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Do early environmental factors influence the relationship between psychopathy and life outcomes: Longitudinal findings from the Dunedin multidisciplinary health and development study

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ABSTRACT

The current study sought to understand whether environmental factors early in development differentiate psychopathic individuals who obtain successful versus unsuccessful life outcomes. In doing so, the study relied upon a large (N = 1037), population representative sample known as the Dunedin Multidisciplinary Health and Development Study (Dunedin Study) which afforded the investigation of this relationship over time from birth to age 45. It was hypothesized that the identified environmental factors would explain differences between those high in psychopathy with varying levels of "success" across criminal behavior, wealth, health, and relationship quality outcomes. Using latent class growth and latent profile analysis and multivariate analysis of variance, it was found that less sensitive parent-child interactions, exposure to adverse childhood experiences, lower socioeconomic status and greater peer delinquency were prevalent in individuals high in psychopathy who had poor life outcomes later in life, to a greater extent than for those high in psychopathy who had comparably more favorable outcomes. Recognizing diverse manifestations of psychopathy and broadening definitions of success allow for a more comprehensive understanding of the construct. Addressing socioeconomic disadvantage and providing targeted, early, client-centered interventions may improve life outcomes for those high in psychopathic traits and reduce societal harm.

1. Introduction

Traditionally, much of the interest around the psychopathic personality (or 'psychopathy') has been fueled by its association with a wide range of socially undesirable outcomes including substance misuse, criminal behavior and violence (see DeLisi, 2018; Douglas et al., 2018; Ellingson et al., 2018 for comprehensive reviews). More recently, however, researchers have begun to examine psychopathy from a broader perspective, by investigating "successful" expressions of the disorder in which the classic personality traits are present, in the absence of criminal behavior. The triarchic psychopathy model is one conceptualisation of the psychopathy construct that is particularly well-suited to answering such questions as it allows for examination of both adaptive and maladaptive domains.

2. "Successful" or non-criminal psychopathy

With respect to psychopathy, "success" has most commonly been defined as the absence of overt criminal activity through the assessment of incarceration status, conviction or arrest counts, reconviction rates, self-reported delinquency, or avoidance of legal repercussions for crimes committed (e.g. Ishikawa et al., 2001; Lasko & Chester, 2021; Sellbom et al., 2022; Wall et al., 2013). Others have operationalized success as the presence of psychopathic traits in non-criminal contexts such as higher status occupational environments (e.g. Babiak et al., 2010; Lilienfeld et al., 2012) or general community samples (e.g. Maffei et al., 2020). However, these operationalizations represent a relatively narrow lens through which to view success. As identified by the various formal diagnostic systems available (e.g. ICD-11 or DSM-5), there are numerous other aspects of life that, if impaired, cause significant difficulties for the

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individual, their friends and family, and society, and are therefore worthy of investigation in relation to psychopathy. For example, social and occupational functioning may also be an important consideration in evaluating the impact of the disorder more broadly (Welsh & Lenzenweger, 2021). In addition, the aforementioned conceptualizations of success are based on the avoidance of negative outcomes, which is largely incongruent with what is considered successful in non-psychopathic individuals (Steinert et al., 2017). Additional research is needed to further elucidate the various expressions of the disorder. Such findings may bear importance to understanding the impact of psychopathic traits at both the individual and societal level.

2.1. Psychopathy and non-criminal outcomes

Beyond criminal involvement, psychopathy has been linked to a range of other life outcomes that some consider to be indicative of "success" (or a lack thereof) including wealth, health and relationships. Several studies have demonstrated that psychopathy, particularly its affective and behavioral components, tend to be negatively associated with indicators of wealth (e.g.Pavlić & Međedović, 2019; Persson & Lilienfeld, 2019). In contrast, psychopathy's interpersonal characteristics have generally been found to be positively associated with aspects of wealth (Pavlić & Međedović, 2019; Persson & Lilienfeld, 2019). With respect to health, the minimal research available tend to demonstrate a relationship between psychopathy (particularly affective and behavioral traits) and related traits (i.e. low self-control and contentiousness), as well as poor health outcomes (e.g. Međedović & Kujačić, 2020; Moffitt et al., 2011). Interpersonal functioning is another outcome worthy of consideration. By definition, those high in psychopathy display a pattern of mean and disinhibited behavior that is likely to put them at odds with those around them. For example, men higher in psychopathic personality traits have been found to be more oriented towards mating behavior and were also less likely to endorse the parental behaviors necessary for child-rearing (Brazil & Volk, 2022). Interestingly however, there are also some positive interpersonal features that make this relationship complex. The few studies that have examined this question directly have tended to find an association between psychopathy and aspects of poor relationship quality, insecure attachment, engagement in physical fights and bullying across various relationship types as well as intimate partner violence (e.g. Andersen et al., 2022; Christian et al., 2017; Robertson et al., 2020; Zara et al., 2024). Although this is not true for boldness which tends to be associated with more successful interpersonal relationship qualities (e.g. Christian et al., 2017). In sum, psychopathic personality traits appear to contribute meaningfully to outcomes in a number of life domains beyond criminality.

