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Attention and Behavior Problems in Childhood Predict Adult Financial Status, Health, and Criminal Activity: A Conceptual Replication and Extension of Moffitt et al. (2011) Using Cohorts from the U.S. and the U.K.

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Transparency and Openness: We have reported how we determined our sample size and all data exclusions. We report all measures used in the study. Data and documentation for the childhood waves of the SECCYD are available upon request from ICPSR (www.icpsr.umich.edu), but the age 26 data have not yet been made publicly available (a co-author on this paper is PI on the age 26 wave). Data and documentation for the NCDS are available upon request from the UK Data Service (https://www.ukdataservice.ac.uk). Computer code for these analyses can be found at Computer code for these analyses can be found at https://osf.io/6548b/. This study was not pre-registered. Data were analyzed using Stata version 16 (StataCorp, 2019).

Abstract

This study is a conceptual replication of a widely-cited study by Moffit and colleagues (2011) which found that attention and behavior problems in childhood (a composite of impulsive hyperactive, inattentive, and impulsive-aggressive behaviors labeled "self-control") predicted adult financial status, health, and criminal activity. Using data from longitudinal cohort studies in the U.S. (n = 1,168) and the U.K. (n = 16,506), we largely reproduced their pattern of findings that attention and behavior problems measured across the course of childhood predicted a range of adult outcomes including educational attainment ($\beta_{U.S.}$ = -.22, $\beta_{U.K.}$ = -.13) and spending time in jail ($OR_{U.S.}$ = 1.74, $OR_{U.K.}$ = 1.48). We found that associations with outcomes in education, work, and finances diminished in the presence of additional covariates for children's home environment and achievement but associations for other outcomes were more robust. We also found that attention and behavior problems across distinct periods of childhood were associated with adult outcomes. Specific attention and behavior problems showed some differences in predicting outcomes in the U.S. cohort, with attention problems predicting lower educational attainment and hyperactivity/impulsivity predicting ever spending time in jail. Together with the findings from Moffitt et al. (2011), our study makes clear that childhood attention and behavior problems are associated with a range of outcomes in adulthood for cohorts born in the 1950s, 1970s, and 1990s across three countries.

Keywords: childhood inattention, impulsivity, hyperactivity, impulsive aggression, adult outcomes, conceptual replication

Public Significance Statement: This study reveals that findings from Moffitt et al. (2011) that children exhibiting attention and behavior problems had greater financial struggles, poorer

health, and a greater likelihood of criminality once they reached adulthood, generalized to cohorts born in different decades in the United States and the United Kingdom. Given the consistency of findings across cohorts, attention and behavior problems in childhood appear to make it difficult to meet the demands of one's environment throughout development.

Attention and Behavior Problems in Childhood Predict Adult Financial Status, Health, and Criminal Activity: A Conceptual Replication and Extension of Moffitt et al. (2011) Using Cohorts from the U.S. and the U.K.

Societies around the world aim to prepare children to be successful as adults, key markers of which are completing their education, earning a comfortable living, staying healthy, and avoiding criminal behavior. One highly influential study by Moffitt et al. (2011) found that the road to success began in childhood. Children lower in a construct they labeled "self-control" (i.e., greater difficulty inhibiting impulsive behavior and controlling their attention) had greater financial struggles, poorer health, and a greater likelihood of criminality decades later (Moffitt et al., 2011). Since its publication, this study has become a cornerstone of the evidence linking children's control of their behavior to their later development, garnering thousands of citations. Though the findings are compelling, some aspects of the study bear replication and extension.

The current paper provides two conceptual replications and extensions of Moffit and colleagues' (2011) main analyses. A conceptual replication tests the hypotheses of the original study using different methods (Schmidt, 2009) and is thus a key step in confirming hypotheses and advancing science (Schmidt, 2009). Our goal was to use a conceptual replication to extend the field's understanding about the nature of and outcomes associated with Moffit et al.'s (2011) construct of childhood self-control.

Developing Self-Control Across Childhood

Children are not born with the ability to control their behavior. Infants rely on adult caregivers to modulate their physiological and emotional states and through this process of co-regulation children learn to regulate their own behavior (Sameroff, 2010). The ability to control one's behavior develops rapidly during early childhood (Zelazo et al., 2016). At school entry, as children exercise greater control of their behavior, teachers and parents enforce greater

expectations for children's behaviors in different activities and settings. By early adolescence, it is expected that children can manage their own behavior according to societal rules and in pursuit of their own goals (Duckworth et al., 2019). Thus, children's self-control emerges in early childhood and evolves across distinct developmental stages, with an increasing capacity for controlling one's own behavior.

Children's control of their behavior has been associated with a range of later outcomes, including academic achievement and social adjustment (Blair & Raver, 2015; Duckworth et al., 2019; Robson et al., 2020), and these associations likely extend into adulthood. In addition to Moffitt et al. (2011), other studies have found that the inability to control one's behavior predicts a higher likelihood of welfare receipt across adulthood (Vergunst et al., 2021) and lower rates of employment (Daly et al., 2015). Problems controlling one's behavior in childhood also predict health-related outcomes in adulthood, including a higher likelihood of smoking (Daly et al., 2016), greater chronic inflammation (Rasmussen et al., 2019), and accelerated aging (Richmond-Rakerd et al., 2021).

Issues for Replication and Extension

There are several reasons why the Moffit et al. (2011) study bears replication and extension. First, the primary findings in Moffitt et al. (2011) emerged from a sample of New Zealanders born in the 1970s. Given this study's impact on the field with over 5,000 citations per Google Scholar (as of November 2022), it is important to establish whether their findings generalize to other countries and other cohorts. Replications build shared confidence in the viability of our scientific knowledge (Duncan et al., 2014; Open Science Collaboration, 2015).

Second, the associations reported between self-control in childhood and adult outcomes may overstate the causal role of self-control and could instead reflect the influences of other

characteristics of children and their families. Moffitt and colleagues (2011) accounted for children's gender, IQ, and social class of their family of origin. However, both childhood self-control and adult well-being are likely influenced by other factors in a child's home environment, including sensitivity from caregivers (Raby et al., 2015) and cognitive stimulation (Rosen et al., 2020), as well as children's own academic achievement (Rabiner et al., 2016). Including control variables for early life factors that likely cause variation in attention and behavior problems but are unlikely to be altered by educational interventions targeting self-control can inform theory and educational practice (Watts & Duncan, 2020). For example, Watts and colleagues (2018) found that associations between delay of gratification in preschool and academic achievement at age 15 were attenuated by two-thirds after controlling for family background, early cognitive ability, and the home environment. Therefore, including additional, theoretically motivated control variables will better specify the role that self-control plays in predicting adult outcomes—independent of the variance that self-control shares with aspects of children's home environment and achievement.

Third, Moffit and colleagues' (2011) highly-cited longitudinal study of self-control used a composite that combined information from different periods of development. Combining information in this way may create a more robust measure, but it also eliminates distinctions among developmental stages and specific behavior problems. Examining such specificity could be informative. Skills learned in early childhood lay the foundation for later skills (Heckman, 2006), so self-control in early childhood could be especially predictive of adult outcomes. On the other hand, the subsequent developmental periods of middle childhood and early adolescence could be more predictive of adult outcomes because they are more proximal to adulthood. To our knowledge, these hypotheses await empirical testing.

It is also important to understand the extent to which control of specific behaviors predict outcomes differentially to inform future interventions. For example, Vergunst and colleagues (2021) found that inattention and aggressive behaviors in kindergarten predicted trajectories of welfare receipt in adulthood, though hyperactivity did not. Duncan and colleagues (2007) found that attention, but not externalizing behaviors, at school entry predicted later achievement across several national datasets. In contrast, impulsivity has been linked to children's later problem behaviors (Eisenberg et al., 2009). Attention problems may be particularly important for outcomes related to education and work (Pingault et al., 2011), while impulsivity may best predict behavioral outcomes. Therefore, exploring specificity will enhance understanding of behavioral skills necessary to achieve positive outcomes in adulthood, knowledge that could be crucial for intervention efforts.

Defining "Self-Control" as Attention and Behavior Problems

We set out to conduct a conceptual replication of one of the most highly cited studies linking children's self-control to their later development (Moffitt et al., 2011). Despite frequent citations of this article, there is not a consensus in the field on how to refer to the childhood behaviors used in that study to predict adult outcomes. Moffitt et al. (2011) used the term "self-control" to refer to their composite of impulsivity, hyperactivity, inattention, and impulsive aggression in childhood. Some researchers who have cited the paper have adopted the authors' term of "self-control" (e.g., Duckworth et al., 2019), while other researchers have referred to it as "self-regulation" (for recent reviews see Inzlicht et al., 2021, and Robson et al., 2020), "inhibitory control" (Diamond, 2013), or "executive function" (Zelazo, 2020).

Given the variable terminology used to refer to the findings in Moffit and colleagues (2011), we resolved to understand the composition of the behavioral composite that we aimed to

replicate. We reviewed items used in the Dunedin study to assess self-control and found that they consisted primarily of children's impulsive, hyperactive, inattentive, and impulsive-aggressive behaviors (for more details see these studies using the Dunedin cohort: Caspi et al., 1995; McGee et al., 1985, 1992; Wright et al., 1996). In our judgement, these items represented problem behaviors emerging from a breakdown of self-control rather than self-control per se. We reasoned that children's impulsive, hyperactive, inattentive, and impulsive-aggressive behaviors represent uncontrolled, reactive response to daily situations, indicating the failure of some internal regulatory process rather than that process itself. This changed how we thought about our investigation, as we subsequently viewed our analyses as examining how children's attention and behavior problems predict adult outcomes. However, we judged that completing the conceptual replication and replicating the behavioral composite as closely as possible was still valuable given Moffitt et al.'s (2011) influence on the field. In the current study, however, we use the term "attention and behavior problems" because we believe it more accurately reflects the behaviors examined here.

