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Not in education, employment and training: pathways from toddler difficult temperament

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Background: Youths disengaged from the education system and labour force (i.e. 'Not in Education, Employment, or Training' or 'NEET') are often at reduced capacity to flourish and thrive as adults. Developmental precursors to NEET status may extend back to temperamental features, though this – and possible mediators of such associations such as attention deficit hyperactivity (ADHD) symptoms and antisocial behaviours (ASB) – have yet to be directly tested. This study investigates if i) difficult temperament in toddlerhood associates with NEET status in adulthood and ii) different subdomains of ADHD (i.e. hyperactivity-impulsivity vs. inattention) in late childhood and ASB in adolescence partially explain this pathway. **Methods:** Participants were 6,240 mother-child dyads (60.7% female) from the Avon Longitudinal Study of Parents and Children. Mothers reported on their child's (a) difficult temperament (i.e. mood, intensity and adaptability) at age 2 and (b) ADHD symptoms at ages 8 and 10. Participants reported their own ASB at age 14 and NEET status in adulthood (ages 18, 20, 22 and 23). **Results:** First, higher levels of difficult temperament in toddlerhood directly associated with an increased probability of being NEET in adulthood. Second, this effect was carried through hyperactivity-impulsivity, but not inattention, in late childhood, and ASB in adolescence; this demonstrates differential contribution to the pathway between the ADHD dimensions, with symptoms of hyperactivity-impulsivity playing a prominent role. **Conclusions:** Early difficult temperament is a vulnerability factor for NEET status in adulthood. Our findings suggest that one developmental pathway for this vulnerability manifests through increased hyperactivity-impulsivity in childhood and ASB in adolescence. Of note, difficult temperament, as measured here, reflects difficulties in emotional and behavioural self-control (e.g. low adaptability and high intensity negative emotional expressions). Our results, therefore, suggest a prominent developmental role for lack of self-control from toddlerhood onwards in increasing risk for NEET. **Keywords:** Difficult temperament; NEET; ADHD; antisocial behaviours; ALSPAC.

Introduction

Young adults who are not in education, employment and training ('NEET') are at increased risk for a myriad of adverse life outcomes. For instance, they are more likely to develop depression, anxiety, drug problems and long-term illnesses, as well as holding lower status occupations even if they subsequently enter employment (Feng, Everington, & Ralston, 2015). In 2018, approximately 783,000 individuals in the United Kingdom between the ages 16 and 24 (11.2% of this age group) faced such risks (Powell, 2018). Additionally, NEET individuals place tremendous economic burdens on the society. These individuals could cost over 3% of the GDP a year collectively, due to lost taxes and related impacts such as crime and poor health (Coles, Godfrey, Keung, Parrott, & Bradshaw, 2010). Evidently, interventions to reduce NEET rate are critical not only to these individuals but also to the society at large. However, a recent systematic review comparing the efficacy of interventions targeting NEETs aged between 16 and 24 years found only a 4% increase in employment, while gains in other areas such as health and earnings lack consistency (Mawn et al., 2017).

These findings suggest that it may be valuable to investigate atypical pathways earlier in development that may lead to NEET. These basic science results may lend insight into why interventions in midadolescence and early adulthood result in only modest gains in employment, and may point to earlier intervention targets. Here, we examine one such plausible pathway beginning much earlier in life, focusing on associations with difficult temperament in toddlerhood, and explore the extent to which attention deficit hyperactivity disorder (ADHD) in childhood and antisocial behaviours (ASB) in adolescence underlie these associations. The results could pave way for more effective interventions targeting at-risk individuals earlier in development, when, presumably, they are more malleable.