2.2. Moderated-expression model of successful psychopathy

As illustrated, psychopathy does appear to be meaningfully associated with outcomes across a range of life domains, although the exact nature of these relationships is not well understood. Given this issue, the current investigation sought to further build upon existing literature by examining potential explanations for individual differences in life outcomes. These differences have been conceptualized using a number of different frameworks (see Benning et al., 2018; Hall & Benning, 2006; Lilienfeld et al., 2015; Steinert et al., 2017). The moderated-expression model, which is the subject of the current investigation, considers the interaction between psychopathic traits and other factors external to the construct, which strengthen or weaken the relationship between the traits and associated outcomes. This view aligns with common developmental theories such as Bronfenbrenner and Morris's (2006) bioecological framework (proximal processes within nested systems) and with Bandura's (1986) reciprocal determinism (dynamic person–behavior–environment interactions) which emphasise context-dependent developmental pathways. From this theoretical perspective, one can seek to understand how two individuals with a similar degree of severity and configuration of psychopathic traits, might display vastly different life outcomes.

Originally proposed by Hall and Benning (2006), Steinert et al. (2017) elaborated on the moderated-expression model by emphasizing the importance of delineating core psychopathy traits such as emotional callousness, grandiosity, and manipulative tendency from those peripheral to the disorder, as the latter should be considered as potential environmental, structural, and contextual moderating variables. We have confined this investigation to environmental factors - the experiences within one's environment during development that have a lasting influence. These experiences are thought to shape what an individual learns about the world, and subsequently contribute to differences in behaviors and life outcomes exhibited among individuals who possess similar psychopathic traits, yet do not share environmental experiences. We acknowledge that early adversity may also contribute to the development of psychopathic traits. In this paper, we explicitly sought to evaluate the moderated-expression perspective which considers environmental factors to be compensatory factors, that attenuate the expression or consequences of psychopathic personality factors. In particular, the parent-child relationship, family dysfunction, childhood socioeconomic status (SES), and peer delinquency are environmental factors identified as pertinent to the research question in previous literature. These are outlined in further detail below.

2.3. Parent-child relationship and family dysfunction

The role of the parent-child relationship and family dysfunction was first considered in early seminal works on psychopathy (e.g. Cleckley, 1941; Karpman, 1948). Empirical research has since extensively examined and illustrated the role of such factors in the development of psychopathic traits and their stability over time (see Schimmenti et al., 2020 for a review). Features of the parent-child relationship and family dysfunction have also been found to be associated with negative outcomes across various life domains including criminal behavior (see Jolliffe et al., 2017 for a review), wealth (Schurer et al., 2019), physical health (e.g. Bellis et al., 2019) and relationships (e.g. Donnellan et al., 2005). Given clear links to both psychopathy and various life outcomes, numerous authors have identified these factors as potential moderators of the relationship between psychopathy and such outcomes (e.g. Lilienfeld et al., 2015; Steinert et al., 2017). Despite this, relatively few studies have sought to elucidate this relationship.

Previous studies have found that harsh and inconsistent discipline, parental warmth and involvement, parental conflict, and willingness towards disclosure to parents are all features of the parent-child relationship that interact with psychopathy to predict aggressive or criminal behavior albeit with some inconsistencies across specific psychopathy traits (Edens et al., 2008; Hipwell et al., 2007; Kimonis et al., 2013; Silva & Stattin, 2016). Thus, the impact of the parent-child relationship may differ largely between the various trait domains, and the potential influence of such factors on non-criminal outcomes of the disorder have not yet been examined. Parental neglect has also been associated with socially adaptive outcomes through psychopathic personality traits, indicating that psychopathy could be an adaptive response to challenging family environments in order to obtain certain advantageous social outcomes (Brazil et al., 2025). Looking at the role of the family more broadly, Ishikawa et al. (2001) found higher rates of parental absence among those with unsuccessful psychopathy presentations compared to those with successful psychopathy presentations, however rates of household domestic violence and experiences of sexual abuse did not differ between these groups. Based on this limited existing literature, it is unclear whether exposure to other adverse childhood experiences may similarly explain different expressions of psychopathic traits, as such questions pertaining to successful psychopathy have not yet been examined.