The Current Study

The goal of this study was to conduct a conceptual replication of the main analyses in Moffitt et al. (2011), using prospective birth cohort studies from the U.S. and the U.K. to probe the generalizability and robustness of their findings that childhood attention and behavior problems predicted poorer adult health, less wealth, and more criminal behavior. We also sought to extend the Moffit et al. (2011) approach in three ways. First, we tested whether the associations between childhood attention and behavior problems and adult outcomes persisted when including a larger set of child and family-level covariates. Second, because Moffit and colleagues used a broad index of attention and behavior problems aggregated across ages

(spanning from ages 3 to 11), we investigated whether predictions varied based on the age at which attention and behavior problems were measured. Third, we assessed whether the associations between childhood attention and behavior problems and adult outcomes varied by the type of behavior problem to determine if past findings attributed to the behavioral composite were being driven by the components of impulsive aggression, hyperactivity/impulsivity, or attention problems.

Prospective studies that span birth to adulthood are rare. Rarer still are prospective studies that collect detailed information about children's attention and behavior problems and their home life throughout childhood. We identified two prospective cohort studies that had the appropriate data to address our aims. The first was the Study of Early Child Care and Youth Development (SECCYD) in the U.S., which collected a rich set of behavioral measures across childhood and allowed us to closely match the composite used in Moffitt et al. (2011) and to conduct similar statistical analyses. In addition to the careful measurement of attention and behavior problems across childhood, the SECCYD has detailed measures capturing children's home environment and development across childhood. The SECCYD recently completed a survey of adult life when participants were 26 years old that included measures of economic and educational attainment, health, and criminal activity during early adulthood. The second dataset is the National Child Development Study (NCDS) from the U.K. Although this dataset has fewer measures of attention and behavior problems compared with the SECCYD, it has rich measures of adult outcomes collected at later ages, allowing us to generate a comprehensive view of participants' lives at midlife (i.e., age 42). Both datasets assessed outcomes in domains similar to those in Moffitt and colleagues (2011), though the outcomes are not assessed in exactly the same manner. We view this fact as a strength, as similar findings across different measures of adult

outcome domains will provide greater confidence in the consistency of results across countries and cohorts.

Method

We did not reanalyze the Dunedin data for this study. However, we include a description of the data sources, measures, and methods used by Moffitt et al. (2011) to demonstrate how we endeavored to follow that study's methods in our analyses of the SECCYD and the NCDS as closely as possible. Table 1 summarizes the ages and years of assessment across the three studies.

Data Sources

Dunedin (New Zealand data used in Moffitt et al. 2011)

The Dunedin Multidisciplinary Health and Development Study (Dunedin) recruited a complete birth cohort of 1,037 children born between April 1972 and March 1973 in Dunedin, New Zealand. The sample was 52% male and primarily White. Children were assessed at ages 3, 5, 7, 9, 11, 13, 15, 18, 21, 26, and 32. Retention was high, with nearly all (96%) of living cohort members assessed in 2004 or 2005 (Moffitt et al., 2011, supplement).

We relied on procedures and estimates reported in the Moffitt et al. (2011) paper and its supplementary materials.

SECCYD (U.S. Cohort)

In 1991, the Study of Early Childcare and Youth Development (SECCYD) recruited mothers from 10 sites across the U.S. during postnatal hospital visits. A total of 1,364 families enrolled in the study and completed a home interview when their infant was 1 month old (for details, see NICHD Early Child Care Research Network, 2005). Because our primary research focus was attention and behavior problems during childhood, we excluded participants who left

the sample before the 54-month assessment and never re-entered the study (n = 196, 14%), leaving us with an analytic sample of 1,168. Data for the current study were collected when children were ages 4, 5, 7, 9, 11, and 26 years of age. The sample was 49% female and 81% Non-Hispanic White. Descriptive statistics are presented in Table 2. A correlation matrix is presented in Table S1 of the supplement.

NCDS (U.K. Cohort)

The National Child Development Study (NCDS) collected data on approximately 17,000 children born in England, Scotland, and Wales during one week of 1958. The current study relied on data collected from the age 0, 7, 11, 33, and 42 waves of data collection (Centre for Longitudinal Studies, 2020a, 2020b, 2020c). During the school-year waves of the study, the sample was refreshed to include immigrants born during the relevant week from 1958. The current analysis relied on participants with at least one non-missing measure of attention and behavior problems from the age 7 or age 11 wave (n = 16,506). Thus, our analysis included approximately 89% of the sample. The sample was approximately 51% male, and almost entirely White (98%). Descriptive statistics are presented in Table 3. A correlation matrix of is presented in Table S2 of the supplement.

Measures

Attention and Behavior Problems in Childhood

Dunedin. Moffitt et al. (2011) described in their Supplementary Information how they created 9 composite subscales of "self-control" (which we refer to as attention and behavior problems):

1. lack of control (ages 3 and 5; observer ratings)
2. impulsive aggression (ages 5, 7, 9, and 11; parent and teacher ratings)

3. hyperactivity (ages 5, 7, 9, and 11; parent and teacher ratings)
4. hyperactivity (ages 9 and 11; parent and teacher ratings)
5. lack of persistence (ages 9 and 11; parent and teacher ratings)
6. impulsivity (ages 9 and 11; parent and teacher ratings)
7. hyperactivity (age 11; self-report)
8. inattention (age 11; self-report)
9. impulsivity (age 11; self-report).

We deduced that each subscale was an average of ratings at each of the ages. To determine items used at each age, we consulted articles published from the Dunedin data, namely Caspi et al. (1995), McGee, Feehan et al. (1992), McGee, Williams et al. (1985), Moffitt et al. (2011), and Wright et al. (1996). We matched the items from each age that were identified in these articles to the subscales listed above; these items are listed in Table S3 in the supplement. We only used items if they appeared in one of the articles above; thus, the items in Table S3 may be an underestimate of the items used by Moffit et al. (2011). They stated in their supplement that the nine subscales were subject to a principal components analysis, with the first axis representing the composite of attention and behavior problems in childhood with strong internal reliability, $\alpha = .86$ (Moffitt et al., 2011, supplement). The composition of the subscales meant the composite disproportionately weighted hyperactivity and impulsivity relative to inattention and impulsive aggression, and disproportionately weighted age 11 relative to other ages.

SECCYD. We reviewed all measures from the waves most closely matching the ages of the Dunedin, namely ages 4, 5, 7, 9, and 11. Although not from the same measures as those used in Moffitt et al. (2011), we found appropriate matches for 37 of the 41 items (90%) that we could determine were used in the Dunedin study. The matched items, available from the first author

upon request, came from the Child Behavior Checklist (Achenbach, 1991), the Child Behavior Questionnaire (Rothbart et al., 2001), and an index of disruptive behaviors reflecting symptoms of Attention Deficit/Hyperactivity Disorder as defined by the Diagnostic and Statistical Manual-IV (American Psychiatric Association, 1994).

We then created nine composites to match those of Moffitt et al. (2011) by item, age, and rater. There were two exceptions. We did not have observer ratings of "lack of control" at ages 3 and 5 and instead substituted parent and teacher ratings at age 4. We also did not have self-reports of hyperactivity, inattention, and impulsivity at age 11 and instead used parent and teacher ratings. We first standardized each of the items. We next took the average of items within raters at a given age, then took the average across parent and teacher ratings for each age, and finally averaged across the observed child ages. We did this for each of the 9 subscales. Following Moffitt et al. (2011), we extracted the first axis of a principal components analysis to create the composite of attention and behavior problems. Our composite was thus highly similar to that used in Moffitt et al. (2011) with regard to item content, timing, raters, and differential weighting of constructs. The composite had high internal consistency ($\alpha = .93$).

NCDS. Relative to the SECCYD, the NCDS contained fewer items assessing children's behavior. We identified appropriate items and scales at the age 7 and age 11 waves, which are available from the first author on request. We relied on items and scales from the Rutter Behavioral Scale (Rutter, 1967; see Centre for Longitudinal Studies, n.d.) and the Bristol Social Adjustment Guide (see Shepherd, 2013) administered at ages 7 and 11. Parents responded to the Rutter Behavioral Scale items, which included ratings of inattention, externalizing behavioral problems, and dysregulation. The Bristol Social Adjustment Guide was administered to children's classroom teachers, and included approximately 250 items describing problematic

behavior. The relevant items and scales could be matched with items from the impulsive aggression and hyperactivity subscales from the Dunedin study. We standardized each item or scale and then generated separate age 7 and age 11 composites of attention and behavior problems by averaging across the items or scales at each wave, respectively (and an index of three binary items from the age-7 wave was formed prior to standardization). The age 7 and age 11 composites of attention and behavior problems had good reliability (α = .79 at both waves). We averaged these two composites to generate the NCDS composite of attention and behavior problems.

Work and Finances in Adulthood

Dunedin. Participants' **socioeconomic status** was indexed as their score on a classification of occupations ranging from 10 to 90. Participants reported their total pre-tax **income** from all sources. Participants' **financial planfulness** was derived by standardizing and averaging two subscales, namely *saving behavior* (a sum of six dichotomous items such as, "Do you make regular savings into a special bank account?") and *financial building blocks* (whether participants owned a home, had a retirement plan, or had investments). A **financial struggles** composite was created by standardizing and averaging two subscales, namely *money management difficulties* (a sum of seven dichotomous items such as, "Since you were 26, did you ever find it difficult to meet the cost of food and other necessities?") and *credit problems* (a sum of six dichotomous items such as, "Since you were 26, have you defaulted on a credit card payment?").

SECCYD. Participants at age 26 reported their **highest degree attained** (1 = less than high school diploma, 9 = advanced degree), their current **occupation** (ranked from 1 to 16, with higher values indicating greater professional prestige), whether they were **unemployed** (1 = yes,

0 = no), and their **annual pre-tax salary** in dollars, which we truncated at the 99th percentile to account for outliers. Participants responded to three items assessing their **financial efficacy**, that is, how well they felt they could manage their own finances (e.g., "managing money", 1 = not at all well, 5 = extremely well); we took the average of these items (α = .73). We created a dichotomous variable to indicate whether they **owned their own home** (1 = yes, 0 = no). Participants also reported the extent to which they had **trouble paying bills** in the last month (1 = no difficulty at all, 5 = overwhelming difficulty), and the extent to which they had **financial worries**, namely the extent to which they felt worried or upset about not having enough money to pay for things (1 = not at all upset, 5 = very upset).