Thomas and Chess (1977) identified nine dimensions of temperament, including mood, intensity, adaptability, approach, rhythmicity, persistence, distractibility, activity and threshold. In particular, children who are described as temperamentally difficult were suggested to show predominantly negative mood, high intensity of emotional expression, low approach to novelty, low adaptability to the environment and reduced biological rhythmicity (Thomas & Chess, 1977). Children with similar traits (e.g. high in impulsivity, negativity, and emotional lability; also known as 'Undercontrolled') have indeed been found

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to have poor educational and employment outcomes (Caspi, 2000). For education, these 'Undercontrolled' children have been found to be more likely to leave secondary school earlier, compared to their 'Well-adjusted' counterparts (Caspi, 2000). Specifically, among those who left school early, 21% of temperamentally difficult children were 'asked to leave school' (i.e. not due to underachievement) – a rate over 5 times higher than their 'Inhibited' and 'Well-adjusted' counterparts. For employment, Caspi, Wright, Moffitt, and Silva (1998) also found that individuals with difficult temperament at age 3 were 15% more likely to be unemployed at between ages 15 and 21, even after controlling for IQ and parental occupation. Taken together, these problems in education and employment suggest that children with a difficult temperament are more likely to become NEET later in life, but intervening variables that could help explain this relationship have yet to be examined. As temperamental difficulty suggests impairment in self-control, we hypothesised that this effect could occur via indicators reflecting similar deficits, such as ADHD and ASB, both known precursors of NEET status.

ADHD has been found to associate both with dimensions of difficult temperament and with ASB. For instance, in a sample of school-aged children diagnosed with ADHD, higher levels of temperamental intensity and activity were associated with ADHD and its subdomains of hyperactivity-impulsivity (e.g. always 'on the go' and lacks self-control) and inattention (e.g. difficulty focusing and easily distracted; Chauhan, Shah, Padhy, & Malhotra, 2019). Symptoms of ADHD, especially those specific to the subdimension of hyperactivity-impulsivity, have in turn been found to associate with higher incidence of ASB, which has high overlap with the poor impulse control behaviours of conduct disorder (e.g. lying, fighting, stealing; American Psychiatric Association, 2013). In particular, Pardini and Fite (2010) found that symptoms of hyperactivity-impulsivity, but not inattention, in boys at age 10 prospectively associated with an increase for risk of conduct disorder behaviours across a 2-year follow-up. Similar associations are also found among girls. For example, Ahmad and Hinshaw (2017) found that symptoms of hyperactivity-impulsivity at age 9.5 significantly associated with subsequent conduct disorder behaviours 4 years later.

Both ADHD and ASB prospectively associate with NEET status. For ADHD, studies have found overall associations with NEET status, but it is unclear at this stage whether subdimensions of ADHD differentially predict NEET status. For example, Agnew-Blais et al. (2018) found that participants high in ADHD symptoms from ages 5 to 18 were at high risk to be NEET at age 18. As for ASB, Rodwell et al. (2018) found that adolescents displaying persistent conduct disorder behaviours were twice as likely to be NEET as young adults (OR = 2.01). These effects remained significant (OR = 1.71) even after controlling for potential confounds of parental education and parental marital status.

In sum, the literature supports the plausibility of an atypical developmental pathway from early difficult temperament to NEET status in adulthood, in which symptoms of hyperactivity-impulsivity and ASB may play important intermediary roles. Using over 2 decades of longitudinal data, this study is the first to test not only the prospective association between difficult temperament in toddlerhood and NEET status in adulthood, but also how this effect can be explained by indicators of impaired emotional and behavioural self-control (e.g. hyperactivity-impulsivity and ASB). We propose two main hypotheses: (a) difficult temperament in toddlerhood will increase the probability of being NEET in adulthood and (b) this effect occurs through symptoms of hyperactivity-impulsivity (but not inattention) and via ASB equivalent to some conduct disorder behaviours. Across these models, we will also include covariates that are associated with NEET status, such as IQ (Hegelund, Flensborg-Madsen, Dammeyer, & Mortensen, 2018), early conduct problems at age 7 (Goldman-Mellor et al., 2016), family adversity and education (Feng et al., 2015). Additionally, we also control for temperamental activity (e.g. 'fidgets during quiet activities' and 'runs to get to desired place') given that (although it is not a part of Thomas and Chess' overall definition of difficult temperament [Thomas & Chess, 1977]) there is evidence that it associates with difficult temperament (McDevitt & Carey, 1978), subdimensions of ADHD (Chauhan et al., 2019) and ASB (Barker & Maughan, 2009).

