed the existence of a socioeconomic gradient in ACE, but emphasises that cohort members from more privileged backgrounds also experience ACE. The figure depicts the bivariate correlation – estimated non-parametrically – between the number of ACE (vertical axis) and parental education (horizontal axis) for both fathers (dark grey dot-dashed line) and mothers (light grey dashed line). The vertical red lines depicts the average age at which parents left full-time education (around age 15), and the vertical dashed line depicts the average

number of ACE in the sample (0.40). The graph shows that for cohort members whose mothers left full-time education between the ages of 12 and 14, experienced more ACE than the sample average (around 0.5), while cohort members whose mothers left full-time education with a university degree (>20 years) experienced around 0.2 ACE. This means that one in two children from low SES experience at least one ACE, while only one in five do so from higher SES backgrounds. A similar gradient is observed for fathers' education levels.

Because separation from parents is such an important contributor to overall ACE, we show in Figure 2b the bivariate relationship between ACE, excluding separation, and parental education levels. We demonstrate that the education gradient in ACE remains the same, although it is less extreme.



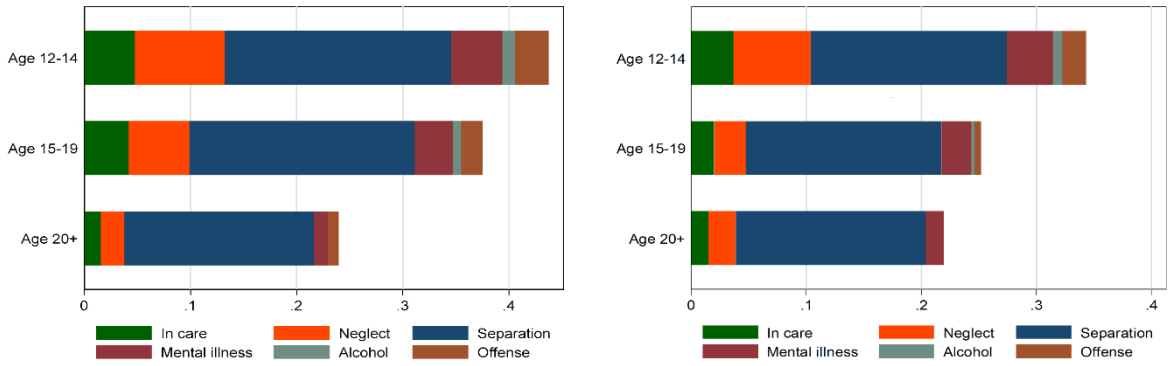
a) Full ACE score (ranging from 0 to 5).

b) ACE score excluding separation from parents (ranging from 0 to 4).

Figure 2: Relationship between parental education and ACE score

Figures 3a (Mother) and 3b (Father) break down the education gradient in ACE by the individual components that contribute to the ACE score. For ease of exposition, we show the education gradient by ACE component by three groups of parental educatio: Left school at age 20+ (university degree), left school between ages 15-19, and left school at age 14 or less. Independent of whether we measure disadvantage by mother's or father's education levels, parental separation is the main contributor to ACE in each education category, making up 75% of total ACE for the more disadvantaged cohort members, and 45% for the most disadvantaged cohort members.

Neglect occurs in each socioeconomic status group, although it is over-represented in the least advantaged group (22% of total ACE, 16% for middle group and 10% for most advantaged group). Alcohol problems and criminal offences contribute least to ACE, which may be due to systematic under-reporting in the survey.



a) Maternal education level. b) Paternal education level.

Figure 3: Relationship between parental education and individual ACE score components

Systematic attrition

An important limitation of our analysis is that many cohort members dropped out from the NCDS, and thus we do not observe their age 55 outcomes. Attrition in our sample is not important if it occurs at random. However, systematic attrition is more likely, which means that experience of ACE is related to the probability to drop out of the sample.

Systematic attrition could lead to either an upward or downward bias in our estimated regression coefficients. Therefore, to test whether systematic attrition is an issue and to sign the likely bias, we present in Table 2 the differences in means of ACE components between our estimation sample and those cohort members who dropped out after age 16.

Table 2 shows that the likelihood of experiencing high-dose ACE (or any sub-component) is almost twice as large for the dropout sample as for the final estimation sample. For instance, cohort members in the final estimation sample have a probability of five percent of having experienced high-dose ACE in childhood. This probability is nine percent of cohort members in the drop-out sample, a statistically significant difference of four percentage points. The respective differences for neglect are four versus eight percent; and for separation 25 versus 51 percent. Children in the dropout sample are twice as likely to have been raised in a household from the lowest socioeconomic class.

If the drop-out sample was also more likely to respond negatively to ACE – which is reasonable to assume because of the stronger exposure – then we are likely to underestimate the relationship between ACE and later-life economic outcomes. Under this assumption we would conclude that selective attrition, at worst, would lead to a downward bias of our estimates.

Table 2: Comparisons of means between final estimation sample and dropout sample

	Final		Dropout		Difference
Childhood Adversity	N	Mean	N	Mean	p-value[1]
ACE Dummy	5760	0.05	9645	0.09	0.000***
ACE Index	5760	0.38	9645	0.7	0.000***
ACE Dummy (excl. separation)	5760	0.02	9645	0.03	0.000***
ACE Index (excl. separation)	5760	0.12	9645	0.2	0.000***
Child in care Age 7-16	5748	0.03	9554	0.05	0.000***
Child neglect Age 7-11[2]	5183	0.04	8835	0.08	0.000***
Separation from Parents Age 7-16	5745	0.25	9615	0.51	0.000***
Mental Illness in family Age 7-16	5570	0.03	9320	0.04	0.000***
Alcohol Abuse in family Age 7	4880	0.01	8177	0.01	0.004**
Offender in family Age 7-11	5570	0.02	9306	0.03	0.000***
Low socioeconomic status	5048	0.56	9662	0.76	0.000***

[1] p-value refers to a t-test statistics on a test for equality of means between estimation and drop out sample. [2] Child neglect is based on a teacher assessment referring to appearance. *p<0.01, **p<0.05, ***p<0.01.

Estimating the economic penalty of ACE

In this section, we present the estimation results of the relationship between age 55 economic outcome measures and ACE. Table 3 presents bivariate and multivariate estimation results, where columns 1, 3, and 5 report bivariate coefficients (no controls, Eq. (1)), and columns 2, 4, and 6 report multivariate coefficients (full set of pre-treatment control variables, Eq. (2)). Each row represents a separate regression model with different dependent variables to measure ACE. Model 1. reports the coefficient of interest for the continuous ACE measure as dependent variable (bound between 0 and 5). Model 2. uses a binary index that indicates whether the individual experienced high-dose ACE. Models 3. to 8. use as dependent variable each component of the ACE index, respectively. Models 9. and 10. present a robustness check to Models 1. and 2. by excluding separation from the ACE index. Table A1 in the Appendix show the full regression results including a demonstration of coefficient sensitivity to adding each block of pre-treatment control variables individually. Significance levels are considered relevant for p-values smaller than 0.10.