NCDS. At age 33, participants reported their **highest educational qualification** (1 = "no qualification", 6 = "degree/higher NVQ5."). At age 42, **social class** was indexed by participants' current job, ranked on a 6-point scale from "professional" to "unskilled" (this variable was transformed such that higher values indicated higher SES). At the age 42 survey, participants also reported their "current main economic activity." We used this variable to generate an indicator of employment, which designated participants as employed if they indicated working as a full-time or part-time paid employee, or if they responded as self-employed. We used this variable to create an indicator for **unemployed** status (0 = no, 1 = yes). Participants who indicated that they were engaged in paid employment reported their last take home pay. We used "gross pay" (i.e., pre-tax earnings) and took additional steps to clean the earnings data. First, we converted pay to **annual earnings** (participants could report pay as occurring over one week, a fortnight, four weeks, a calendar month, or one year). We top-coded earnings at the 99th percentile, and bottom coded at £1,200 for any respondent who indicated earning an annual amount below £1,200 (approximately 1.5% of respondents). We then converted earnings to 2019

US dollars by first converting earnings to 2019 Great British Pounds (i.e., multiplied by 1.68 to adjust for inflation in GBP from 2000 to 2019) and then US dollars using the exchange rate in 2019 (i.e., multiplied by 1.28). Finally, we imputed earnings values of "0" for participants who responded to the employment survey but did not indicate working full- or part-time. To measure **financial health,** we used an item for which the participant reported on "how well" they were "managing financially these days." Responses were transformed such that higher values indicated greater financial standing (1 = "finding it very difficult", 5 = "living comfortably"). Finally, we generated a binary indicator of whether the participant **owned their current home**.

Physical Health in Adulthood

Dunedin. An indicator of participants' **physical health** was created from five sets of physical assessments, as described in the supplement to Moffitt et al. (2011). *Clustering of metabolic abnormalities* was a count of six at-risk biomarkers, namely "(i) overweight, (ii) high blood pressure, (iii) high total cholesterol, (iii) low high-density cholesterol, (v) high glycated hemoglobin, and (vi) poor cardiovascular fitness" (Moffitt et al., 2011, supplement, p. 5). If a participant had three or more of these biomarkers, they were classified as having clustered metabolic risk (17% of sample). *Respiratory function* was operationalized as a significant airflow limitation as assessed by respiratory expiration (4% of sample). *Periodontal disease* was determined by dental examiners as two or more sites with 4 or more mm of gum detachment from the teeth. *Sexually transmitted infection* was determined through blood tests for herpes simplex virus type 2 infection. *Elevation in inflammation* was determined through a blood assay for levels of high-sensitivity C-Reactive Protein greater than 3 mg/L (20% of sample). Presence of each of these at-risk biomarkers was summed to create a physical health index (range 0-5).

SECCYD. To characterize participants' physical health, we created dichotomous

outcomes indicating clinical health risk. We calculated whether the participant was **overweight** at age 26 (1 = yes, 0 = no), using participants' self-reported height and weight to calculate their BMI and comparing this to established cutoffs from the U.S. Centers for Disease Control and Prevention (2021). We created a dichotomous variable to indicate whether participants reported that they had **poor health** (1 = yes, 0 = no). We also created a dichotomous variable (1 = yes, 0 = no) to indicate whether the participant reported any **health impairment** that limited their activities (i.e., cutting down on time spent on work or other activities, accomplishing less than desired, limited in the kinds of work or other activities possible to complete, or difficulty performing work or other activities).

NCDS. Participants reported their height and weight. We used this information to calculate body mass index and to create an **overweight** indicator if their BMI was 25 or above (0 = no, 1 = yes). Whether participants were in **poor health** was derived from their ratings of their own health as "excellent," "good," "fair" and "poor." We generated a binary indicator of poor health, with ratings of "poor" and "fair" coded as "1" and ratings of "excellent" and "good" coded as "0."

Mental Health and Substance Use in Adulthood

Dunedin. Whether or not participants suffered from **recurrent depression** was assessed by a health professional using the Diagnostic Interview Schedule (Robbins et al., 1995); recurrent depression was indicated if a participant reported recurring episodes of depression between ages 18 and 32 (17% of sample; Moffitt et al., 2011, supplement). **Substance dependence** was also determined through the health professional-administered Diagnostic Interview Schedule. Participants were assessed for tobacco dependence, alcohol dependence, cannabis dependence, and dependence on any other substances; a sum of the number of

substances on which the participant was dependent was created (73% not dependent, 20% dependent on one substance, 7% dependent on two or more substances; Moffitt et al., 2011, supplement).

SECCYD. Participants reported their depressive symptoms using the CES-D scale (Radloff, 1977). Participants were considered to be experiencing **depression risk** (1 = yes, 0 = no) if they scored above the clinical cutoff of 16 (Lewinsohn et al., 1997). We created a dichotomous variable indicating whether the participants currently **use tobacco**, including e-cigarettes (1 = yes, 0 = no). Participants indicated the frequency with which they used alcohol and marijuana in the last 30 days. We created a dichotomous variable to indicate whether they had engaged in **near daily alcohol use** (i.e., using alcohol for 20 or more days in the last 30 days; 1 = yes, 0 = no). We created a similar variable for **near daily marijuana use** (1 = yes, 0 = no). We created another dichotomous variable indicating **other drug use over the past year**, including heroin, opioids not prescribed, and other drugs (1 = yes, 0 = no).

NCDS. Participants' **depression risk** was determined from self-reports of symptoms on 24 items that included somatic complaints, excessive worrying, and emotional dysregulation. Following the NCDS user guide (see Shepherd (2001), page 85), we summed across the 24 binary items, and counted those scoring at 7 or higher as having an elevated risk for depression. Whether a participant **drinks most days** was derived from their report of how often they had alcoholic drinks (0 = no, 1 = drinks "on most days"). Participants also reported the frequency with which they used several different illicit drugs by indicating "never," "yes, not in the last 12 months," or "yes, in the last 12 months." We created a dichotomous indicator for whether they had used **cannabis in the past year**. We also created a dichotomous indicator of whether the participant had used any other **illicit drugs in the past year** (e.g., heroin).

Single Parent Status in Adulthood

Dunedin. Whether a participant was a **single parent** was derived from a life history calendar that included information on when children were born and where they were currently living (Moffitt et al., 2011, supplement).

SECCYD. Participants reported their current marital status and the number of children they had, if any, by age 26. We used this information to create a dichotomous variable to indicate whether the participant was a **single parent** (1 = yes, 0 = no).

NCDS. Participants indicated whether they had a spouse or partner living in their household and whether they had any of their own children living with them. We created a dichotomous variable for **single parent**, indicating whether participants had a child of their own in the home but did not have a spouse or partner in the household (1 = yes, 0 = no).

Criminal Activity in Adulthood

Dunedin. Whether a participant had a **criminal conviction** between age 17 and age 32 was determined through a search of the New Zealand Police database for property crimes, drug crimes, violent crimes, and court order violations. A quarter of the sample had at least one conviction (Moffitt et al., 2011, supplement).

SECCYD. Participants reported the number of times they had **ever spent time in jail**. We dichotomized this outcome to indicate whether the participant had ever spent time in jail (1 = yes, 0 = no).

NCDS. Participants reported whether they had **ever been arrested** and taken to a police station since their last interview, which was 9 years before for the majority of the sample (i.e., their age 33 interview: Shepherd, 2001, p. 17).

Covariates

Dunedin. As indicated in their supplementary materials, Moffitt et al. (2011) used child gender, children's social class origins, and child IQ as covariates. Children's social class origins were indicated through ratings of their parents' occupational status on a six-point scale; the highest of either parent's ratings from each wave (birth to age 11) was averaged to create a single rating of social class. Child IQ was measured using the Wechsler Intelligence Scale for Children-Revised (WISC-R; Wechsler, 1974) at ages 7, 9, and 11; children's scores across waves were averaged into a single IQ score.

SECCYD. For analyses with the SECCYD, we used three tiers of covariates—one of which mirrored those used by Moffitt et al. (2011) and two others that we added in order to rule out competing explanations for our findings. The first tier corresponded as closely as possible to Moffitt et al. (2011): we used the child's gender, the highest of either parent's occupational ranking averaged from birth to age 11, and the child's IQ at age 10, measured with a later version of the Wechsler test, namely the Wechsler Abbreviated Scale of Intelligence (Psychological Corporation, 1999). Given that the SECCYD used a multi-site design and had participants of different races/ethnicities, we also controlled for site (i.e., using dummy variables) and whether a participant was non-Hispanic White in this first tier of covariates.

For the second covariate tier, we included variables that would capture aspects of the child's home environment that could also predict outcomes in adulthood. We included the quality of parenting averaged across ages 3 to 11, which assessed both warmth and stimulation observed and coded during parent-child interaction at a lab visit. We also included: the proportion of waves from birth to age 11 in which the mother's husband or partner was present in the home; the mother's vocabulary assessed when the child was three years old via the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1981); mothers' depressive symptoms

averaged from age 1 month to 11 years (Radloff, 1977); and the family's income-to-needs ratio averaged from age 1 month 0 to 11 years (Vandell et al., 2010).

The third covariate tier included children's achievement because we anticipated that achievement might correlate both with teacher ratings of behavior as well as with outcomes in adulthood. We used three subscales from the Woodcock-Johnson (Woodcock & Johnson, 1990), namely the Picture Vocabulary, Letter-Word Identification, and Applied Problems subscales, averaging across the same ages from which we drew measures of attention and behavior problems, that is, ages 4, 5, 7, 9, and 11.

NCDS. As with the SECCYD, we included sets of covariates in our models that first follow the Moffit et al. (2011) approach and then add to it with a more extensive set of covariates. Thus, our first set of covariates included participant gender, father's socioeconomic status (7-category ranking) averaged at age 7 and 11 (we transformed this variable such that higher values indicated higher levels of SES), and general cognitive ability at age 11 taken from the "General Ability Test" included in the NCDS (alpha = .94; see Shepherd, 2012). We also controlled for a set of dummy variables indicating birth region and an indicator for ethnicity (coded as non-White = 0; White = 1).