Methods

Sample

The Avon Longitudinal Study of Parents and Children (ALSPAC) is an ongoing, population-based study that investigates influences (e.g. environmental and genetic) on the health and development of children. Pregnant women with expected delivery dates between Apr. 1st, 1991 and Dec. 31st, 1992, and who resided in the former Avon Health Authority, England were eligible to take part (Fraser et al., 2013). An initial cohort of 14,541 pregnant women was recruited, with 13,988 children alive at 12 months of age. Compared to the 1991 National Census Data (Boyd et al., 2013), the overall sample was broadly typical of the U.K. general population. The present sample consists of mothers and children of primarily White ethnicity (>96%). In terms of social class, the majority of mothers in the present sample belong to social class II (intermediate, 35.7%) and social class IIINM (non-manual, 41.3%), based on the Registrar General Occupational Classification (Office of Population Censuses & Surveys, 1991).

Ethical approval for the study was obtained from the ALSPAC Law and Ethics Committee and the Local Research Ethics Committees. Further information on ALSPAC (http://www.bris.ac.uk/alspac/) and data available through a fully searchable data dictionary and variable search tool (http://www.bristol.ac.uk/alspac/researchers/our-data/) are available online.

Measures

NEET status was assessed at ages 18, 20, 22 and 23. At each time point, participants were coded as 0 if they engaged in employment, education or training, and as 1 if they engaged in none of the activities (i.e. NEET). Since only 3% of the participants reported being NEET at 2 or more timepoints, the scores were summed across the 4 timepoints and dichotomised again. Here, 0 represents never having NEET status at these time points and 1 represents having NEET status at 1 or more timepoints.

Difficult temperament was assessed at age 2 using the Carey Toddler Temperament Scale (CTTS; Carey & McDevitt, 1978). Mothers reported on their child's temperament on 5-point scales, ranging from 1 ('almost never') to 5 ('almost always'). However, several items have low endorsement rates for 'almost never' (less than 5%), so these items were made into 4-point scales. The five dimensions of difficult temperament as defined by Thomas and Chess (1977) were initially tested, measured with the most internally consistent items: mood (3 items, e.g. 'is pleasant during face washing'), intensity (4 items, e.g. 'screams when frustrated'), adaptability (4 items, e.g. 'accepts delay for desired objects'), approach (9 items, e.g. 'approaches new visitors at home') and rhythmicity (7 items, e.g. 'takes daytime naps at different times'). Here, items with low factor loadings ($\lambda < 0.35$) were excluded from the analysis and remaining items were coded such that higher scores reflected more difficult temperament. All subscales demonstrated acceptable reliability, ranging from $\alpha = .65$ (rhythmicity) to $\alpha = .87$ (approach). A second-order confirmatory factor analysis (CFA) was performed to investigate the factor structure of difficult temperament. Here, the first-order dimensions of approach ($\lambda_{approach} = .17$) and rhythmicity ($\lambda_{rhythmicity} = .34$) were both excluded from the model, due to low factor loadings. Items from the remaining three dimensions of mood ($\lambda_{mood} = .50$), intensity ($\lambda_{intensity} = .70$) and adaptability ($\lambda_{adaptability} = .71$) were then used to create a second-order factor that reflects a propensity for vehement, negative mood and low behavioural self-regulation.

ADHD was assessed at ages 8, 10 and 14 using items from the Development and Well-being Assessment (DAWBA) interview, a well-established measure developed for the British Child Mental Health Surveys (Goodman, Ford, Richards, Gatward, & Meltzer, 2000). Each item was introduced with the stem 'Over the last 6 months, and as compared with other children the same age, has s/he often…' and mothers reported children's 9 symptoms of hyperactivity-impulsivity (e.g. 'child often fidgets') and 9 symptoms of inattention (e.g. 'was easily distracted') on 3-point scales ranging from 0 ('no') to 2 ('a lot more than others'). Scores for each symptom were summed across the two timepoints and the levels were collapsed into 3 ordered categories including 0 (i.e. 0 at both time points), 1 (i.e. a sum score of 1 across the timepoints) and 2 (i.e. a sum score of 2 and above). This was done because many response categories had low endorsement rates (less than 5%). Scores for the subdimensions of both hyperactivity-impulsivity ($\alpha = .91$) and inattention ($\alpha = .93$) demonstrated excellent reliability. These symptoms were included in the model in a correlated two-factor structure.