We find a statistically significant association between ACE and all economic outcomes, independent of whether we control for confounding variables or not. A one-unit increase in ACE is associated with a 10.6 percent penalty in (log) net earnings at age 55 (column 1). Once controlling for the full set of pre-treatment variables, this penalty falls to 7.3 percent, although it is still statistically significant at the five percent level. The estimated earnings penalty is most sensitive to

the inclusion of father's occupational class, as expected. The earnings penalty increases to almost 20 percent when considering high-dose ACE (Model 2.). This association is robust to excluding separation from the ACE index (Models 9. and 10.). The key contributor in terms of magnitude and statistical significance to the negative relationship between earnings and ACE is the experience of neglect as reported by the teacher (Model 4.). The multivariate correlation coefficient indicates an earnings penalty due to neglect of 23 percent (significant at the 5 percent level).

Table 3: Relationship between ACE and economic outcomes at age 55.

	Log net earnings		Welfare dependence (0, 1)		Subjective poverty (0, 1)	
	Raw	Controls	Raw	Controls	Raw	Controls
1. ACE Index	-.106***	-.073**	.055***	.051***	.039***	.034***
(0-6)	(.031)	(.032)	(.009)	(.010)	(.007)	(.008)
2. ACE > 1	-.275***	-.192**	.121***	.106***	.046**	.032
(0,1)	(.090)	(.088)	(.027)	(.028)	(.021)	(.021)
By ACE items						
3. In care	-.213*	-.140	.109***	.098***	.042	.031
(0,1)	(.114)	(.110)	(.035)	(.035)	(.027)	(.027)
4. Neglect	-.228**	-.225**	.140***	.132***	.060***	.053***
(0,1)	(.093)	(.092)	(.025)	(.026)	(.020)	(.020)
5. Separation	-.094*	-.068	.048***	.045***	.037***	.027**
(0,1)	(.050)	(.051)	(.015)	(.016)	(.012)	(.013)
6. Mental illness	-.107	-.033	.064**	.051*	.080***	.080***
(0,1)	(.100)	(.097)	(.030)	(.030)	(.023)	(.023)
7. Alcohol abuse	-.247	-.087	.053	.045	.046	.029
(0,1)	(.244)	(.239)	(.078)	(.079)	(.061)	(.062)
8. Offender	-.247*	-.067	.106**	.082*	.134***	.119***
(0,1)	(.143)	(.140)	(.042)	(.043)	(.033)	(.034)
Robustness						
9. ACE index (0-5)	-.145***	-.092**	.074***	.066***	.050***	.047***
(excl. separation)	(.045)	(.045)	(.013)	(.014)	(.010)	(.011)
10. ACE > 1	-.301**	-.181	.167***	.144***	.063**	.052
(excl. separation)	(.145)	(.142)	(.041)	(.041)	(.032)	(.032)
Mean Outcome	7.124		0.165		.091	
Observations	2,793		5,084		5,042	

Note: Dependent variables are: Columns (1) and (2) log of net monthly salary for individuals with positive earnings and less or equal to 20,000 pound per month (dropped: 209 observations). Columns (3) and (4) = 1 if individual received any government transfers including other forms of income, benefits or tax credits (n9incc1, nd9wrben), and 0 otherwise. Columns (5) and (6): =1 if currently finding it quite or very difficult to manage financially, and 0 otherwise (n9finnow: comfortably, living alright, or just getting by). Columns (2), (4), and (6) include a full set of early childhood control variables: Female, low birth weight, premature birth, Mother's age at birth, Number of siblings, Father's social class, Father's age when left fulltime education, Mother's age when left fulltime education, geographic location when cohort member was born. Full estimation results are reported in Tables A1-A5 in the Appendix. Standard errors are reported in parentheses. Significance levels: *** 0.01 ** 0.05 * 0.10.

Similarly, ACE is also positively associated with both welfare dependency and subjective poverty. A one-unit increase in ACE is associated with a 5.1 percentage point increase in the likelihood of being welfare dependent over and above the influence of pre-treatment control

variables. Relative to the base probability of 16.5 percent, this implies an increase in this probability by over 30 percent. Again, this probability increase is substantially larger for cohort members with high-dose ACE (10.6 percentage points, or 64 percent from base probability). Once excluding separation from the ACE index, the respective probability increases in welfare dependency are 6.6 and 14.4 percentage points, respectively. Consistent with our findings for earnings, the experience of neglect, is the key contributor to the significant relationship between ACE and welfare dependency, dwarfing the impact of any other ACE component (13.2 percentage points, significant at the 1 percent level).

Although we find a statistically significant relationship between ACE and subjective poverty, the association is weaker and less robust than for the more objective earnings and welfare dependency measures. A one-unit increase in ACE is associated with a 3.4 percentage point increase in the probability of subjective poverty, which implies a 37 percent increase from the base probability. High-dose ACE are not significantly associated with subjective poverty. The key contributing factors to the relationship between ACE and subjective poverty are in order of relevance (each significant at the 1 percent level): Offense family member (12 percentage points, significant at 1 percent level), family member with mental illness (eight percentage points), and neglect (five percentage points).

Channels through which ACE may affect lifetime economic outcomes

So far, we have shown that ACE is strongly associated with earnings and increased welfare dependency and subjective material poverty. We have furthermore demonstrated that neglect experiences – as assessed by the cohort member's teacher – is the key contributing factor to the significant association between ACE and earnings/welfare dependency. In contrast, the key factor driving the relationship between ACE and subjective poverty are whether the cohort member grew up in a family where a family member had contact with criminal justice or mental health services (although neglect is the third strongest contributor).

In what follows, we identify the channels through which early-life adverse experiences impact upon later-life economic outcomes. To do so, we decompose the raw outcome differences observed between cohort members with and without ACE into differences due to observable characteristics measured in mid-life – including human and health capital, and family formation decisions – and differences in unobservable characteristics (see Eq. (6)). To be able to distinguish between a `treatment' and `control' group, we use the binary measure of high-dose ACE. Treatment is defined as two or more ACE, and is compared against zero or one ACE.[7]

Because of missing observations, we can conduct this analysis only with a smaller estimation sample for each age 55 outcome measure. The respective samples are for earnings: N=2,083, welfare dependence: N=3,436, and subjective poverty: N=3,289. In this smaller sample, the raw differences between treatment and control group are larger. For instance, the raw difference in net earnings is 23.7 percent, in welfare dependence 6.4 percentage, and in subjective poverty experience is 9.2 percent.