Following the approach taken with the SECCYD, our next set of covariates included more extensive measures of the home and family environment. This set of covariates included a measure of the father's involvement at ages 7 and 11, the number of people per room in the home at age 11, whether the family earned income from employment at age 11, and an indicator for whether the family faced a "serious financial hardship" during the year preceding the age-11 interview. Finally, we also controlled for a set of binary indicators from the age-7 interview measuring family difficulties with: 1) housing; 2) finances; 3) physical illness or disability; 4)

mental illness or neurosis; 5) divorce, separation, desertion; 6) domestic tension; 7) unemployment; 8) alcoholism.

As with the SECCYD, we also tested models that included covariates for mathematics and reading achievement at ages 7 and 11 (see Shepherd, 2012). The Southgate Group Reading Test was administered at age 7, and it measured word recognition and comprehension, and the Problem Arithmetic Test was used to measure age-7 mathematics achievement. At age 11, a reading comprehension test was administered, which involved filling in a missing word to complete a sentence (alpha = .82). The age-11 mathematics test consisted of arithmetic problems that tapped both numeracy and geometry knowledge (alpha = .94).

Analytic Approach

We employed the same basic statistical approach for both datasets. In our first step, we focused on models that relate adult outcomes to childhood attention and behavior problems, with a similar set of covariates to those used by Moffitt et al. (2011):

1. $Outcome_{iAD} = a_1 + \beta_1 Attention\ and\ Behavior\ Problems_{\ iCD} + \chi Moffit_{iCD} + e_i$

where $Outcome_{iAD}$ is a given outcome (e.g., educational attainment) for the i^{th} child measured at time "AD" (i.e., adulthood; age 26 in the SECCYD, age 33 or 42 in the NCDS). $Attention\ and\ Behavior\ Problems_{iCD}$ represents the composite measure of "attention and behavior problems" for child "i" at time "CD" (i.e., childhood). In both datasets, we also include a set of covariates meant to match the set used by Moffit et al. (captured by $\chi Moffit_{iCD}$). Thus, in the SECCYD, this included IQ, parental occupational status, gender, race/ethnicity and site. In the NCDS, this set included IQ, parental occupational status, gender, race/ethnicity, and region of birth. In this model, β_1 represents the parameter of interest, as it captures the predicted association between a given adult outcome and a 1-SD increase in attention and behavior

problems.

We then extended this approach by including additional covariates for family home life:

2. $Outcome_{iAD} = a_1 + \beta_1 Attention\ and\ Behavior\ Problems_{iCD} + \chi Moffit_{iCD} + \emptyset Family_{iCD} + e_i$

where all parameters are defined as before, and $\emptyset Family_{iCD}$ represents the set of measures capturing family environment (for full list in both datasets, see "Measures" section).

Finally, we tested whether attention and behavior problems relations persist when covariates for concurrent achievement were considered:

3. $Outcome_{iAD} = a_1 + \beta_1 Attention\ and\ Behavior\ Problems_{iCD} + \chi Moffit_{iCD} + \emptyset Family_{iCD} + \lambda Ach_{iCD} + e_i$

where all parameters are defined as before, and λAch_{iCD} represents a set of measures capturing achievement during childhood (see "Measures" section for specific achievement measures used in both datasets).

Continuous outcomes were standardized, which allowed us to interpret β_1 similarly to an effect size, as it captures the associated SD change in the outcome predicted for a 1-SD change in attention and behavior problems. For binary outcomes, we used logistic regression, with coefficients converted to odds ratios. All models were run in Stata, with the "robust" option used for standard error estimation. Following model estimation, we compared effect sizes reported in Moffitt et al. (2011) to effect sizes obtained from the SECCYD and NCDS.

We also sought to examine whether a gradient of attention and behavior problems predicted key outcomes following the quintile analyses conducted by Moffit et al. (2011). To investigate this, we split our behavioral composite measures into categorical variables indicating quintiles, which allowed us to estimate outcomes at each part of the distribution. We re-ran our regression models using a set of mutually exclusive dummy variables corresponding to quintiles

of attention and behavior problems with the bottom quintile as the comparison group. In order to limit the risk of Type I error due to running a substantial number of additional analyses across the full set of outcome variables included in the SECCYD and NCDS studies, we instead narrowed our focus to four outcomes: 1) highest degree earned, 2) overweight, 3) depression risk, and 4) ever having spent time in jail. These four outcomes were selected *a priori* because they represented important life markers across each of the key domains of adult development present in our previous analyses and because they were comparable across both cohorts.

Our final set of analyses were then used to extend the basic Moffit et al. (2011) modeling approach in several theoretically meaningful ways. First, we disaggregated the composite of attention and behavior problems by developmental period, namely early childhood (for the U.S. cohort only), middle childhood (i.e., ages 7 to 9), and early adolescence (i.e., age 11). The composites by developmental period showed adequate internal consistency (alphas = .78 to .92). We ran regression models predicting highest degree earned, overweight, depression risk, and ever having spent time in jail, and used attention and behavior problems at distinct developmental stages as the main predictors in separate models, which included covariates described in equation 3 above. The final, combined model placed attention and behavior problems from distinct developmental stages in the same model along with covariates from *Equation 3* to understand if attention and behavior problems in a particular stage are uniquely associated with adult outcomes.

Second, we disaggregated the attention and behavior problems composite by measurement component: 1) impulsive aggression, 2) hyperactivity/impulsivity, and 3) attention problems. This analysis was only possible using the U.S. cohort because the large number of items provided adequate coverage of the three distinct components of attention and behavior

problems. We again predicted the adult outcomes of highest degree earned, overweight, depression risk, and ever having spent time in jail, with separate models for impulsive aggression, hyperactivity/impulsivity, and attention problems (again relying on the covariates from *Equation 3*). The final combined model placed impulsive aggression, hyperactivity/impulsivity, and attention problems in the same model to understand if a particular set of behaviors was uniquely associated with adult outcomes after accounting for the others.

We intended to adjust for multiple hypothesis testing but were unable to because Stata does not allow pooling of adjusted *p*-values across imputed datasets. We decided that the missing data correction was more important than the correction for multiple tests because non-random sample attrition in our longitudinal studies would bias estimates if not corrected by a valid missing data adjustment (Enders, 2013).

Strategies for Handling Missing Data

Dunedin. Moffitt and colleagues (2011) reported a participant retention rate of 96% and that those with missing data did not differ significantly on attention and behavior problems from those with no missing data. Without a missing data strategy to follow, we chose to use multiple imputation in the SECCYD and NCDS datasets.

SECCYD. About 70% of the SECCYD sample were retained between age 4 and age 26. Those who remained in the study differed from those who left, having parents with higher occupational rankings, higher child IQ, more enriched home environments, higher achievement, and fewer childhood attention and behavior problems (*p*s < .001). Participants were also more likely to remain in the study by age 26 if they were female, non-Hispanic White, and came from a particular study site (*p*s < .001). To correct for this nonrandom sample attrition, we used multiple imputation, creating 100 datasets using chained regression equations and pooling

regression estimates and standard errors in all analyses. Multiple imputation is effective at correcting attrition bias when attrition can be predicted using variables observed in the dataset (Enders, 2013), as is the case here.

NCDS. Approximately 76% of the participants with non-missing behavioral data from age 7 or age 11 had at least one non-missing outcome measure at age 33 or 42 (n = 12,503). To test if key participant characteristics related to attrition, we regressed an indicator for whether the participant remained in the study on the age 7 measure of attention and behavior problems, gender, ethnicity, average SES at age 7 and 11, and the age 11 IQ score. Those who remained in the study exhibited fewer attention and behavior problems ($p < .05$), were more likely to be female ($p < .001$) and White ($p < .001$) and had higher scores on the age-11 IQ test ($p < .001$). As with the SECCYD, we used multiple imputation to correct for non-random attrition and missing values on independent variables. For our analytic sample (i.e., participants with at least one non-missing attention and behavior problem item at either age 7 or age 11, n = 16,506), we generated 25 imputed datasets using the chained equations commands in Stata 16.0. We used a smaller number of imputed datasets for the NCDS because of its large sample size (Graham et al., 2007). These models included all of the dependent variables and independent variables described above (i.e., measures of age 7 and age 11 attention and behavior problems and control variables). However, because participants were only asked to report earnings if they indicated employment at the age 42 survey, our imputation models did not converge when the indicator for employment and earnings were both included in the imputation model. Thus, our results include imputed results for the employment indicator, but we did not impute on the earnings measure. Instead, our earnings measure includes actual reported earnings for those who indicated work, and zeros for those who were not working at age 42.

Transparency and Openness

We have reported how we determined our sample size and all data exclusions. We report all measures used in the study. Data and documentation for the childhood waves of the SECCYD are available from ICPSR (www.icpsr.umich.edu), but the age 26 data have not yet been made publicly available. We were able to access these data because one of the co-authors is the principal investigator for the age 26 wave. Data and documentation for the NCDS are available upon request from the UK Data Service (https://www.ukdataservice.ac.uk). Computer code for these analyses can be found at https://osf.io/6548b/. This study was not pre-registered. Data were analyzed using Stata version 16 (StataCorp, 2019).

Results

Conceptual Replication of Moffit et al. (2011)

Our first aim was to replicate the analyses in Moffitt and colleagues (2011) that linked childhood attention and behavior problems to adult outcomes. Table 4 presents the estimates from our conceptual replication models, and for ease of comparison, we also present results reported by Moffitt et al. (2011; drawn from Table 1, Model 2) in the left-hand panel of our table. The key replication results are in columns labeled "Model 1" for both the U.S. and U.K. cohorts, and these results correspond to *Equation 1*, as each model controlled for child gender, IQ, parental occupation, site/region of birth, and race/ethnicity.