ASB were assessed at age 14 using 7 self-report items adapted from the Edinburgh Study of Youth Transitions and Crimes (Smith & McVie, 2003). Participants reported on frequency of behaviours such as 'respondent has hit kicked or punched someone on purpose' or 'has taken something from a shop without paying', on a 4-point scale ranging from 1 ('not at all') to 4 ('6+ times'). The items were dichotomised into 'none' and 'at least once' as many response categories had low endorsement rates (less than 5%). The items were declared as categorical and included in the model as indicators of a single latent variable.

See Table S1 for full information on model fit indices of study variables.

Covariates. We controlled for established predictors of NEET related to both the child and the family. Relating to the child, these include: (a) IQ measured at age 8 using Wechsler Intelligence Scale for Children III^{UK} (Wechsler, 1998), (b) gender as reported at age 2 months, (c) Key stage 1 summary score (higher score equals better performance), a national curriculum assessment of English reading, writing, spelling and mathematics at age 7 years, (d) activity score measured at age 2 years using the CTTS (Carey & McDevitt, 1978) and (e) conduct problems measured at age 7 years using the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001). Relating to the family, we controlled for family financial difficulties and mother's education level and psychopathology, as measured by the Family Adversity Index (FAI; Bowen, Heron, Waylen, & Wolke, 2005) when the study child is at ages 0–2. A high score on FAI represents having higher risks. These covariates were included on every path in the model. Additionally, parent-DAWBA band score for ADHD at age 14 was included as an additional control for NEET status.

Included versus excluded sample

Participants who provided data on their NEET status were selected for this study, resulting in a sample of 6,240 mother-child dyads (60.7% females). We tested if study variables and covariates predicted inclusion/exclusion from the analytic sample using multivariate logistic regression. No significant differences were found for (a) difficult temperament, (b) symptoms of ADHD, (c) activity level and (d) conduct problems at age 7. However, the odds ratios (ORs) indicated that children excluded from the study were more likely to (a) have higher levels of ASB at age 14 years (OR = 1.102, $p = .037$), (b) be male (OR = .453, $p < .001$), (c) have lower IQ (OR = .981, $p < .001$), (d) have a lower key stage 1 score (OR = .889, $p < .001$) and (e) have higher scores on FAI (OR = 1.190, $p = .001$).

Data analysis

All analyses, including the CFA models mentioned, were conducted using Mplus version 8.4 (Muthén & Muthén, 1998-2017), and all models were tested using an SEM framework. All analyses were conducted using the weighted least squares mean and variance adjusted (WLSMV) estimator. Using WLSMV in conjunction with covariates accounts for missingness in the data, provided that the pattern of missingness is at random with respect to covariates (Asparouhov & Muthén, 2010). Goodness-of-fit for all models was assessed using the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and root mean square error of approximation (RMSEA), where CFI and TLI above .90 (Bentler & Bonett, 1980) and RMSEA below .08 (Browne & Cudeck, 1993) indicate acceptable model fit. Potential skew in standard errors underlying indirect effects was accounted for using bootstrapping ($B = 10{,}000$), and we report bias-corrected 95% confidence intervals for indirect effects in the results (Preacher & Hayes, 2008). The indirect effects were examined using the 'IND' command in Mplus, where the products of path coefficients are used to test the indirect effects (Muthén & Muthén, 1998-2017).