We decompose these observed raw differences into the relative contribution of the following observable characteristics as observed in young adulthood (age 33), if available: (i) Cognitive skills proxied by math and verbal test scores (Age 16); (ii) Non-cognitive skills proxied by locus of control (Age 33); (iii) Mental health problems proxied by the Malaise Inventory (Age 33); (iv) Physical health problems (Age 33); (v) Highest level of completed education (Age 33); (vi) Whether married (Age 33); (vii) Number of children (Age 33); and (viii) Employment status (Age 33). All remaining differences are considered to be due to unobserved characteristics.

Figure 4 summarises the decomposition analysis (full estimation results are presented in the Appendix) for those components that contribute significantly (p-value < 0.10). First to note is that young-adulthood observable characteristics explain almost all of the observed earnings differences between cohort members with and without high-dose ACE. Only 10 percent of the earnings gap is due to unobserved characteristics.

The largest contributor to observed earnings differences are educational outcomes by age 33, which explain almost 40 percent of the earnings gap. The second and third largest contributors are cognitive skills measured at age 16 (20 percent) and labor force attachment at age 33 (15 percent). Non-cognitive skills, mental health, and physical health combined contribute another 20 percent to the raw earnings difference.

In stark contrast, the observed differences in both welfare dependence and subjective poverty by ACE cannot be explained as much by differences in observable differences by age 33. Differences in unobservable factors explain approximately 60 percent of the welfare dependence gap and 81 percent of the subjective poverty gap. Differences in mental and physical health at age 33 combined explain the largest proportion of the overall difference in welfare dependence (almost 20 percent), followed by differences in cognitive skills (five percent), and differences in educational attainment (three percent). The largest contribution to differences in subjective poverty come from differences in educational attainment.

One reason for why the relationship between ACE and welfare dependency and subjective poverty are less well explained by observable characteristics in young adulthood is that there may be measurement error or misclassification in these measures. This is particularly true for subjective

poverty experiences, a measure solely based on individual's perceptions and rankings of their financial wellbeing, which we collapsed into a binary indicator of subjective poverty. Cohort members may have different thresholds as to what they consider as problematic or different reference points.[8]

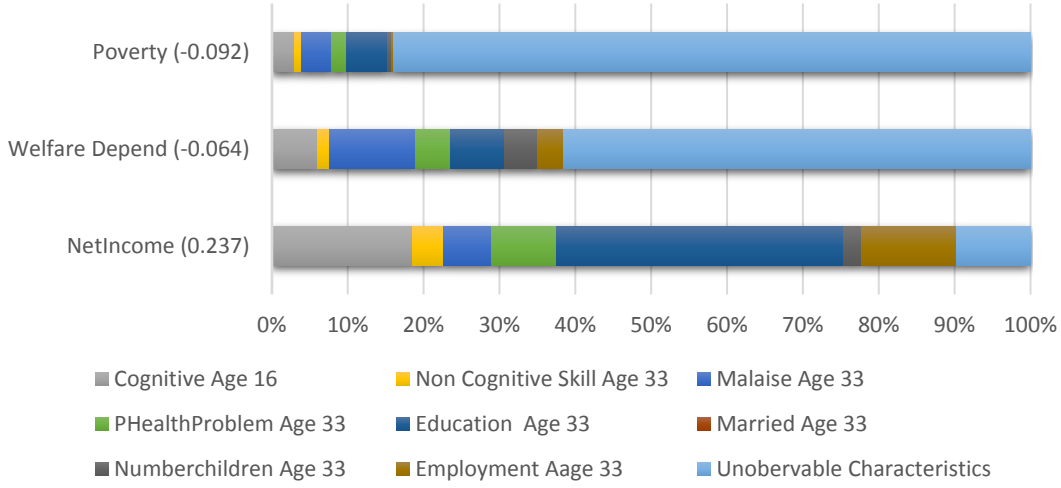


Figure 4. Decomposition of the relationship between ACE (0, 1) and age 55 economic outcomes into differences in observable and unobservable characteristics.

Note: Net Income represents the log of net monthly earnings at age 55, welfare dependence is a dummy variable =1 if individual is welfare dependent and 0 otherwise. Poverty is a dummy variable =1 if individual is self-assessed classified as being in poverty and 0 otherwise. ACE=1 is for cohort members who experience 2+ ACE, ACE=0 is for cohort members who experience 1 or less ACE. Small negative and statistically insignificant values are set to zero. Full estimation results are presented in Table A6 in the Appendix.

Given the important role of neglect – as assessed by the teacher between ages 7 and 11 – in the link between ACE and earnings and welfare dependence, we repeat the decomposition analysis using neglect as `treatment' indicator (see Figure 5). In this smaller estimation sample, the raw earnings differences between those who were flagged by their teacher as neglected and those who were not is around 20 percent. Almost 100% of the earnings penalty is explained by differences in health and human capital attainment by age 33. Differences in cognitive skills at age 16 explain more than 30 percent of the earnings penalty; and more than 45 percent are due to differences in educational attainment by age 33. This suggests that teacher's observations about a student's potential for neglect are not only a strong – if not the strongest – predictor of later-life earnings, but the mechanisms are clearly laid out; neglect is linked with earnings almost entirely through differential health and human capital trajectories. Again, differences in welfare dependence and subjective poverty are poorly explained by differences in observable characteristics.

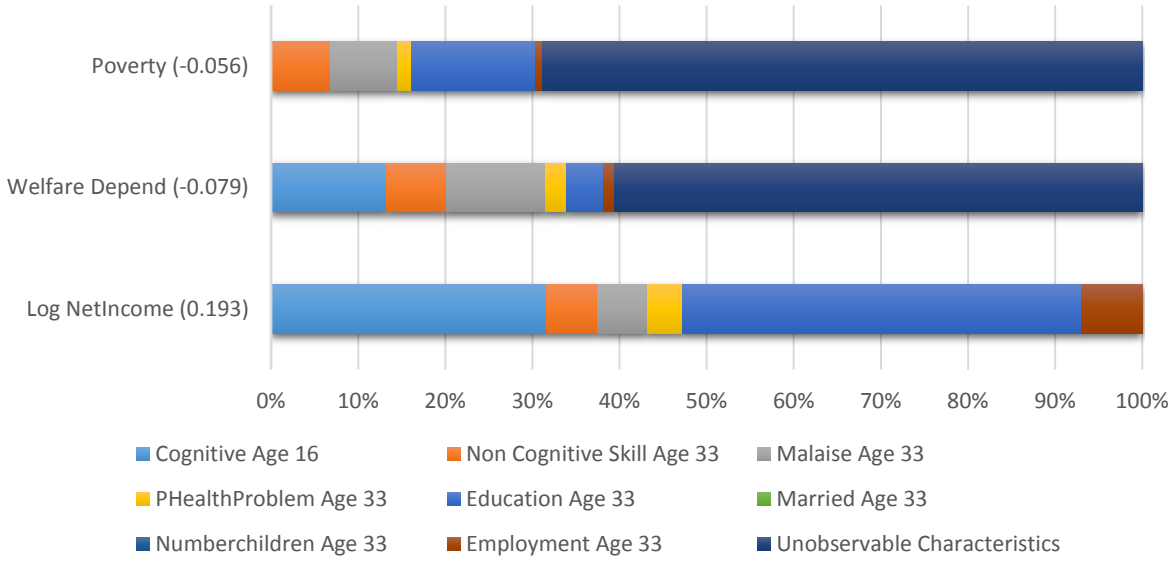


Figure 5. Decomposition of the relationship between Child Neglect (0, 1) and age 55 economic outcomes into differences in observable and unobservable characteristics.