As Table 4 shows, the estimates were very similar across studies, and in some cases nearly identical. Attention and behavior problems during childhood predicted lower educational attainment (i.e., highest degree earned) at age 26 in the U.S. cohort, $\beta = -0.22$, 95% CI [-0.28, -0.15], and at age 33 in the U.K. cohort, $\beta = -0.13$, 95% CI [-0.15, -0.12]; holding a lower-status occupation at age 26 in the U.S., $\beta = -0.16$, 95% CI [-0.23, -0.08], and at age 42 in the U.K., $\beta = -$

0.08, 95% CI [-0.12, -0.03]; and a greater likelihood of neither working nor being in school at age 26 in the U.S., Odds Ratio (OR) = 1.43, 95% CI [1.07, 1.92], and unemployment at age 42 in the U.K., OR = 1.32, 95% CI [1.24, 1.40]. Although childhood attention and behavior problems were not a significant predictor of a lower annual salary in the U.S., β = -0.08, 95% CI [-0.17, 0.001], the estimated association was very similar to that observed in the U.K. cohort, β = -0.07, 95% CI [-0.09, -0.05]. Similarly, attention and behavior problems predicted lower financial efficacy in adulthood in the U.S., β = -0.15, 95% CI [-0.24, -0.07], and financial health in the U.K., β = -0.07, 95% CI [-0.09, -0.04]. Attention and behavior problems did not predict home ownership at age 26 in the U.S., OR = 1.01, 95% CI [0.83, 1.24], but the measure did predict a lower likelihood of owning one's own home at age 42 in the U.K., OR = 0.73, 95% CI [0.69, 0.77]. In the U.S. cohort, attention and behavior problems also predicted greater trouble paying bills, β = 0.17, 95% CI [0.09, 0.25], as well as greater financial worries, β = 0.14, 95% CI [0.06, 0.22].

With regard to health outcomes, attention and behavior problems were not a significant predictor of overweight status according to CDC guidelines at age 26 in the U.S., OR = 1.15, 95% CI [0.97, 1.37], but the odds ratio was of similar magnitude to the significant estimate for the U.K. cohort with a larger sample size, OR = 1.13, 95% CI [1.07, 1.18]. Attention and behavior problems did not predict self-rated poor health at age 26 in the U.S., OR = 1.05, 95% CI [0.82, 1.36], though it did at age 42 in the U.K., OR = 1.26, 95% CI [1.19, 1.32]. In the U.S. cohort, attention and behavior problems predicted a higher likelihood of reporting any of four health impairments that interfered with daily life, OR = 1.33, 95% CI [1.10, 1.61].

Attention and behavior problems also predicted outcomes in the areas of mental health and substance use, predicting a greater risk of depression in the U.S. sample, OR = 1.26, 95% CI

[1.06, 1.49], and in the U.K., OR = 1.29, 95% CI [1.22, 1.37], as well as a higher likelihood of smoking in the U.S. cohort, OR = 1.45, 95% CI [1.14, 1.84] and in the U.K. cohort, OR = 1.44, 95% CI [1.37, 1.52]. There was no evidence that attention and behavior problems predicted near-daily alcohol use in the U.S., OR = 1.03, 95% CI [0.79, 1.33], or in the U.K., OR = 1.02, 95% CI [0.96, 1.08]. Although the measure of attention and behavior problems was not a significant predictor of near-daily marijuana use in the U.S., OR = 1.22, 95% CI [0.99, 1.51], the estimate was fairly similar to that obtained from the U.K. cohort for having used cannabis in the past year in the U.K., OR = 1.36, 95% CI [1.25, 1.47]. Attention and behavior problems did not predict a higher likelihood of engaging in other drug use in the past year in the U.S., OR = 1.02, 95% CI [0.81, 1.29], though they did predict illicit drug use in the past year in the U.K., OR = 1.28, 95% CI [1.14, 1.44]. The measure of attention and behavior problems was not a statistically significant predictor of single parenthood by age 26 in the U.S., OR = 1.23, 95% CI [0.96, 1.57], though it was statistically significant in the U.K., OR = 1.14, 95% CI [1.05, 1.24]. Attention and behavior problems predicted higher likelihood of having ever spent time in jail by age 26 in the U.S., OR = 1.74, 95% CI [1.29, 2.33] and having spent any time in jail in the last nine years in the U.K. cohort, OR = 1.48, 95% CI [1.35, 1.62].

Inclusion of Additional Control Variables

We next examined whether attention and behavior problems predicted adult outcomes after including additional covariates (i.e., *Equations 2* and *3*). The estimates from the models reported above attenuated by about one third, on average, with the addition of control variables measuring characteristics of the home environment during childhood and child academic achievement (see Table 4, Models 2 and 3, respectively). Most of the attenuation occurred in the areas of education and work, where associations attenuated sometimes by nearly half. For

example, in the U.S. cohort, the association for highest degree earned dropped from β = -0.22 to β = -0.13, 95% CI [-0.20, -0.07] once covariates for home environment and child achievement were added. Similarly, in the U.K. cohort, the prediction dropped from β = -0.13 to β = -0.08, 95% CI [-0.09, -0.06]. Similar patterns were observed for earnings, with the fully controlled earnings estimate in the U.S. cohort falling below statistical significance, β = -0.05, 95% CI [-0.14, 0.04]. However, the magnitude was almost identical to the fully-controlled association observed in the U.K. cohort, β = -0.04, 95% CI [-0.06, -0.02]. Yet, despite magnitude reductions, across most of the outcomes observed in the "work and finances" category, the prediction for attention and behavior problems remained statistically significant even when the additional covariates were added.

Associations with physical health were not substantially altered after including additional control variables, with attention and behavior problems predicting health impairments, OR = 1.29, 95% CI [1.05, 1.58] in the U.S. cohort as well as being overweight, OR = 1.11, 95% CI [1.06, 1.17] and having poor health, OR = 1.19, 95% CI [1.13, 1.26] in the U.K. cohort.

In the area of mental health and substance use, the association between childhood attention and behavior problems and adult depression risk in the U.S. cohort was no longer statistically significant after the inclusion of home environment characteristics and academic achievement covariates, OR = 1.11, 95% [0.93, 1.33]. However, attention and behavior problems continued to predict depression risk in the U.K. cohort, OR = 1.25, 95% CI [1.17, 1.33]. Attention and behavior problems remained predictive of smoking in the U.S. cohort, OR = 1.36, 95% CI [1.04, 1.79], but not other kinds of substance use, ORs 1.01 to 1.16 *p*s = ns. In the U.K. cohort, associations between childhood attention and behavior problems and substance use remained largely unchanged for smoking, OR = 1.38, 95% CI [1.31, 1.46], near daily alcohol

use, OR = 1.04, 95% CI [0.98, 1.11], cannabis use in the past year, OR = 1.36, 95% CI [1.25, 1.48] and illicit drug use in the past year, OR = 1.24, 95% CI [1.10, 1.40]. The association between childhood attention and behavior problems and single parenthood in the U.S. cohort attenuated further, OR = 1.09, 95% CI [0.81, 1.46], though it remained of similar size in the U.K. cohort, OR = 1.11, 95% CI [1.02, 1.21]. Finally, the association between attention and behavior problems and ever spending time in jail attenuated somewhat but remained significant in both the U.S. cohort, OR = 1.63, 95% CI [1.17, 2.28] and the U.K. cohort, OR = 1.40, 95% CI [1.26, 1.55].

Gradient of Attention and Behavior Problems

To illustrate our findings for quintiles of attention and behavior problems, Figure 1 presents estimates from three model specifications; we present the results for only four outcomes (highest degree earned, overweight, depression risk, and ever having spent time in jail) as illustrations because plotting all of our findings would be unwieldy. Figure 1 displays estimated means and predicted probabilities of outcomes by quintile of attention and behavior problems from three sets of models: 1) unadjusted regression models (i.e., bivariate associations), 2) models using the covariates from Moffitt and colleagues (i.e., *Equation 1*), and 3) our full set of control variables (i.e., *Equation 3*). As Figure 1 reflects, we found that a gradient of attention and behavior problems predicted adult outcomes, though we also found some evidence of non-linearity. For example, the association between attention and behavior problems and time spent in jail appeared to be strongest for the participants who struggled most with childhood attention and behavior problems (i.e., quintiles 4 and 5), and the relation for the bottom 3 quintiles appeared to be much weaker.

It should also be noted that we found remarkably similar patterns of effects across the

two datasets. All of the graphs suggested that including covariates attenuated the relation between attention and behavior problems and each outcome, though most of this attenuation occurred when the first set of covariates for SES, IQ, gender, race, and region/site of birth were included. There was limited additional attenuation due to including the covariates for family home life and academic achievement.

Disaggregating Childhood Attention and Behavior Problems

Developmental Period

Because the overall attention and behavior problems composite combined measures across multiple child ages, we extended our study to ask if attention and behavior problems at different developmental periods were more consequential for adult outcomes than others. Table 5 presents the estimates from separate regression models predicting select adult outcomes from the attention and behavior problems composite (column 1) and then from the measures from each of the three developmental periods (columns 2 to 4). Column 5 presents a combined model in which all of the measures predict adult outcomes simultaneously. All of these models include the "full" set of controls corresponding to equation 3 above.

Overall, the estimates for attention and behavior problems during each developmental period were largely similar to the estimate for the overall composite of attention and behavior problems averaged across childhood. For some outcomes (i.e., jail time and depression), we saw some indication that attention and behavior problems in later childhood or early adolescence may have stronger associations with adult functioning. Importantly, we observed little evidence to suggest that early childhood attention and behavior problems were uniquely important when compared with attention and behavior problems at other developmental periods.

Components of Attention and Behavior Problems

Our next analysis disaggregated the attention and behavior problems composite by component. This analysis was only possible using the U.S. cohort because the large number of items assessing attention and behavior problems provided adequate coverage of the three distinct components. Table 6 presents the results of regression models using childhood impulsive aggression, hyperactivity/impulsivity, and attention problems to predict adult outcomes in the U.S. cohort. For these models, we followed the same approach as the one taken in Table 5: we began by treating each measure independently (columns 1 to 4) before including the various components of attention and behavior problems simultaneously in a combined model (column 5).

After accounting for all control variables, the strongest predictor of one's highest degree earned at age 26 was attention problems, β = -0.16, 95% CI [-.23, -.09] with an estimate somewhat larger than that for the overall composite measure, β = -0.13. None of the components were strong predictors of being overweight in young adulthood, OR = 1.00 to 1.10, or depression risk, OR = 1.08 to 1.11, with estimates similar in size to that for the overall attention and behavior problems composite. The strongest predictor of having ever spent time in jail was hyperactivity/impulsivity, OR = 1.74, 95% CI [1.22, 2.48], with an estimate somewhat larger than that for the composite attention and behavior problems measure, OR = 1.63. This pattern of relative strength among behavioral components was unchanged when including all components of attention and behavior problems in the combined regression model (column 5).