2.4. Childhood socioeconomic background

Family resources during childhood and adolescence have also been identified as a possible moderator of the relationship between psychopathy and life outcomes (Lilienfeld et al., 2015; Steinert et al., 2017). SES has been found to be an important predictor of psychopathy (see Farrington & Bergstrøm, 2018 for a review), as well as key life outcomes including future SES (e.g. Muhammad Zakir et al., 2020), criminal behavior (see Jolliffe et al., 2017 for a review), health (e.g. Milaniak & Jaffee, 2019), and relationship quality (see Karney, 2021 for comprehensive reviews). However, despite these links to both psychopathy and life outcomes, minimal research has directly investigated SES from a moderated-expression theoretical perspective.

Masui and Ura (2016) examined childhood SES as a potential moderator of the relationship between psychopathy and aggressive humor style (e.g. sarcasm, using humor to tease, criticize, or manipulate others) and found that low childhood SES strengthened this relationship. In contrast, Zwaanswijk et al. (2018) found that the relationship between psychopathic traits in youth, and conduct problems was comparable across the different levels of family SES therefore indicating that SES may not moderate the relationship between psychopathy and behavioral outcomes. Other research has largely examined SES in adulthood with inconsistent findings. Although one study found that high SES strengthened the relationship between psychopathy traits and incarceration likelihood (Anestis et al., 2019), other findings suggest that high SES may serve as a protective factor in the relationship between psychopathy and criminality (Sellbom et al., 2022; Walsh & Kosson, 2007). As is evident, existing research regarding the potentially moderating role of SES in the relationship between psychopathy and success is largely inconsistent and has limited this investigation to criminal and externalizing behavior outcomes but the evidence is largely cross-sectional.

2.5. Peer delinquency

In addition to parent, family and socioeconomic factors, it has been proposed that peer delinquency may also be an important moderator of the relationship between psychopathy and life outcomes (Steinert et al., 2017). Although youth high in psychopathy are more likely to engage with delinquent peers (Kimonis et al., 2004) and peer delinquency appears to be an important predictor of negative life outcomes pertaining to criminal behavior (Assink et al., 2015) and physical health (Bryan et al., 2013) only one study has examined moderator effects. Specifically, Kerr et al. (2012) found that those higher in psychopathic traits were *less* influenced by peer delinquency in their own delinquent behaviors compared to those low in such traits. Other studies have found that peer delinquency at least partially mediates the relationship between psychopathy and criminal offending, and therefore promotes crime even among high psychopathy individuals (e.g. Bryson et al., 2020; Ray et al., 2017). While informative, such research has only examined criminal behavior outcomes, therefore further research is required to elucidate the role of peer delinquency in moderating the relationship between psychopathy and other life outcomes from a longitudinal perspective.

3. Current study

This study was designed to build upon the emerging literature in elucidating what differentiates psychopathic individuals with "successful" versus "unsuccessful" life outcomes from a moderated-expression perspective. Specifically, we aimed to investigate a variety of relevant environmental variables that had been prospectively assessed as potential moderators (here, antecedents) of the relationship between psychopathy and outcomes including parent, family, socioeconomic and peer factors. Moreover, in keeping with the recommendations of Steinert et al. (2017), we wanted to expand on existing literature by taking a broader and more comprehensive approach to operationalizing the outcomes associated with psychopathy. In doing so, we examined a variety of life domains such as criminal, occupational, physical health and relationship outcomes, in order to gain an extensive understanding of the various manifestations of the disorder. This investigation utilized a population representative, longitudinal sample in which a breadth of psychopathological, physical health, and psychosocial data was available across multiple points from birth to age 45 years, the Dunedin Multidisciplinary Health and Development Study (hereafter the Dunedin Study).

Several outcome variables were selected in an effort to broadly operationalize life success in the context of psychopathy. As the study drew upon archival data from the Dunedin Study sample, variable selection was constrained to the data available within this existing dataset. Notwithstanding data availability, effort was made to select robust outcome variables that would enable a comprehensive understanding of success across the life span. This process resulted in the identification of four life outcome variables considered representative of the spectrum of success across a variety of key life domains including criminal behavior, wealth, health and relationships, which we used to establish longitudinal trajectories of success.