Note: Net Income represents the log of net monthly earnings at age 55, welfare dependence is a dummy variable =1 if individual is welfare dependent and 0 otherwise. Poverty is a dummy variable =1 if individual is self-assessed classified as being in poverty and 0 otherwise. Neglect is determined by teachers at ages 7-11 if the child appeared malnourished or dirty. Small negative and statistically insignificant values are set to zero. Full estimation results are presented in Table A7 in the Appendix.

V. DISCUSSION AND CONCLUSION

This study quantified the degree to which early-life adverse childhood experiences are associated with later-life economic outcomes; it identified the core components of adversity that are linked with economic outcomes; and it showed the likely mechanisms through which this link was established. The motivation of this study is the assumption that what matters for children's life trajectories is not only socioeconomic disadvantage or poverty, but the negative life events of chronic adversities that children in economically disadvantaged families disproportionally experience. Such an assumption has important implications, because it allows for the possibility that some children in disadvantaged families are not at risk of later-life disadvantage, and – crucially – that some children in economically privileged families are very much at risk of later-life disadvantage.

Using high-quality British cohort data, we show that children in economically disadvantaged families are on average two times more likely to experience at least one ACE, relative to children from privileged families. Yet, there is a non-negligible proportion of children in those better off families who experience ACE. Therefore, our findings could contribute to a new way of

thinking and defining childhood poverty. Currently, childhood poverty is predominantly defined as living below a specific threshold of household income, after adjusting for family size and composition (Roosa et al. 2005; Whiteford and Adema 2007, Adamson 2012).

The aforementioned findings may also contribute to public policy discussions about the effectiveness of Child Protection Services and the role of primary school teachers in raising concerns over child neglect. In our analysis, teacher-assessed neglect yields the strongest association with age 55 earnings and welfare dependence among all components of our ACE index. Although this cannot be interpreted as causal, it implies that what the teacher observes serves as a powerful predictor of life-time outcomes that are of relevance to policy makers. Children flagged as `neglected' earn almost 23 percent less than comparable children without such a label 45 years later, and they are 80 percent more likely to be welfare dependent. This association is statistically significant, and exist over and above of the influence of potential confounders. Large public expenditure savings could be expected if such children were targeted and nurtured earlier through the help of the school system. This conclusion is consistent with our finding that the mechanisms through which ACE is linked with later-life economic outcomes are health and human capital attainment by age 33.

The key limitation of our study is that we cannot interpret our findings as causal even though we have controlled for a large number of early-childhood factors including health at birth, parental socioeconomic status and other important household characteristics. We cannot say for sure that if those cohort members had not experienced ACE they would earn similar salaries or face similar welfare dependencies as those cohort members that did not experience ACE. There may have been other unobservable factors that occurred in the life of the child between age 7 and 16 that correlated with one of the ACE components but that affected health and human capital accumulation, and thus shaped later-life economic outcomes. One of these factors could be parental cognitive ability, or parental financial income, which we measured only with approximations (parental education, father's occupational status). One way to overcome such problem is to use siblings- or twin-fixed-effects methodologies that allow to more carefully control for fixed family factors. Such methods have been used in Fletcher and Schurer (2017), Currie and Tekin (2012), and Slade and Wissow (2007) to identify the causal impact of maltreatment experiences on young adulthood personality and crime, respectively. Unfortunately, the NCDS does not provide siblings information.

Another important limitation of our study is that, although we initially have information on 18,558 cohort members at sweep 0 (age 0-1), our final estimation sample is troubled by a high degree of sample attrition due to systematic drop out. In a descriptive analysis of comparing ACE

and pre-retreatment covariate means between stayers and drop outs demonstrates that we lose those cohort members with a higher likelihood of ACE and of poorer socioeconomic background in childhood. If these are also the cohort members who are likely to respond most sensitively to the experience of ACE in terms of health and human capital accumulation, and labour market outcomes, then we are likely to underestimate the impact of ACE on later-life economic outcomes. Since this is a reasonable assumption, we understand our estimation results as a lower bound.

This is one of the first studies to quantify the earnings penalty of adverse childhood experiences (ACE), and the role of ACE in later-life welfare dependency and (subjective) poverty. Such experiences – which include out-of-home care, neglect, separation from parents, and a series of other negative experiences – occur disproportionately in economically disadvantaged families, but economic privilege does not make children immune to such experiences. We are the first to estimate a later-life earnings penalty of 20 percent for children with high-dose ACE, an association that increases to 23 percent for children who were neglected (undernourished, dirty). Similarly large associations were found for welfare dependence. We demonstrate that the earnings penalty of high-dose ACEs and neglect is almost exclusively explained by differences in human and health capital attainment by age 33.

Our findings support recent evaluations of the likely burden of child maltreatment – which includes more than just out-of-home care and neglect – to society. These suggested that non-fatal child maltreatment has an estimated average life-time cost per victim of $210,012 within the US economy (Fang et al 2012). The estimated average lifetime cost of non-fatal child maltreatment by a primary care-giver in the UK is estimated to be £89,390. The largest contributors to this cost are social care costs, short-term health-related costs, and the costs resulting from a lower probability of employment (Conti et al., 2017). In Australia, child maltreatment places an economic burden on society of approximately $10.7 billion (Taylor et al 2008).

Future research is needed to better understand the factors causing child maltreatment and how child protection services can better target the victims of child maltreatment. In the UK, 58,239 children as of 2016 are listed under a child protection plan (National Society for the Prevention of Cruelty to Children 2017). In Australia, over 162,175 children received some form of child protection services in 2016. Amongst these children, 73 percent were more likely to be repeat offenders, with neglect being one of the common factors for receiving child protection services (Australian Institution of Health and Welfare, 2017). Thus, our findings are useful to motivate further research into what factors predominantly lead to these early life adversities and what processes can be put in place to identify and minimise the frequency of negative experiences that lie outside the control of children.