Additional Results

We conducted sensitivity analyses to determine whether family income or child gender moderated the association between childhood attention and behavior problems and adult outcomes. We found very little evidence for moderation along these dimensions (see Table S4 of the Supplementary Materials) and concluded that childhood attention and behavior problems

were predictive of adult outcomes, regardless of a child's gender or family income.

Discussion

The first goal of this study was to understand whether the finding that attention and behavior problems in childhood predicted a range of outcomes in adulthood in the Dunedin Study from New Zealand (Moffitt et al., 2011) would generalize to cohorts from the U.S. and the U.K. Our analyses produced remarkably similar results; in some cases, coefficients were nearly identical to those reported by Moffitt and colleagues (2011). These convergent findings emerged from cohorts born in different decades than the Dunedin sample, from different countries, and assessed at two different stages of life—young adulthood in the U.S. cohort and middle age in the U.K. cohort. The findings also held across the wide range of adult outcomes examined. Our findings, along with the original findings from Moffitt et al. (2011), provide evidence from three countries and cohorts that attention and behavior problems in childhood are robustly predictive of diverse outcomes in adulthood with important implications. Differences in education, earnings, and financial health imply diverging fates for later savings and standard of living. In the U.S., it also implies lower savings for retirement and healthcare. Attention and behavior problems also predict later health, substance use, and time in jail—consequential outcomes for individuals but also burdens to society. As a result, children's attention and behavior problems appear to be important for the lifespan. Indeed, using a subsequent wave of the Dunedin study (age 45), Richmond-Rakerd et al. (2021) reported that attention and behavior problems in childhood predict accelerated aging, poorer health, and less preparation for financial well-being in retirement.

The few findings that did not generalize to the U.S. and U.K. may result from age or cohort differences. For example, we did not find that attention and behavior problems predicted

homeownership at age 26 in the U.S. cohort. Given that the median age at the purchase of one's first home is 32 in the United States (Consumer Financial Protection Bureau, 2020), home ownership is likely a better measure of financial health later in adulthood than at age 26. Similarly, attention and behavior problems predicted poor overall health at midlife (in the U.K. cohort) but not in young adulthood (the U.S. cohort), perhaps reflecting less variability in health among young adults compared with adults in middle age. We also found that attention and behavior problems were not strongly predictive of single parenthood. In the U.S. cohort, this might also be due to the age differences in the time of assessment—fewer people will have children at age 26 compared with age 32. This difference might also be due to the period in which this cohort was born: adolescent fertility has declined steadily in the United States since the 1990s (Lindberg et al., 2016). Even if attention and behavior problems are important drivers of development across the times and places examined, attention and behavior problems may still shape outcomes differently for certain cohorts or at different ages.

Why are attention and behavior problems so predictive of adult outcomes across contexts? Attention and behavior problems make it difficult to adjust to the academic and social demands of children's environments and these difficulties likely carry forward in development (Masten & Cicchetti, 2010). Success in many areas of adulthood depends on planning, setting goals, attending to one's actions in pursuit of those goals, and inhibiting behaviors that would be counterproductive to those goals (Diamond, 2013). Completing higher education, for example, requires building on knowledge gained in the home environment and on children's intelligence, but it also depends on individuals' efforts and ability to make plans, to follow through with plans, and to ignore temptations (Duckworth et al., 2019). Ensuring that one has savings for emergencies or unforeseen expenses requires attention to goals, financial discipline, and

inhibiting impulses to spend rather than save (Moffitt et al., 2011). Similarly, promoting one's health requires building habits of exercise and nutrition that trade temporary gains for long-term benefits (Inzlicht et al., 2021; Richmond-Rakerd et al., 2021). Problems of impulsivity and inattention likely interfere with these goals.

Of course, many other factors influence adult outcomes as well, ranging from influences from the family of origin to ongoing transactions between individuals in their environment in adulthood (Sameroff, 2010). Children who display impulsivity, for example, may also be more likely to engage in other behaviors such as risk-taking (Duckworth & Steinberg, 2015), delinquent, or antisocial behaviors (Shaw et al., 2005), which may lead to greater difficulties in adolescence (Moffitt et al., 2011; Shaw et al., 2012). Similarly, for children exhibiting aggressive behavior, aggression may become a learned response for dealing with challenges or social dilemmas and become chronic (Nagin & Tremblay, 1999; Tremblay et al., 2018). Impulsive aggression can lead to social or peer rejection (Evans et al., 2015; Saylor & Amann, 2016), making it more difficult to get along with others or receive social support that helps individuals accomplish goals and cope with stress and adversity (Pilcher & Bryant, 2016). The downstream consequences of impulsive behavior and impulsive aggression in childhood may increase risk for poor adult outcomes through these pathways. Future work can examine this possibility, but what we can conclude from the current study is that attention and behavior problems in childhood portend difficulties meeting the demands of one's environment throughout development.

Our findings also carry implications for the process of conceptual replication. We sought to follow the original analyses as closely as possible and reconstructed the composite of attention and behavior problems at the individual item-level. We achieved a close reconstruction of the composite using the U.S. cohort, but the behavioral items for the U.K. cohort were only available

beginning at age 7. Ultimately, the difference did not appear to influence the results, though the process was revealing in other ways. Working at the item-level gave us a clear sense of the item content and the constructs measured. After reviewing the items, which assessed impulsive, hyperactive, inattentive, and impulsive-aggressive behaviors, we viewed them as attention and behavior problems emerging from low self-control rather than low self-control itself. Working at this level also gave us a sense of how closely our analyses aligned closely with the original study. We found remarkably similar effects across the three datasets, despite some differences in measurement across them.

Our second goal was to understand whether attention and behavior problems predicted adult outcomes independently of children's home environment and childhood achievement. The associations for outcomes related to education, work, and finances attenuated by about one third, on average, in both the U.S. and U.K. cohorts. This means that the adult outcomes were predicted, in part, by the covariance shared between attention and behavior problems and other childhood characteristics. Significant associations in other domains, however, including physical health, mental health and substance use, and involvement with law enforcement, were less affected by additional controls. The stability and persistence of associations may emerge from the breadth of the attention and behavior problems composite, which combines information across raters and multiple waves. However, given that the composite combines so much information, its meaning can be difficult to interpret.

Our third goal was to understand whether attention and behavior problems during specific periods of childhood showed differential associations with adult outcomes. One limitation of our study is that our behavioral measure began at age 4 in the U.S. cohort and at age 7 in the U.K. cohort rather than at age 3 as in the Moffitt et al. (2011) study. To the extent that individual

differences in attention and behavior problems emerge prior to this age, our analyses did not capture that variability. However, when examining attention and behavior problems in early childhood, middle childhood, and adolescence, we did not find evidence that any one period was driving associations, but rather that each was predictive of outcomes in adulthood.

Early childhood is often noted as a critical period for intervention, but our findings did not suggest it was the sole predictor of adult outcomes. Our findings suggest that reductions in attention and behavior problems during any period of childhood could link to more positive adult outcomes. However, early intervention may be important for other reasons, perhaps because early skills serve as the foundation for later skills (Heckman, 2006) or because early childhood is potentially more malleable for interventions designed to improve children's control of their behavior (e.g., Zelazo et al., 2016).

Our findings offer some clarity about which aspects of attention and behavior problems are most predictive of adult outcomes. Attention problems measured across childhood was the strongest predictor of children's later educational attainment, aligning with prior findings that children's attention predicts academic achievement (Duncan et al., 2007) and educational attainment (McClelland et al., 2013). This suggests that attentional control underlies learning (Blair & Raver, 2015) and may promote educational attainment indirectly through achievement. Attention may also be related to persistence and goal completion (Duckworth et al., 2019), qualities necessary to complete schooling. In contrast, hyperactivity/impulsivity was the strongest predictor of having ever spent time in jail. It may be that impulsivity is linked to more sensation-seeking and risky behavior (Duckworth & Steinberg, 2015), leading to a higher likelihood of involvement with law enforcement.

Despite the clear evidence that childhood attention and behavior problems predicted

important adult outcomes, the implications for interventions remain somewhat obscured. Although we found consistency in the prediction for various measures of attention and behavior problems, including those disaggregated by age and component, the most consistent predictor of adult outcomes was the behavioral composite aggregated across ages and type of attention and behavior problems. Thus, if interventions hope to generate the effects reported here, they may need to affect a broad set of behaviors over a sustained period of time. Although some early childhood interventions have found success at positively affecting control of behavior (e.g., Raver et al., 2009), and a recent review details approaches that interventions can take to act on self-control (Duckworth et al., 2018), intervening to affect a broad array of behavioral capacities over the course of childhood is a tall order. What is more, intervention studies frequently report smaller effects than those in correlational studies, even correlational studies that include control variables (Bailey et al., 2018). The associations reported here should be considered upper bounds of effect sizes that could emerge from interventions targeting attention and behavior problems.

Future Directions

We now have findings from three cohorts and countries that attention and behavior problems in childhood predict a range of adult outcomes. Although there are cultural differences among the countries examined, each of them is high-income and Anglophone and the samples were mostly White. Though we did not find evidence for heterogeneity by family income or child gender, it is not yet clear how these findings would generalize to other settings. Unfortunately, there are few studies anywhere in the world that follow the same set of children prospectively into adulthood, so similar studies in other countries may not be forthcoming for a while.

Despite the strength of longitudinal studies for following participants into adulthood, they

are also limited by the measures available to researchers when the participants were children. Given that measures of children's behavior have advanced since the NCDS, Dunedin, and SECCYD studies observed children born in the 1950s, 1970s, and 1990s, respectively, future studies should work towards clarifying the distinctions among behavior problems, self-control, and executive function by comparing these constructs and examining their prediction of adult outcomes. Until then, however, the takeaway from the present study is that attention and behavior problems in childhood, as operationalized in this study, predict a range of important adult outcomes decades later.

Conclusion

The consistency with which findings held across datasets, cohorts, and countries underscores the importance of attention and behavior problems for development across the lifespan. The consistency also provides compelling support to the broader notion that characteristics and experiences of individuals in childhood affect them well into adulthood. Given the years and range of experiences an individual has in the decades between childhood and adulthood, these consistent findings are all the more remarkable. We hope this study encourages researchers to conduct similar investigations of adult outcomes linked to other childhood predictors and to share prospective datasets to facilitate future conceptual replication studies.