The analyses proceeded in three main steps. First, we tested if difficult temperament at age 2 was associated with increased likelihood of being NEET in adulthood. Second, we examined if this effect occurs through hyperactivity-impulsivity and/or inattention in late childhood, and sequentially through ASB at age 14. For both models, associations are reported as unstandardised probit coefficients and linear regression coefficients for categorical and continuous dependent variables, respectively. Probit coefficients indicate the impact a one-unit change in the predictor variable has on the cumulative normal

probability of the dependent variable (Muthén & Muthén, 1998-2017). Finally, as an alternative data analytic method, we also implemented multiple imputation (MI) in Mplus with 20 imputed datasets (Muthén & Muthén, 1998-2017), with all the variables described above, to test the robustness of the results, given the presence of missing data. See Table S2 for full information on model fit indices and comparison of parameter estimates.

Results

Descriptive statistics

As shown in Table 1, the latent difficult temperament variable was significantly correlated with both subdimensions of ADHD, NEET status and all covariates. Hyperactivity-impulsivity was significantly correlated with inattention, ASB and all covariates. Inattention was significantly correlated with ASB and NEET status, and all covariates except activity level. Finally, ASB were correlated with NEET status and all covariates except sex and IQ.

Direct effect

First, we tested the direct effect of difficult temperament on NEET status. With the covariates accounted for, higher levels of mother-reported difficult temperament at age 2 significantly increased the likelihood of being NEET in adulthood (self-reported; $b = .092$, $p = .001$).

Indirect effects

Next, we tested whether this direct effect occurred via subdimensions of childhood ADHD (hyperactivity-impulsivity and inattention) and adolescent ASB (see Figure 1 for parameter estimates). Four findings are highlighted. First, difficult temperament associated with higher levels of both hyperactivity-impulsivity and inattention. Second, only higher levels of hyperactivity-impulsivity, but not inattention, significantly associated with higher levels of ASB. Third, higher levels of ASB significantly predicted increased likelihood of NEET status. Fourth, the indirect effect from difficult temperament to NEET status via ASB was only significant through the hyperactivity-impulsivity subdomain ($b = .004$, 95% bootstrapped CI [.001, .009]), but not through inattention ($b = .000$, 95% bootstrapped CI [−.003, .003]). This specific indirect effect accounted for 4.3% of the total effect. Similar to the previous model, the direct effect remained significant, but was reduced by 19.6% after introducing the intermediary variables.

Multiple imputation

These two models were tested again using multiply imputed data sets. As shown in Table S2, path coefficients were similar in the imputed and

Table 1 Descriptive statistics and bivariate associations for study variables

	Diff Temp	Hyp-Imp	IA	ASB	NEET	Sex	IQ	Key 1	Activity	Conduct	FAI
Diff Temp	1										
Hyp-Imp	.360***	1									
IA	.295***	.790***	1								
ASB	.052	.150***	.130***	1							
NEET	.092**	.084**	.073**	.118***	1						
Sex	−.120***	−.217***	−.238***	−.041	−.035	1					
IQ	−.117***	−.154***	−.218***	.010	−.058**	−.080***	1				
Key1	−.127***	−.255***	−.357***	−.072**	−.113***	.082***	.591***	1			
Activity	.654***	.269***	.199***	.068**	.013	−.102***	−.083*	−.096***	1		
Conduct	.357***	.438***	.375***	.153***	.106***	−.041*	−.124***	−.141***	.173***	1	
FAI	.194***	.184***	.172***	.103***	.073***	.035*	−.133***	−.169***	.074***	.135***	1
M	33.364	3.249	3.923	0.875	N/A	N/A	106.937	10.530	22.948	1.477	.422
SD	6.194	4.521	5.087	1.293	N/A	N/A	16.112	3.329	4.540	1.398	.662
Min	16	0	0	0	0	0	45	8	9	0	0
Max	54	18	18	7	1	1	149	12	36	10	3

Test variables are: Diff Temp = Difficult temperament, Hyp-Imp = Hyperactivity-impulsivity, IA = Inattention, ASB = Antisocial behaviours, NEET = NEET status; covariates are: Sex, Key 1 = Key stage 1 score, Activity = Activity level, Conduct = Conduct problems (SDQ), FAI = Family Adversity Index; *$p < .05$; **$p < .01$; ***$p < .001$; Correlations are calculated based on latent scores; Descriptive statistics calculated using sum scores.