APPENDIX:

Table A1. Full estimation results for outcome net income (log), adding subsequently blocks of control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ACE Index (0-6)	-0.106***	-0.100***	-0.105***	-0.087***	-0.107***	-0.083**	-0.094***	-0.107***	-0.073**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Female		-0.404***							-0.406***
		(0.03)							(0.03)
Low birth weight			-0.008						-0.013
			(0.07)						(0.07)
Born <36 weeks			-0.097						-0.048
			(0.13)						(0.12)
2 siblings (base: 1 sibling)				0.072					0.032
				(0.07)					(0.06)
3 siblings				-0.002					-0.048
				(0.07)					(0.07)
4 (+) siblings				-0.089					-0.010
				(0.07)					(0.07)
Teenage Mom (age < 20)					-0.012				0.062
					(0.08)				(0.08)
Mom age 20-34					0				0
					(.)				(.)
Mature mother (age>34)					0.030				0.071
					(0.05)				(0.05)
No father (Base: skill-man.)						0.048			0.098
						(0.14)			(0.14)
Manager						0.393***			0.166**
						(0.07)			(0.08)
Professional						0.257***			0.145***
						(0.05)			(0.05)
Skilled non-manual						0.196***			0.132**
						(0.06)			(0.05)
Unskilled non-manual						0.211			0.157
						(0.13)			(0.13)
Unskilled non-manual						-0.048			-0.033
						(0.05)			(0.05)

Not Determined						-0.036			-0.009
						(0.08)			(0.08)
Age Father Left Education							0.052***		0.037***
							(0.01)		(0.01)
Age Mother Left Education							0.032**		0.028**
							(0.01)		(0.01)
Age 0 Region Child Lives=1								-0.071	-0.027
								(0.07)	(0.07)
Age 0 Region Child Lives=2								0.022	0.053
								(0.06)	(0.06)
Age 0 Region Child Lives=3								0.027	0.037
								(0.07)	(0.07)
Age 0 Region Child Lives=4								-0.049	-0.044
								(0.07)	(0.07)
Age 0 Region Child Lives=5								-0.130*	-0.098
								(0.07)	(0.07)
Age 0 Region Child Lives=6								0.009	0.004
								(0.07)	(0.07)
Age 0 Region Child Lives=8								0.025	0.040
								(0.08)	(0.08)
Age 0 Region Child Lives=9								-0.045	-0.013
								(0.08)	(0.08)
Age 0 Region Child Lives=10								-0.086	-0.059
								(0.08)	(0.08)
Age 0 Region Child Lives=11								-0.047	0.006
								(0.06)	(0.06)
Sigma Constant	7.151***	7.370***	7.153***	7.143***	7.147***	7.063***	5.877***	7.178***	6.362***
	(0.02)	(0.03)	(0.02)	(0.06)	(0.02)	(0.03)	(0.16)	(0.04)	(0.19)
Constant	0.899***	0.876***	0.898***	0.896***	0.898***	0.888***	0.887***	0.897***	0.858***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observation	2793	2793	2793	2793	2793	2793	2793	2793	2793

Note: Dependent variable is net earnings for column 1 to 9. Column (1) computes ACE on log net earnings without any controls. Columns (2) to (9) includes regressions of ACE on net earnings by adding sets of control variables. Column (2) includes controls for gender. Column (3) includes controls for health of the child at birth. Column (4) includes controls for number of siblings in the family. Column (5) controls for characteristics of the mother. Column (6) includes controls for the father (if applicable) and the father's job classification. Column (7) controls for age parents left full time education. Column (8) controls for geographic location when cohort member was born. Column (9) regresses ACE on net earnings controlling all the factors in Columns (2) to (8). Standard errors are reported in parentheses. Significance levels: *** 0.01 ** 0.05 * 0.10.

Table A2: Relationship between ACE(0,6) and economic outcomes at age 55

	(1) Any earnings	(2) Net Income (>0)	(3) Welfare	(4) Poverty
ACE Index (0-6)	-0.083***	-0.192**	0.106***	0.031
	(0.02)	(0.09)	(0.03)	(0.02)
Female	0.057***	-0.406***	-0.018*	0.003
	(0.01)	(0.03)	(0.01)	(0.01)
Low birth weight	-0.014	-0.011	0.007	-0.017
	(0.02)	(0.07)	(0.02)	(0.02)
Born < 36 weeks	-0.047	-0.060	0.003	0.051*
	(0.03)	(0.12)	(0.04)	(0.03)
1 sibling	0	0	0	0
	(.)	(.)	(.)	(.)
2 siblings	0.021	0.034	-0.020	-0.003
	(0.02)	(0.06)	(0.02)	(0.02)
3 siblings	0.009	-0.048	-0.007	0.008
	(0.02)	(0.07)	(0.02)	(0.02)
4 (+) siblings	-0.011	-0.098	0.004	0.004
	(0.02)	(0.07)	(0.02)	(0.02)
Teenage Mom (age < 20)	-0.009	0.055	-0.013	0.066***
	(0.02)	(0.08)	(0.03)	(0.02)
Mom age 20-34	0	0	0	0
	(.)	(.)	(.)	(.)
Mature mother (age>34)	0.019	0.068	-0.006	0.014
	(0.02)	(0.05)	(0.02)	(0.01)
No father	-0.039	0.061	0.031	0.076**
	(0.04)	(0.13)	(0.04)	(0.03)
Manager/Legislator	0.031	0.167**	0.005	0.03
	(0.03)	(0.08)	(0.03)	(0.02)
Professional	0.011	0.145***	-0.003	0.013
	(0.02)	(0.05)	(0.02)	(0.01)
Skilled non-manual	0.019	0.132**	-0.022	0.005
	(0.02)	(0.06)	(0.02)	(0.01)
Skilled manual	0	0	0	0
	(.)	(.)	(.)	(.)
Unskilled non-manual	-0.025	0.147	0.04	0.064**
	(0.04)	(0.13)	(0.04)	(0.03)
Unskilled non-manual	-0.029*	-0.033	0.022	0.030**
	(0.02)	(0.05)	(0.02)	(0.01)
Undetermined	-0.055**	-0.014	0.034	0.023
	(0.02)	(0.08)	(0.03)	(0.02)
Age Father Left Education	0.010***	0.037***	0.001	-0.005**
	(0.00)	(0.01)	(0.00)	(0.00)
Age Mother Left Education	-0.006	0.028**	-0.001	0.003
	(0.00)	(0.01)	(0.00)	(0.00)
Age 0 Region Child Lives=1	0.017	-0.027	0.007	-0.002
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=2	0.015	0.051	-0.018	0.008
	(0.02)	(0.06)	(0.02)	(0.01)
Age 0 Region Child Lives=3	0.010	0.039	-0.019	-0.013
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=4	0.017	-0.046	-0.021	-0.002
	(0.02)	(0.07)	(0.02)	(0.02)