With respect to conceptualizing psychopathy, we relied on the Triarchic Psychopathy Model framework developed by Patrick et al. (2009) as it is largely considered an integration of the various perspectives on psychopathy that identifies three key phenotypic domains that recur throughout the psychopathy literature: *boldness*, *meanness*, and *disinhibition*. Importantly, the triarchic model considers criminal behavior as peripheral rather than central to the disorder, making it a more appropriate conceptualization when examining non-criminal expressions of the construct. To date, research is yet to examine the outcomes associated with psychopathy across such a broad range of life domains, and as extensive a time period as the current study. To facilitate consideration of successful and unsuccessful psychopathy, latent mixture modelling was used to establish empirically derived psychopathy classes (at minimum, low and high psychopathy).

Concerning the primary analyses, we theorized that the identified environmental factors would explain differences between those high in psychopathy with varying levels of success across criminal behavior, wealth, health, and relationship quality outcome trajectories. An unsafe, neglectful, and impoverished environment with influence from delinquent peers should theoretically foster few positive learning opportunities, and cause individuals to adopt protective coping strategies and behaviors that may later become maladaptive when no longer in such environments. In the absence of these negative environmental conditions or in more positive environments, the opposite should be true. Specifically, it was hypothesized that quality parent-child relationships, reduced familial dysfunction, higher childhood SES, and less exposure to peer delinquency would be present in those high in both psychopathy and successful life outcomes (hereafter "successful psychopathy") to a greater extent than those who have less successful life outcomes (referred to as "unsuccessful psychopathy") (Anestis et al., 2019; Bryson et al., 2020; Edens et al., 2008; Ishikawa et al., 2001; Ray et al., 2017; Silva & Stattin, 2016; Walsh & Kosson, 2007).

4. Method

4.1. Participants

Participants were members of an ongoing research project known as the Dunedin Multidisciplinary Health and Developmental Study (hereafter, the Dunedin Study) which has extensively examined the health and behavior of a New Zealand birth cohort across the life course. The Dunedin Study sample consists of 1037 individuals (535 females and 502 males) who represent 91% of the total infants born between 1st April 1972 and 31st March 1973 in the city of Dunedin, Aotearoa/New Zealand. The 9% of eligible infants who did not partake in the study did

not differ from those who did with respect to sociodemographic and birth characteristics. Since the establishment of the Dunedin Study cohort, members have been traced for follow-up at regular intervals across which times participation rates have remained high. The Dunedin Study cohort is representative of the population of New Zealand's South Island with respect to the distribution of socioeconomic resources and ethnicity according to the New Zealand census, with the majority being of New Zealand European/Pākeha ethnicity. At age 45, 8.6% of the cohort reported Māori (the indigenous people of New Zealand) ethnicity. While a large proportion of participants continue to reside throughout New Zealand, the remaining participants reside in various places worldwide including in Australia (172), UK (34), North America (11 USA, 4 Canada), Europe (10), Asia (7), Middle East (3), and Africa (2) (based on age 38 data). See Poulton et al. (2023) for further details regarding the Dunedin Study sample.

4.2. Measures

Fig. 1 shows an overview of the measures included in the current study, and the timepoints at which each was assessed in the Dunedin Study. Descriptive statistics for the environmental moderator variables included in the analyses can be found in Table S1.

4.2.1. Psychopathy

Multidimensional Personality Questionnaire Triarchic Psychopathy Scales. This study relied upon the Multidimensional Personality Questionnaire (MPQ; Tellegen et al., 2023) Form NZ (see Krueger et al., 1996 for further detailed description) to enable the use of the MPQ-based triarchic psychopathy scales (hereafter the MPQ-Tri scales) originally developed and validated by Brislin et al. (2015) and later revised and further validated in the Dunedin Study sample by Veltman et al. (2023) to assess the triarchic psychopathy constructs of boldness, meanness and disinhibition. MPQ-Tri scales were available at age 18 and age 26 and contain a total of 21 Boldness items, 19 Meanness items, and 20 Disinhibition items presented in a lone-statement format with *"true"* or *"false"* responses, or in a forced-choice format with *"a"* or *"b"* responses. Scale scores were calculated as an average across scale items, with a higher score indicative of the presence of that particular psychopathy domain. As reported in Veltman et al. (2023), analyses of internal consistency (Cronbach's α) for each of the scales revealed 0.71 Boldness, 0.72 Meanness, and 0.80 Disinhibition[1] at age 18, and 0.79 Boldness, 0.77 Meanness, and 0.76 Disinhibition at age 26. Scores were then averaged across the two timepoints to generate an average scale score for each triarchic psychopathy domain. Further details regarding the MPQ-Tri scales including a complete list of scale items is available in Veltman et al. (2023).