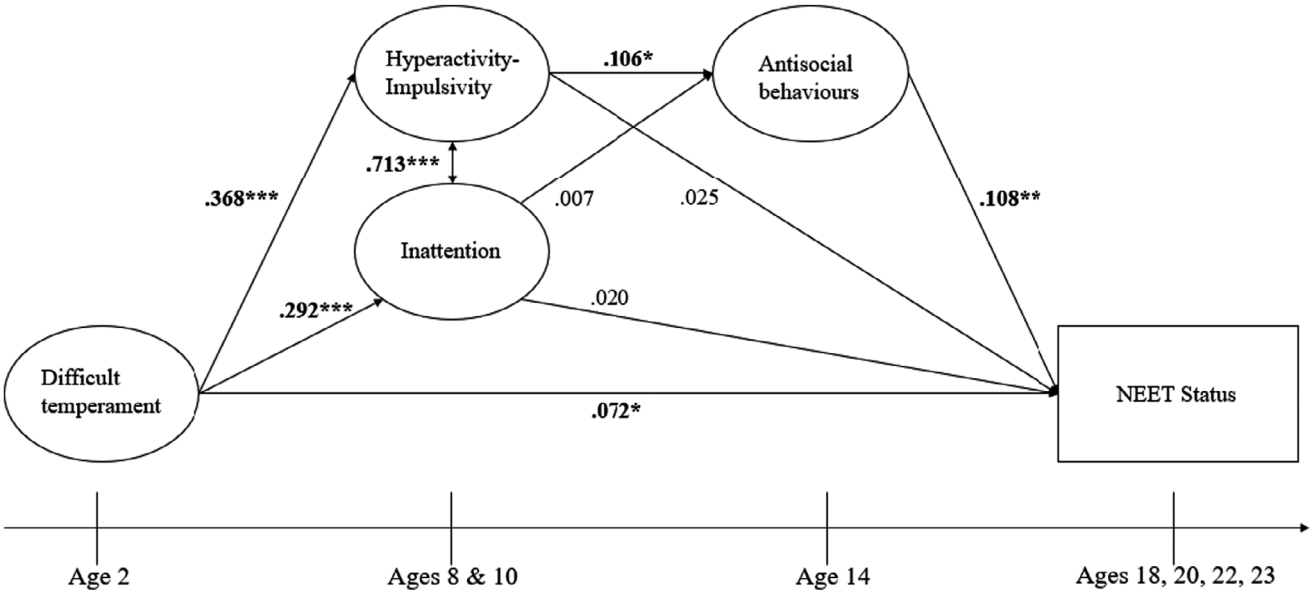

Figure 1 Unstandardised path estimates for the model testing indirect effects. *$p < .05$; **$p < .01$; ***$p < .001$

nonimputed data sets, and the significance of parameter estimates remained the same. We therefore will discuss the results of the WLSMV-based models.

Discussion

Given the personal and economic costs of being NEET ('Not in Education, Employment and Training'), this study sought to uncover a developmental pathway to NEET status that might point to early targets for intervention. We highlight two key findings: (a) difficult temperament at age 2 associated with NEET status in young adulthood, even after controlling for several important confounds (intelligence, early academic achievement, family adversity, temperamental activity and early conduct problems), (b) a significant indirect effect was found from difficult temperament to NEET status through hyperactivity-impulsivity (but not inattention) in childhood and ASB in adolescence. To note, estimates from our study may be conservative, as participants lost due to attrition tended to be less able (e.g. lower IQ and key stage 1 score) and more antisocial than those in the analytic sample. Stronger effects may be observed in more inclusive samples. Additionally, against our expectations, only dimensions of mood, intensity and adaptability loaded adequately onto the second-order difficult temperament variable. Therefore, difficult temperament in this study includes indicators of emotional and behavioural regulation such as 'screams when frustrated' and 'accepts delay for desired objects', but not items measuring biological rhythmicity (e.g. 'daily waking time varies') and approach (e.g. 'wary at first in new place').