Age 0 Region Child Lives=5	0.001	-0.010	-0.008	-0.025
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=6	0.028	0.003	-0.005	-0.015
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=7	0	0	0	0
	(.)	(.)	(.)	(.)
Age 0 Region Child Lives=8	0.028	0.037	-0.037	-0.025
	(0.03)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=9	0.034	-0.011	-0.056**	-0.007
	(0.02)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=10	0.014	-0.058	0.012	-0.037*
	(0.03)	(0.08)	(0.03)	(0.02)
Age 0 Region Child Lives=11	0.013	0.010	-0.046**	0.002
	(0.02)	(0.06)	(0.02)	(0.02)
Constant	0.236***	6.350***	0.190***	0.108**
	(0.06)	(0.19)	(0.06)	(0.05)
Observations	8478	2793	5084	5047

Note: Dependent variables are: Column (1) log of net monthly salary for individuals with null or positive earnings and less or equal to 20,000 pound per month. Column (2) log of net monthly salary for individuals with positive earnings and less or equal to 20,000 pound per month. Columns (3) measures welfare dependency = 1 if individual received any government transfers including other forms of income, benefits or tax credits (n9incc1, nd9wrben), and 0 otherwise. Columns (4): Poverty =1 if currently finding it quite or very difficult to manage financially, and 0 otherwise (n9finnow), and =0 otherwise (comfortably, living alright, or just getting by). Standard errors are reported in parentheses. Significance levels: ***0.01 **0.05 *0.1.

Table A3: Relationship between ACE (excl. separation) and and economic outcomes at age 55

	(1) Any earnings	(2) Net Income (>0)	(3) Welfare	(4) Poverty
ACE Index (excl. separation)	-0.066***	-0.092**	0.066***	0.046***
	(0.01)	(0.05)	(0.01)	(0.01)
Female	0.057***	-0.407***	-0.017	0.003
	(0.01)	(0.03)	(0.01)	(0.01)
Low birth weight	-0.013	-0.014	0.009	-0.018
	(0.02)	(0.07)	(0.02)	(0.02)
Born < 36 weeks	-0.045	-0.053	0.001	0.049*
	(0.03)	(0.12)	(0.04)	(0.03)
1 sibling	0	0	0	0
	(.)	(.)	(.)	(.)
2 siblings	0.022	0.034	-0.021	-0.004
	(0.02)	(0.06)	(0.02)	(0.02)
3 siblings	0.011	-0.047	-0.009	0.007
	(0.02)	(0.07)	(0.02)	(0.02)
4 (+) siblings	-0.001	-0.094	-0.002	-0.003
	(0.02)	(0.07)	(0.02)	(0.02)
Teenage Mom (age < 20)	-0.008	0.056	-0.014	0.063***
	(0.02)	(0.08)	(0.03)	(0.02)
Mom age 20-34	0	0	0	0
	(.)	(.)	(.)	(.)
Mature mother (age>34)	0.019	0.068	-0.006	0.014
	(0.02)	(0.05)	(0.02)	(0.01)
No father	-0.039	0.045	0.039	0.072**
	(0.04)	(0.13)	(0.04)	(0.03)
Manager/Legislator	0.030	0.169**	0.005	0.028
	(0.03)	(0.08)	(0.03)	(0.02)
Professional	0.010	0.145***	-0.002	0.015
	(0.02)	(0.05)	(0.02)	(0.01)
Skilled non-manual	0.018	0.135**	-0.022	0.006
	(0.02)	(0.06)	(0.02)	(0.01)
Skilled manual	0	0	0	0
	(.)	(.)	(.)	(.)
Unskilled non-manual	-0.022	0.156	0.037	0.062*
	(0.04)	(0.13)	(0.04)	(0.03)
Unskilled non-manual	-0.027*	-0.031	0.021	0.029**
	(0.02)	(0.05)	(0.02)	(0.01)
Undetermined	-0.047**	-0.005	0.025	0.013
	(0.02)	(0.08)	(0.03)	(0.02)
Age Father Left Education	0.010***	0.036***	0.001	-0.005**
	(0.00)	(0.01)	(0.00)	(0.00)
Age Mother Left Education	-0.005	0.028**	-0.001	0.004
	(0.00)	(0.01)	(0.00)	(0.00)
Age 0 Region Child Lives=1	0.018	-0.027	0.006	-0.002
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=2	0.014	0.049	-0.016	0.009
	(0.02)	(0.06)	(0.02)	(0.01)
Age 0 Region Child Lives=3	0.010	0.036	-0.018	-0.013
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=4	0.016	-0.047	-0.020	-0.001
	(0.02)	(0.07)	(0.02)	(0.02)

Age 0 Region Child Lives=5	0.002	-0.099	-0.008	-0.025
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=6	0.028	0.003	-0.006	-0.015
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=7	0	0	0	0
	(.)	(.)	(.)	(.)
Age 0 Region Child Lives=8	0.029	0.036	-0.037	-0.026
	(0.03)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=9	0.034	-0.011	-0.055**	-0.006
	(0.02)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=10	0.012	-0.061	0.014	-0.036*
	(0.03)	(0.08)	(0.03)	(0.02)
Age 0 Region Child Lives=11	0.012	0.005	-0.044**	0.004
	(0.02)	(0.06)	(0.02)	(0.02)
Constant	0.246***	6.360***	0.185***	0.105**
	(0.06)	(0.19)	(0.06)	(0.05)
Observations	8478	2793	5084	5047

Note: This table presents estimation results of an OLS regression of ACE (excluding separation) on age 55 outcomes. Dependent variables are: Column (1) log of net monthly salary for individuals with null or positive earnings and less or equal to 20,000 pound per month. Column (2) log of net monthly salary for individuals with positive earnings and less or equal to 20,000 pound per month. Columns (3) measures welfare dependency = 1 if individual received any government transfers including other forms of income, benefits or tax credits (n9incc1, nd9wrben), and 0 otherwise. Columns (4): Poverty =1 if currently finding it quite or very difficult to manage financially, and 0 otherwise (n9finnow), and =0 otherwise (comfortably, living alright, or just getting by). Standard errors are reported in parentheses. Significance levels: ***0.01 **0.05 *0.1.