4.3. Outcome measures

Criminal Convictions. The total number of criminal convictions held by each participant was obtained via consultation of official criminal conviction records held by the New Zealand Police. Criminal conviction records capture all New Zealand convictions, and any Australian convictions known to the New Zealand Police from the age at which conviction is permissible (ages 14 and 10 respectively). The total number of convictions obtained by study members at ages 26, 32, 38 and 45 were included in the current analyses.

Self-Reported Variety of Crimes. Participants were asked to retrospectively report their engagement in criminal behavior within the previous 12-month period using Elliott and Huizinga's (1989) structured instrument as adapted for use in the Dunedin Study. Items encompassed four offence categories: property offenses, rule offenses, drug-related offenses, and violent offenses. A variety of crimes score was calculated by summing the number of different *types* of crimes the individual had engaged at least once within the past year a higher score indicating more extensive involvement in criminal behavior. Variety of crimes scores were obtained for study members at ages 26, 32, 38 and 45. See Beckley et al. (2018) for further detail regarding variety of self-reported offending scores.

Socioeconomic Status in Adulthood. Socioeconomic status was assessed using the Elley and Irving (1976) scale at age 26, and later the New Zealand Socioeconomic Index (NZSEI; Davis et al., 1997) at ages 32, 38 and 45. Both measures used occupation information provided by the participant, and associated education level and income data derived from the New Zealand Census, to assign a score on a scale from 1 (low SES) to 6 (high SES). At age 26, participants who identified themselves as homemakers and students were excluded from the analyses. At subsequent timepoints, for study members who were homemakers or unemployed, SES scores were applied based on information available regarding their most recent occupation, their partner's employment or education level.

Metabolic Syndrome. Metabolic syndrome was based on the measurement of five key biomarkers that were assessed as part of the physical examination conducted in the age 26, 32, 38 and 45 cohorts. These biomarkers were: high waist circumference (≥88 cm for women, ≥102 cm for men), high blood pressure (≥130/85 mmHg), low high-density lipoprotein cholesterol level (<50 mg/dL for women, <40 mg/dL for men), high glycated hemoglobin (≥5.7%), and high triglyceride level (≥200 mmol/L). The presence of three or more of these biomarkers was considered indicative of metabolic syndrome, in accordance with Adult Treatment Panel III guidelines (National Cholesterol Education Program Adult Treatment Panel III, 2002).

Perpetration of Intimate Partner Violence. Perpetration of intimate partner violence (IPV) was assessed using a 33-item scale comprised of items derived from the Conflict Tactics Scales-Revised (Straus, 1990), in addition to supplementary items. Item content assessed perpetration of both physical and psychological violence. At ages 26, 32, 38 and 45 study members who were or had been in a romantic relationship recently were asked to report their engagement in violent behaviors towards their partner in the 12 months prior to the assessment on a dichotomous scale from 0 (not present) to 1 (present). Individual item scores were summed across all 33 items to obtain an overall IPV perpetration scale score at each age. A comprehensive description of this measure and complete list of scale items is available in Bourassa et al. (2020).

4.3.1. Environmental antecedent variables

Environmental antecedent variables were summarized as average scores across the timepoints assessed for ease of interpretation of the findings.

Parent-Child Interaction. Parenting behavior was assessed during an observation of the parent (most often the mother) interacting with their child (the study member) at age three. The interaction was rated based on eight characteristics including expressions of affection, evaluation of the child, handling and management of the child, reactions to the child's need and performance, focus of attention, and the child's physical appearance. Ratings were scored on a bipolar rating scale whereby behavior considered to be indicative of over- or under-demanding parenting, and similarly over- or under- responsive parenting (i.e. overly permissive, or overly authoritarian), was considered indicative of less sensitive parenting. Item were rated on a scale from 0 (sensitive parenting) to 2 (less sensitive parenting) and summed to create an overall index of observed parental behavior, with higher scores indicating less sensitive parenting. Cronbach's α for the less sensitive parent-child interaction scale calculated to be 0.80.