How might these long-term developmental linkages arise? One possibility is that temperamental difficulty indexes problems in self-control that undermine young people's chances of entering and/or sustaining education and employment. Indeed, Moffitt et al. (2011) found that children with low self-control (e.g. high in emotional lability and impulsivity) were more than twice as likely to leave school early and without educational qualifications. As for employment, those with low self-control have been found to spend more time in unemployment, compared to their high self-control counterparts (Daly, Delaney, Egan, & Baumeister, 2015). This relationship between difficult temperament and NEET status also occurs indirectly via symptoms of ADHD (especially those of hyperactivity-impulsivity) and ASB.

While dimensions of difficult temperament have been found to concurrently and retrospectively associate with ADHD (Chauhan et al., 2019; Mcintosh & Cole-Love, 1996), our study extends this literature by showing that the overall factor of difficult temperament prospectively associates with both subdimensions of ADHD. Existing evidence suggests that this longitudinal relationship could be explained by difficult temperament acting as a precursor of ADHD symptoms (see review by Campbell, Halperin, & Sonuga-Barke, 2014). For instance, Campbell (2002) observed that toddlers with emerging signs of ADHD tend to exhibit behaviours similar to temperamentally difficult toddlers in our study, such as difficulty calming down, proneness to temper tantrums and noncompliance. Our findings are similar but extending into prospective associations. Indeed, the measurement of difficult temperament in our study includes items such as 'screams when frustrated' and 'shows strong reactions to failure' that reflect low emotional self-control, and items such as 'accepts delay for desired objects' and 'can be coaxed from forbidden activity' that capture behavioural

self-control (Carey & McDevitt, 1978). It is important to note that these relationships remain significant even after controlling for indicators of high motor activity (e.g. 'fidgets during quiet activities' and 'runs to get to desired place'). This demonstrates that the associations between difficult temperament and symptoms of hyperactivity-impulsivity and inattention are independent of temperamental activity levels.

We also found that symptoms of hyperactivity-impulsivity were prospectively associated with ASB, whereas symptoms of inattention did not. This is consistent with the literature, since frequent ASB may be indicative of impulsivity/low self-control (Pratt, Cullen, Blevins, Daigle, & Unnever, 2002) and impaired emotional regulation (Rodwell et al., 2018). Indeed, Unnever, Cullen, and Pratt (2003) found that the effects of ADHD on youths' self-reported delinquent involvement primarily arose through low self-control. Here, we found that hyperactivity-impulsivity, which is closely related to low self-control, prospectively associated with ASB, while inattention had no significant effect. Similarly, hyperactivity-impulsivity may also associate with ASB via impaired emotional control (e.g. irritability). For example, childhood irritability has been found to associate prospectively with both hyperactivity-impulsivity symptoms (Orri et al., 2019) and associate genetically with conduct problem symptoms (Stringaris, Lewis, & Maughan, 2014). Additionally, irritability is also predicted by dimensions of difficult temperament such as high intensity and low adaptability (Whelan, Leibenluft, Stringaris, & Barker, 2015), lending further support to this indirect pathway that arises from reduced emotional and behavioural self-control.

Finally, adolescent ASB was found to associate with NEET status. Adolescents frequently engaging in antisocial and disruptive behaviours are more likely to face disciplinary measures and even expulsion from school, facilitating their disengagement from education (Finn, 1989). The literature has also suggested that higher levels of antisocial or aggressive behaviours associate with negative emotions and emotional regulation, which could undermine one's ability to enter and sustain employment (Rodwell et al., 2018).

Taken together, reduced self-regulatory capacities associated with difficult temperament and hyperactivity-impulsivity may set children on an atypical developmental pathway, where they are eventually 'ensnared' into lifestyles (e.g. engagement in ASB) that then lead to problems in education and employment (Moffitt et al., 2011). It is interesting to note that symptoms of hyperactivity-impulsivity have been found to decrease towards late adolescence, while those of inattention increase (Larsson, Dilshad, Lichtenstein, & Barker, 2011); however, it is hyperactivity-impulsivity that associates with ASB (Ahmad & Hinshaw, 2017; Pardini & Fite, 2010). This may merit attention in future research.