Table A4. Full estimation results of ACE without separation (0,1) and economic outcomes at age 55

	(1) Any earnings	(2) Net Income (>0)	(3) Welfare	(4) Poverty
ACE Dummy (excl. separation)	-0.135***	-0.181	0.144***	0.051
	(0.03)	(0.14)	(0.04)	(0.03)
Female	0.057***	-0.407***	-0.017*	0.003
	(0.01)	(0.03)	(0.01)	(0.01)
Low birth weight	-0.015	-0.012	0.009	-0.017
	(0.02)	(0.07)	(0.02)	(0.02)
Born < 36 weeks	-0.047	-0.057	0.004	0.051*
	(0.03)	(0.12)	(0.04)	(0.03)
1 sibling	0	0	0	0
	(.)	(.)	(.)	(.)
2 siblings	0.021	0.033	-0.020	-0.003
	(0.02)	(0.06)	(0.02)	(0.02)
3 siblings	0.009	-0.049	-0.007	0.008
	(0.02)	(0.07)	(0.02)	(0.02)
4 (+) siblings	-0.009	-0.103	0.004	0.003
	(0.02)	(0.07)	(0.02)	(0.02)
Teenage Mom (age < 20)	-0.014	0.051	-0.008	0.067***
	(0.02)	(0.08)	(0.03)	(0.02)
Mom age 20-34	0	0	0	0
	(.)	(.)	(.)	(.)
Mature mother (age>34)	0.019	0.067	-0.006	0.014
	(0.02)	(0.05)	(0.02)	(0.01)
No father	-0.047	0.035	0.046	0.0796**
	(0.04)	(0.13)	(0.04)	(0.03)
Manager/Legislator	0.032	0.172**	0.004	0.0264
	(0.03)	(0.08)	(0.03)	(0.02)
Professional	0.012	0.147***	-0.004	0.013
	(0.02)	(0.05)	(0.02)	(0.01)
Skilled non-manual	0.019	0.134**	-0.022	0.005
	(0.02)	(0.06)	(0.02)	(0.01)
Skilled manual	0	0	0	0
	(.)	(.)	(.)	(.)
Unskilled non-manual	-0.023	0.152	0.039	0.063*
	(0.04)	(0.13)	(0.04)	(0.03)
Unskilled non-manual	-0.029*	-0.035	0.023	0.030**
	(0.02)	(0.05)	(0.02)	(0.01)
Undetermined	-0.053**	-0.016	0.034	0.022
	(0.02)	(0.08)	(0.03)	(0.02)
Age Father Left Education	0.009***	0.036***	0.001	-0.005**
	(0.00)	(0.01)	(0.00)	(0.00)
Age Mother Left Education	-0.005	0.028**	-0.001	0.003
	(0.00)	(0.01)	(0.00)	(0.00)
Age 0 Region Child Lives=1	0.019	-0.025	0.006	-0.002
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=2	0.016	0.053	-0.018	0.008
	(0.02)	(0.06)	(0.02)	(0.01)
Age 0 Region Child Lives=3	0.010	0.037	-0.018	-0.013
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=4	0.018	-0.043	-0.022	-0.002
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=5	0.002	-0.098	-0.009	-0.03
	(0.02)	(0.07)	(0.02)	(0.02)

Age 0 Region Child Lives=6	0.03	0.004	-0.006	-0.015
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=7	0	0	0	0
	(.)	(.)	(.)	(.)
Age 0 Region Child Lives=8	0.029	0.035	-0.037	-0.026
	(0.03)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=9	0.035	-0.010	-0.057**	-0.007
	(0.02)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=10	0.013	-0.061	0.013	-0.037*
	(0.03)	(0.08)	(0.03)	(0.02)
Age 0 Region Child Lives=11	0.013	0.008	-0.046**	0.002
	(0.02)	(0.06)	(0.02)	(0.02)
Constant	0.237***	6.354***	0.190***	0.108**
	(0.06)	(0.19)	(0.06)	(0.05)
Observations	8478	2793	5084	5047

Note: Dependent variables are: Column (1) log of net monthly salary for individuals with null or positive earnings and less or equal to 20,000 pound per month. Column (2) log of net monthly salary for individuals with positive earnings and less or equal to 20,000 pound per month. Columns (3) measures welfare dependency = 1 if individual received any government transfers including other forms of income, benefits or tax credits (n9incc1, nd9wrben), and 0 otherwise. Columns (4): Poverty =1 if currently finding it quite or very difficult to manage financially, and 0 otherwise (n9finnow), and =0 otherwise (comfortably, living alright, or just getting by). Standard errors are reported in parentheses. Significance levels: *** 0.01 ** 0.05 * 0.1.

Table A5: Relationship between child neglect (0,1) and economic outcomes at age 55

	(1) Any earnings	(2) Net Income (>0)	(3) Welfare	(4) Poverty
Child neglected Age 7-11	-0.116***	-0.225**	0.132***	0.052**
	(0.02)	(0.09)	(0.03)	(0.02)
Female	0.055***	-0.405***	-0.011	0.006
	(0.01)	(0.04)	(0.01)	(0.01)
Low birth weight	-0.022	-0.022	-0.001	-0.024
	(0.02)	(0.07)	(0.02)	(0.02)
Born < 36 weeks	-0.043	-0.103	0.014	0.061**
	(0.04)	(0.13)	(0.04)	(0.03)
1 sibling	0	0	0	0
	(.)	(.)	(.)	(.)
2 siblings	0.027	0.050	-0.014	0.002
	(0.02)	(0.07)	(0.02)	(0.02)
3 siblings	0.016	-0.022	-0.006	0.019
	(0.02)	(0.07)	(0.02)	(0.02)
4 (+) siblings	0.012	-0.045	-0.005	0.003
	(0.02)	(0.07)	(0.02)	(0.02)
Teenage Mom (age < 20)	-0.006	0.066	-0.031	0.080***
	(0.03)	(0.09)	(0.03)	(0.02)
Mom age 20-34	0	0	0	0
	(.)	(.)	(.)	(.)
Mature mother (age>34)	0.020	0.090*	-0.004	0.016
	(0.02)	(0.05)	(0.02)	(0.01)
No father	-0.074*	0.034	0.064	0.078**
	(0.04)	(0.15)	(0.04)	(0.04)
Manager/Legislator	0.044	0.175**	0.0002	0.023
	(0.03)	(0.08)	(0.03)	(0.02)
Professional	0.014	0.143***	-0.004	0.020
	(0.02)	(0.05)	(0.02)	(0.01)
Skilled non-manual	0.016	0.154***	-0.014	0.011
	(0.02)	(0.06)	(0.02)	(0.01)
Skilled manual	0	0	0	0
	(.)	(.)	(.)	(.)
Unskilled non-manual	-0.006	0.110	0.023	0.053
	(0.04)	(0.14)	(0.04)	(0.03)
Unskilled non-manual	-0.024	-0.037	0.012	0.024*
	(0.02)	(0.05)	(0.02)	(0.01)
Undetermined	-0.046*	-0.017	0.038	0.024
	(0.02)	(0.08)	(0.03)	(0.02)
Age Father Left Education	0.012***	0.035***	0.0018	-0.006**
	(0.00)	(0.01)	(0.00)	(0.00)
Age Mother Left Education	-0.005	0.030**	0.002	0.005*
	(0.00)	(0.01)	(0.00)	(0.00)
Age 0 Region Child Lives=1	0.028	-0.030	0.014	0.001
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=2	0.013	0.063	-0.007	0.007
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=3	0.019	0.048	-0.018	-0.015
	(0.02)	(0.07)	(0.02)	(0.02)
Age 0 Region Child Lives=4	0.017	-0.063	-0.008	-0.010
	(0.02)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=5	0.007	-0.092	0.001	-0.025
	(0.02)	(0.07)	(0.02)	(0.02)