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Table 1

Ages and Years of Assessments for the Three Birth Cohorts

Study	Country	Birth year	Ages and Years of Childhood Behavioral Assessments					Ages and Years of Adult Assessments	
NCDS	United Kingdom	1958			7		11	33	42
					1965		1969	1991	2000
Dunedin	New Zealand	1972-73	3	5	7	9	11	32	
			1975	1977	1979	1981	1983	2004	
SECCYD	United States	1991	4	5	7	9	11	26	
			1995	1996	1998	2000	2002	2017	

Note: Assessments for the Dunedin study stretched into each subsequent year.

Table 2

Descriptive Statistics: U.S. Cohort (SECCYD; N = 1,168)

	n	*M* / %	SD	Min	Max
Key Predictors					
Childhood attention and behavior problems	973	0.00	1.00	-1.39	4.51
Non-Hispanic White	1,168	81.4%			
Female	1,168	48.7%			
Wechsler IQ (age 9)	1,012	106.86	14.44	62	147
Parental occupation (age 0-11)	1,167	1.66	1.02	0.46	5.19
Proportion of epochs partner/husband present (age 0-11)	1,168	0.82	0.29	0	1
Maternal depression (age 0-11)	1,168	9.50	6.42	0	39.20
Income-to-needs ratio (age 0-11)	1,167	3.84	2.96	0.16	22.46
Parenting quality (age 3-11)	1,167	-0.02	0.74	-3.35	1.36
Maternal PPVT (age 3)	1,100	99.25	18.37	40	159
Woodcock-Johnson PPVT (age 4-11)	1,152	485.55	13.46	402	529
Woodcock-Johnson Letter-Word (age 4-11)	1,151	453.83	28.11	316	536
Woodcock-Johnson Applied Problems (age 4-11)	1,151	473.70	19.19	356	531
Adult Outcomes at Age 26					
Highest degree obtained	814	5.24	1.63	1	9
Occupational ranking	806	9.62	5.30	1	17
Unemployed	803	3.9%			
Annual salary (USD 2019)	769	43,596	33,150	0	212,000
Financial efficacy	810	3.97	0.85	1	5
Owns own home	811	17.3%			
Trouble paying bills	812	1.86	1.11	1	5
Financial worries	812	2.26	1.25	1	5
Overweight	801	50.2%			
Poor health	806	9.6%			
Health impairment	805	25.3%			
Depression risk	808	32.8%			
Uses tobacco	806	7.9%			
Near daily alcohol use	796	11.6%			
Near daily marijuana use	785	13.4%			
Used drugs in the past year	784	15.7%			
Single parent	803	12.3%			
Ever spent time in jail	804	5.0%			

Note. These descriptive characteristics were generated from the non-imputed data.

Table 3

Descriptive Statistics: U.K. Cohort (NCDS; N = 16,506)

	n	*M*/%	SD	Min	Max
Key Predictors					
Childhood attention and behavior problems	16,506	0.00	1.00	-1.73	9.01
White	12,772	98%			
Female	16,506	49%			
Childhood IQ	14,130	42.94	16.14	0	80
SES	15,690	4.05	1.49	1	7
Adult Outcomes at Age 42					
Highest degree (at age 33)	10,797	2.43	1.51	0	5
Social class of current job	9,301	3.93	1.25	1	6
Unemployed	10,938	15%			
Annual earnings (USD 2019)	8,899	39,129	52,393	0	412,877
Financial health	11,026	3.97	1.01	1	5
Owns home	10,864	82%			
Overweight	10,782	52%			
Poor health	11,024	18%			
Depression risk	10,917	18%			
Drinks on most days	11,024	20%			
Smokes cigarettes everyday	11,024	26%			
Used cannabis in last 12 months	10,910	6%			
Used illicit drugs in last 12 months	10,910	3%			
Single parent	11,026	7%			
Been arrested and taken to station in past 9 years	10,928	4%			

Note. These descriptive characteristics were generated from the non-imputed data.

Table 4

Regression Estimates for Attention and Behavior Problems Predicting Adult Outcomes Across Dunedin, SECCYD, and NCDS Studies

Dunedin (age 32, New Zealand; Moffitt et al., 2011)			**SECCYD (age 26, U.S., *N* = 1,168)**					**NCDS (age 42, U.K., *N* = 16,506)**			
	Est.	**Eq. 1 Models**		**Est.**	**Eq. 1 Models**	**Eq.2 Models**	**Eq. 3 Models**		**Eq. 1 Models**	**Eq. 2 Models**	**Eq. 3 Models**
Work and finances											
Socioeconomic status	β	-0.08*	Highest degree	β	-0.22***	-0.14***	-0.13***	Highest degree (age 33)	-0.13***	-0.12***	-0.08***
					[-.28,-.15]	[-.20,-.07]	[-.20,-.07]		[-.15,-.12]	[-.13,-.10]	[-.09,-.06]
			Occupational ranking	β	-0.16***	-0.11**	-0.11**	Social class current job	-0.08**	-0.07**	-0.04*
					[-.23,-.08]	[-.19,-.03]	[-.19,-.03]		[-.12,-.03]	[-.11,-.03]	[-.08,-.00]
			Unemployed	OR	1.43*	1.34	1.35	Unemployed	1.32***	1.27***	1.26***
					[1.07,1.92]	[0.96,1.85]	[0.97,1.87]		[1.24,1.40]	[1.19,1.35]	[1.18,1.34]
Income	β	-0.11**	Annual salary	β	-0.08	-0.05	-0.05	Annual earnings	-0.07***	-0.06***	-0.04***
					[-.17,.00]	[-.14,.04]	[-.14,.04]		[-.09,-.05]	[-.08,-.04]	[-.06.-.02]
Financial planfulness	β	-0.14***	Financial efficacy	β	-0.15***	-0.11*	-0.11*	Financial health	-0.07***	-0.05***	-0.04**
					[-.24,-.07]	[-.20,-.02]	[-.20,-.02]		[-.09,-.04]	[-.07,-.03]	[-.06,-.02]
			Owns own home	OR	1.01	1.12	1.13	Owns home	0.73***	0.76***	0.78***
					[.83,1.24]	[0.90,1.40]	[0.91,1.41]		[0.69,0.77]	[0.72,0.80]	[0.73,0.82]
Financial struggles	β	0.16***	Trouble paying bills	β	0.17***	0.11**	0.11**				
					[.09,.25]	[.03,.20]	[.03,.19]				
			Financial worries	β	0.14**	0.09*	0.09*				
					[.06,.22]	[.01,.18]	[.01,.17]				
Physical health											
Physical health index	IRR	1.11*	Overweight	OR	1.15	1.04	1.02	Overweight	1.13***	1.12***	1.11***
					[.97,1.37]	[0.87,1.26]	[0.84,1.24]		[1.07,1.18]	[1.07,1.18]	[1.06,1.17]
			Poor health	OR	1.05	0.93	0.92	Poor health	1.26***	1.21***	1.19***
					[0.82,1.36]	[0.70,1.23]	[0.69,1.23]		[1.19,1.32]	[1.15,1.28]	[1.13,1.26]
			Health impairment	OR	1.33**	1.29*	1.29*				
					[1.10,1.61]	[1.06,1.58]	[1.05,1.58]				
Mental health and substance use											
Recurrent depression	OR	1.10	Depression risk	OR	1.26**	1.11	1.11	Depression risk	1.29***	1.25***	1.25***
					[1.06,1.49]	[0.93,1.33]	[0.93,1.33]		[1.22,1.37]	[1.18,1.33]	[1.17,1.33]
Substance dependence	IRR	1.19*	Uses tobacco	OR	1.45**	1.37*	1.36*	Smokes cigarettes	1.44***	1.40***	1.38***

					[1.14,1.84]	[1.05,1.79]	[1.04,1.79]		[1.37,1.52]	[1.33,1.48]	[1.31,1.46]
			Near daily alcohol	OR	1.03	1.03	1.01	Drinks most days	1.02	1.02	1.04
					[0.79,1.33]	[0.77,1.38]	[0.75,1.35]		[0.96,1.08]	[0.96,1.08]	[0.98,1.11]
			Near daily marijuana	OR	1.22	1.16	1.16	Cannabis in past year	1.36***	1.34***	1.36***
					[0.99,1.51]	[0.91,1.48]	[0.90,1.48]		[1.25,1.47]	[1.23,1.45]	[1.25,1.48]
			Other drug past year	OR	1.02	1.04	1.03	Illicit drugs in past year	1.28***	1.22**	1.24**
					[0.81,1.29]	[0.81,1.33]	[0.80,1.33]		[1.14,1.44]	[1.09,1.37]	[1.10,1.40]
Single parent											
Single-parent	OR	1.48**	Single parent	OR	1.23	1.09	1.09	Single parent	1.14**	1.11*	1.11*
					[0.96,1.57]	[0.83,1.45]	[0.81,1.46]		[1.05,1.24]	[1.02,1.21]	[1.02,1.21]
Criminal activity											
Criminal conviction	OR	1.71***	Ever spent time in jail	OR	1.74***	1.58**	1.63**	Ever arrested past 9 years	1.48***	1.41***	1.40***
					[1.29,2.33]	[1.15,2.17]	[1.17,2.28]		[1.35,1.62]	[1.28,1.56]	[1.26,1.55]

Note. *$p < .05$, **$p < .01$, ***$p < .001$. 95% CIs are shown in square brackets. Eq. = Equation, IRR = incident rate ratio, OR = odds ratio for 1 SD difference in attention and behavior problems, β = standardized OLS coefficient. Dunedin estimates are from Table 1, Model 2 of Moffitt et al. (2011). Each column presents separate regression models corresponding to equations 1, 2, and 3, respectively. Models corresponding to equation 1 include parental occupation, childhood IQ, child gender, race/ethnicity, and study site/region of birth. Models corresponding to equation 2 add: income-to-needs ratio, parenting quality, epochs husband/partner in the home, maternal PPVT and maternal depression for the SECCYD. Equation 2 controls for the NCDS included father involvement, number of people per room, whether employed and hardship at age 11, as well as father involvement and difficulties with housing, finances, physical illness, mental illness, divorce, domestic tension, unemployment, and alcoholism measured at age 7. Models corresponding to equation 3 add childhood academic achievement.