Given these findings, interventions targeting self-regulation at an early age may be helpful in mitigating downstream maladaptive outcomes. Indeed, self-control has been empirically found to stabilise at between age 8.5 and 10.5 years (Vazsonyi & Ksinan Jiskrova, 2018), suggesting that childhood offers a key window for intervention. A meta-analysis of self-control intervention programs with children of a mean age below 10 years lends support to the efficacy of early intervention on self-control and delinquency (Piquero, Jennings, Farrington, Diamond, & Gonzalez, 2016). Of note, some of these programs also included elements of emotional understanding and communication, which target children's emotional regulation. Small-to-medium effect sizes for improvement in self-control (0.32) and delinquency (0.27) were found (Piquero et al., 2016), suggesting that early interventions targeting self-control may reduce the risks of becoming NEET later in life.

Strengths and limitations

There are three main strengths to this study. First, using a longitudinal data-set spanning over two decades, we were able to demonstrate how atypical development leading to NEET status begins early in life in toddlerhood. Second, the study included over 6,000 mother-child dyads, providing substantial statistical power. Third, by examining how different components of ADHD contribute to the developmental pathway, our results lend support for the role of reduced self-regulation in this cascade.

Our findings should also be considered in the context of four limitations. First, both difficult temperament and ADHD symptoms were reported by mothers, which could inflate the strength of the associations we observed. However, since ASB and NEET status were both self-reported, this issue of shared method variance does not inflate the overall indirect effect of interest. Secondly, the present study uses a community sample that consists of over 96% ethnically White participants; therefore, replications of these findings in other cohorts are necessary to further examine their generalisability to families of other ethnicities and at higher levels of clinical risk. Third, effect sizes of observed estimates were modest, which could arise partly from selective attrition. Here, proportionately more of the most at-risk families were lost to follow up over time, leading to an underrepresentation of participants with behavioural problems and poor educational/employment outcomes. This is similar to a study by Wolke et al. (2009), where selective attrition reduced the *prevalence* rate of disruptive behaviours. However, they found that the *associations* between outcomes and risks remained intact, and that the observed estimates were more

conservative than the likely true effects. Additionally, despite the modest effect sizes, the present findings could still be of practical significance at the population level, which is supported by the research on aspirin and heart attacks (Rosnow & Rosenthal, 1996). Here, NEET is also a highly costly issue to society, and faced by a substantial percentage of young adults, so even modest improvements could translate into a significant gain at the population level. This could include improved mental and physical health among these individuals, as well as recovered lost taxes for the government. Finally, more research is needed to examine other pathways through which early difficult temperament associates with NEET status. For instance, temperamentally difficult children may experience interpersonal difficulties early on (Szewczyk-Sokolowski, Bost, & Wainwright, 2005), and positive peer relationships are consistently associated with higher educational attainment (Dika & Singh, 2002); this impact on education attainment may then increase their risk of being becoming NEET.

Conclusion

NEET is a critical issue at personal and societal levels; therefore, an understanding of its developmental origins is important for identifying early targets for intervention. To our knowledge, this study is the first to test how an overall difficult temperament in toddlerhood associates with NEET status in adulthood, as well as testing indirect pathways involving subdimensions of ADHD and ASB. The results and the literature suggest that this indirect pathway could be explained by underlying impairments in emotional and behavioural self-control. However, future research with more diverse samples is needed to assess the generalisability of these findings.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. Supplementary table for model fit indices.
Table S2. Supplementary table comparing model parameters obtained using nonimputed and imputed data.

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Key points

- Early difficult temperament is associated with NEET in adulthood.
- Toddler difficult temperament is directly associated with increased risk for being NEET in adulthood.
- This direct effect also occurs indirectly via hyperactivity-impulsivity (but not inattention) and antisocial behaviours.
- Reduced self-regulatory capacity may help explain this longitudinal relationship.

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