Age 0 Region Child Lives=6	0.039	0.010	-0.003	-0.013
	(0.02)	(0.08)	(0.02)	(0.02)
Age 0 Region Child Lives=7	0	0	0	0
	(.)	(.)	(.)	(.)
Age 0 Region Child Lives=8	0.030	0.015	-0.024	-0.033
	(0.03)	(0.08)	(0.03)	(0.02)
Age 0 Region Child Lives=9	0.029	0.007	-0.035	-0.015
	(0.03)	(0.08)	(0.03)	(0.02)
Age 0 Region Child Lives=10	0.009	-0.066	0.034	-0.043**
	(0.03)	(0.09)	(0.03)	(0.02)
Age 0 Region Child Lives=11	0.015	0.003	-0.039*	-0.001
	(0.02)	(0.07)	(0.02)	(0.02)
Constant	0.198***	6.322***	0.113*	0.083*
	(0.07)	(0.20)	(0.06)	(0.05)
Observations	7518	2489	4506	4470

Note: Dependent variables are: Column (1) log of net monthly salary for individuals with null or positive earnings and less or equal to 20,000 pound per month. Column (2) log of net monthly salary for individuals with positive earnings and less or equal to 20,000 pound per month. Columns (3) measures welfare dependency = 1 if individual received any government transfers including other forms of income, benefits or tax credits (n9incc1, nd9wrben), and 0 otherwise. Columns (4): Poverty =1 if currently finding it quite or very difficult to manage financially, and 0 otherwise (n9finnow), and =0 otherwise (comfortably, living alright, or just getting by). Standard errors reported in parentheses. Significance levels: *** 0.01 ** 0.05 * 0.1.

Table A6: Decomposition Analysis of the impact of ACE (0,1) on Age 55 Outcomes

Mechanism	Statistic	Log Net Earnings	Welfare Dependence	Poverty
Cognitive Skill Age 16	effect	0.046	-0.005	-0.003
	p-value	0.177	0.046**	0.3700
Non-Cognitive Skill Age 33	effect	0.010	-0.012	-0.001
	p-value	0.175	0.372	0.427
Malaise Inventory Age 33	effect	0.016	-0.009**	-0.004
	p-value	0.201	0.036	0.124
Physical Health Problem Age 33	effect	0.021**	-0.004	-0.002
	p-value	0.042	0.131	0.209
Education Outcome Age 33	effect	0.095***	-0.005	-0.005
	p-value	0.002	0.289	0.161
Marriage Status Age 33	effect	-0.0001	0.000	0.000
	p-value	0.960	0.658	0.904
Number Children Age 33	effect	-0.006	0.003	0.001
	p-value	0.311	0.233	0.557
Employment Age 33	effect	0.031**	0.002	-0.000
	p-value	0.047	0.214	0.401
Residual Effect	effect	0.024	-0.045	-0.078**
	p-value	0.802	0.213	0.022

Note: Estimation results for equation (6) with treatment being ACE(0,1). One sided p-values are reported. Significance levels: *** 0.01 ** 0.05 * 0.1.

Table A7: Decomposition analysis of impact of Child Neglect (0,1) on Age 55 Outcomes

Mechanism	Statistic	Log Net Earnings	Welfare Dependence	Poverty
Cognitive Skill Age 16	effect	0.082***	-0.010**	-0.004
	p-value	0.004	0.026	0.607
Non-Cognitive Skill Age 33	effect	0.015	-0.005*	-0.004*
	p-value	0.145	0.077	0.088
Malaise Inventory Age 33	effect	0.015	-0.009*	-0.004
	p-value	0.249	0.063	0.162
Physical Health Problem Age 33	effect	0.011	0.301	-0.001
	p-value	0.181	0.301	0.421
Education Outcome Age 33	effect	0.119***	-0.003	-0.008*
	p-value	0.000	0.565	0.086
Marriage Status Age 33	effect	-0.0002	-0.0001	0.000
	p-value	0.866	0.895	0.907
Number Children Age 33	effect	-0.002	-0.001	0.000
	p-value	0.746	0.725	0.881
Employment Age 33	effect	-0.015	-0.001	0.0004
	p-value	0.245	0.495	0.576
Residual Effect	effect	-0.032	-0.047	-0.037
	p-value	0.764	0.214	0.253

Note: Estimation results for equation (6) with treatment being Child Neglect (0,1). One sided p-values are reported. Significance levels: *** 0.01 ** 0.05 * 0.1.

NOTES

[1] Conti et al. (2017), Hariharan and Schurer (2017), and Kelly-Irving et al. (2013a) use self-reported maltreatment indicators from a special module that was provided as part of the biomarker assessment.

[2] It should be noted that in 2013, around the same time when the cohort members were interviewed at age 55, welfare reforms occurred in the UK. This reform came into effect beginning 1st April 2013 to replace the Disability Allowance Program with the Personal Independence Program (PIP). Similarly, limits were imposed on the total amount of benefits that a 16-64 year old could claim (Department for Work and Pensions 2015). We believe that this policy change will not have a major impact on our welfare dependency findings as the data questionnaire was conducted for Sweep 9 of the NCDS between September 2013 and March 2014. This is during a time period after the welfare eligibility changes have fully come into effect (to ensure no crossover between the old and new system) whereby each cohort member is exposed to the same type of welfare regime.

[3] Controlling for early life health is important as such factors are associated with poor labour market outcomes. For instance, Johnson and Schoeni (2011) show that low birth weight reduces labor force participation probabilities by 5 percentage points and labor market earnings by roughly 15 percent.

[4] Black et al. (2005) highlight that family size and birth order are both negatively correlated with educational outcomes, as well as earnings and employment, particularly for women.

[5] Fixing refers here to manipulating treatment status by keeping everything else constant.

[6] The sample sizes vary for the different outcome measures. There are 5,760 individuals with non-missing information on the ACE Index. Yet, there are only 3,784 individuals with positive monthly net salary, and 5,627 and 5,694 individuals with non-missing information on subjective poverty (self-assessments) and welfare dependence. The final estimation sample with non-missing information is for these three outcomes are 2,793, 5,084, and 5,042 individuals respectively.

[7] We emphasise that we use the terms treatment and control group not to imply random variation in assignment, but to distinguish between two groups that can be compared.

[8] Misclassification due to different reference points is a problem inherent in all measures that are based on Likert scale responses, for instance life satisfaction data or personality assessments (Chang 1994).

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