Table 5

Regression Estimates for Attention and Behavior Problems During Discrete Developmental Periods Predicting Adult Outcomes

		SECCYD (Age 26, U.S., *N* = 1,168)					**NCDS (Age 42, U.K., *N* = 16,506)**				
	Est.	Separate Models by Developmental Period				Combined Model	Separate Models by Developmental Period				Combined Model
Highest degree earned		(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Childhood (age 4.5 – 11)	β	-0.13*** [-.20,-.07]				-	-0.08*** [-.09,-.06]				-
Early childhood (age 4.5 - 5)	β		-0.07* [-.14,-.01]			0.00 [-.09,.08]		†			†
Middle childhood (age 7-9)	β			-0.12*** [-.19,-.06]		-0.08 [-.18,.02]			-0.06*** [-.07,-.04]		-0.03** [-.05,-.01]
Early adolescence (age 11)	β				-0.11*** [-.17,-.05]	-0.06 [-.15,.03]				-0.07*** [-.09,-.06]	-0.06*** [-.08,-.04]
Overweight											
Childhood (age 4.5 – 11)	OR	1.02 [0.84,1.24]				-	1.11*** [1.06,1.17]				-
Early childhood (age 4.5 - 5)	OR		1.10 [0.92,1.32]			1.14 [0.92,1.41]		†			†
Middle childhood (age 7-9)	OR			1.03 [0.85,1.24]		1.05 [0.79,1.38]			1.10*** [1.05,1.16]		1.09** [1.03,1.15]
Early adolescence (age 11)	OR				0.95 [0.80,1.14]	0.88 [0.69,1.11]				1.08** [1.03,1.13]	1.04 [0.98,1.09]
Depression risk											
Childhood (age 4.5 – 11)	OR	1.11 [0.93,1.33]				-	1.25*** [1.17,1.33]				-
Early childhood (age 4.5 - 5)	OR		1.13 [0.94,1.36]			1.15 [0.93,1.42]		†			†
Middle childhood (age 7-9)	OR			1.02 [0.84,1.25]		0.86 [0.65,1.14]			1.16*** [1.10,1.22]		1.07* [1.01,1.14]
Early adolescence (age 11)	OR				1.11 [0.93,1.34]	1.15 [0.90,1.48]				1.23*** [1.16,1.31]	1.20*** [1.12,1.28]
Time in jail											
Childhood (age 4.5 – 11)	OR	1.63** [1.17,2.28]				-	1.40*** [1.26,1.55]				-

Early childhood (age 4.5 - 5)	OR	1.31			1.02	†			†
		[0.96,1.80]			[0.70,1.51]				
Middle childhood (age 7-9)	OR		1.59**		1.38		1.23***		1.08
			[1.15,2.19]		[0.89,2.14]		[1.13,1.35]		[0.98,1.19]
Early adolescence (age 11)	OR			1.48**	1.21			1.39***	1.35***
				[1.11,1.99]	[0.81,1.80]			[1.26,1.53]	[1.22,1.49]

Note. **p* < .05, ***p* < .01, ****p* < .001. 95% CIs are shown in square brackets. OR = odds ratio for 1 SD difference in attention and behavior problems, β = standardized OLS coefficient. All models included controls associated with Equation 3 (see Table 5 note). Model 5 includes attention and behavior problem composites from each developmental period simultaneously to test the unique importance of attention and behavior problems during each developmental period. The "-" sign notes that the attention and behavior problem composite describing all of childhood was excluded because of redundancy with the other composites. †The NCDS did not measure attention and behavior problems prior to age 7.

Table 6

Regression Estimates for Components of Attention and Behavior Problems Predicting Adult Outcomes, Using SECCYD (Age 26, N *= 1,168)*

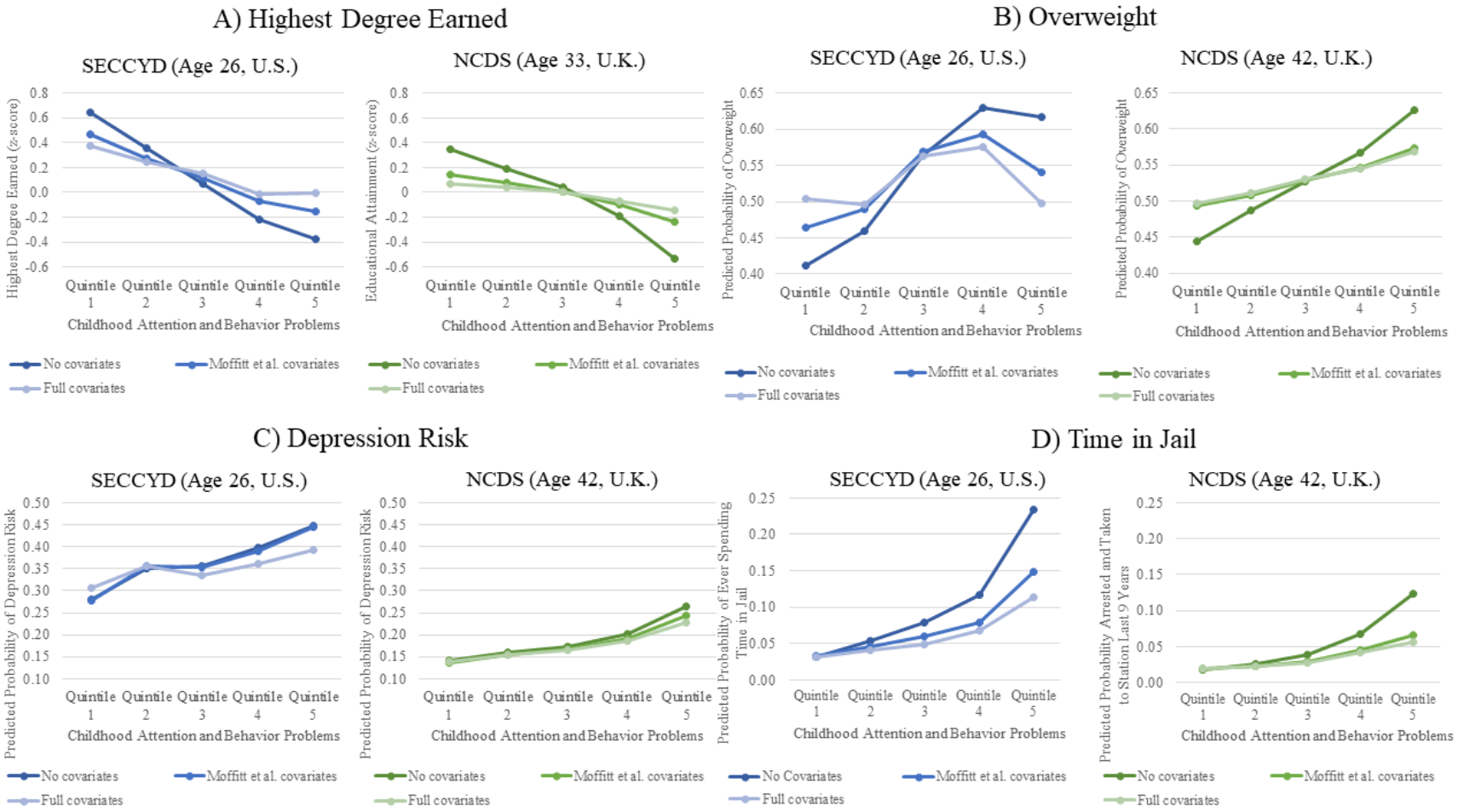
	Est.					Combined Model
Highest degree earned		(1)	(2)	(3)	(4)	(5)
Attention and behavior problems	β	-0.13***				-
		[-.20,-.07]				
Impulsive aggression	β		-0.11**			-0.05
			[-.18,-.04]			[-.15,.05]
Hyperactivity/impulsivity	β			-0.11**		0.01
				[-.19,-.04]		[-.10,.12]
Attention problems	β				-0.16***	-0.15**
					[-.23,-.10]	[-0.23,-.06]
Overweight						
Attention and behavior problems	OR	1.02				-
		[0.84,1.24]				
Impulsive aggression	OR		1.08			1.04
			[0.89,1.32]			[0.80,1.34]
Hyperactivity/impulsivity	OR			1.10		1.16
				[0.91,1.34]		[0.87,1.34]
Attention problems	OR				1.00	0.89
					[0.82,1.21]	[0.70,1.14]
Depression risk						
Attention and behavior problems	OR	1.11				-
		[0.93,1.33]				
Impulsive aggression	OR		1.11			1.09
			[0.93,1.33]			[0.85,1.40]
Hyperactivity/impulsivity	OR			1.08		0.98
				[0.89,1.31]		[0.73,1.32]
Attention problems	OR				1.10	1.07

					[0.92,1.32]	[0.84,1.37]
Ever spent time in jail						
Attention and behavior problems	OR	1.63**				-
		[1.17,2.28]				
Impulsive aggression	OR		1.36*			0.99
			[1.01,1.84]			[0.66,1.49]
Hyperactivity/impulsivity	OR			1.74**		1.63
				[1.22,2.48]		[0.97,2.74]
Attention problems	OR				1.52*	1.12
					[1.07,2.17]	[0.70,1.79]

Note. *$p < .05$, **$p < .01$, ***$p < .001$. Estimates are shown with 95% CIs in square brackets shown below them. OR = odds ratio for 1 SD difference in attention and behavior problems, β = standardized OLS coefficient. All models presented included the full set of controls corresponding to Equation 3 (see Table 5 note), with separate models fit for each component of attention and behavior problems. Model 5 includes all of the attention and behavior problem components in a single model to test the unique importance of each component of attention and behavior problems. The "-" sign notes that the attention and behavior problem behavior composite describing all components was excluded because of redundancy with the other composites.

Figure 1

Select Adult Outcomes in SECCYD and NCDS by Quintile of Childhood Attention and Behavior Problems



Note. Plotted values were pooled across imputed datasets. Moffitt et al. covariates are child gender, IQ, and parental occupation. Full covariates add characteristics of the home environment during childhood and achievement.