Discipline. At ages seven and nine, a parent of each study member (most commonly the mother) completed a questionnaire regarding the

[1] Due to the unavailability of some revised MPQ-Tri scale items at age 18, the Spearman-Brown correction was applied to calculate internal consistency at this timepoint.

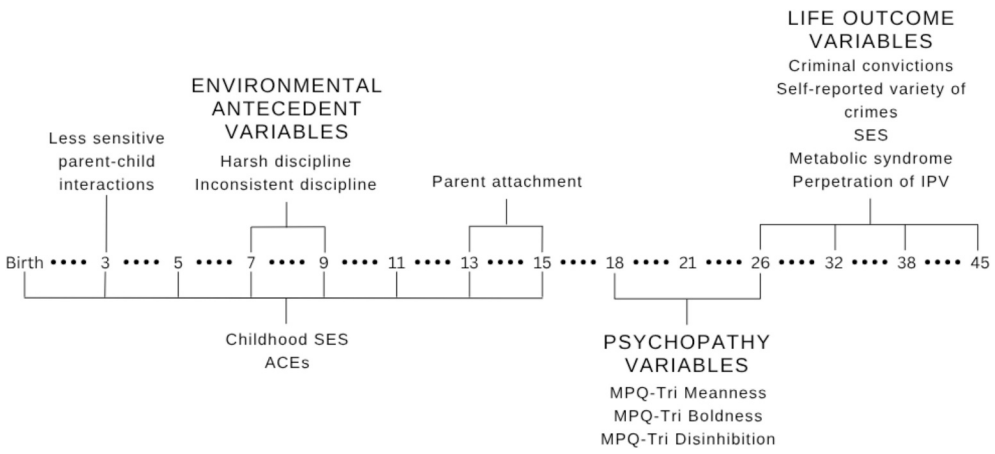


Fig. 1. Overview of the Measures Included in the Current Study and the Timepoints at Which Each was Assessed in the Dunedin Study Sample. Note. SES = socioeconomic status; ACEs = adverse childhood experiences; MPQ-Tri = MPQ Triarchic Psychopathy Scales; IPV = intimate partner violence.

disciplinary practices used to manage their child's misbehavior. In a similar manner to previous research (e.g. Belsky et al., 2005; Magdol et al., 1998; Moffitt et al., 2001), the current study relied on items from the discipline questionnaire to assess harsh and inconsistent parental discipline. Harsh discipline was measured based on parent's endorsement of having engaged in 10 harsh disciplinary behaviors the day prior to the assessment session. The number of harsh disciplinary behaviors endorsed as having occurred the previous day were summed at age seven and nine, and then averaged across the two ages, with a higher score indicting harsher discipline practices. Reliability estimates (Cronbach's α) for harsh discipline at age seven and age nine were α = 0.63 and α = 0.68 respectively. This measure is detailed in Magdol et al. (1998).

Parents were also asked to rate the consistency of discipline behaviors. Specifically, the parent was asked to rate how changeable both their own and the child's other parent's discipline tended to be scale from 0 (very changeable) to 3 (always the same), and whether the two parents handle misbehavior differently from 0 (no) to 2 (a lot). The two items pertaining to changeability of discipline were reverse coded so that a higher score indicated a greater degree of inconsistent discipline. Scores across the three inconsistency items were summed at ages seven and nine, and then averaged across the two timepoints, with a higher score indicating more inconsistent discipline. With respect to internal consistency, the inconsistent discipline scale revealed a Cronbach's α = 0.40 at age seven, and α = 0.46 at age nine.

Parent Attachment. At ages 13 and 15, participants reported their attachment with their parents using a shortened 24-item form of the Inventory of Parent and Peer Attachment (Armsden & Greenberg, 1987). The 12 items pertaining to the parental relationship assessed the extent to which the parent-child relationship is characterized by trust, communication, and alienation. Participants responded using a 4-point Likert scale ranging from 1 (almost never) to 4 (almost always or always). Response scores for Alienation scale items were summed and subtracted from the sum of the Communication and Trust scale item scores to obtain an overall parent attachment score, with higher scores indicative of greater parent attachment. As reported in Nada-Raja et al. (1992), reliability estimates (Cronbach's α) for the parent attachment scale was α = 0.82. Further detail regarding this measure, including a complete list of scale items is available in Nada-Raja et al. (1992).

Adverse Childhood Experiences. Adverse childhood experiences (ACEs) were assessed based on information gathered prospectively as part of each assessment phase from a variety of sources including official records, collateral informants, and observations. In particular, two domains of dysfunction were assessed, each of which included five specific adversities: childhood harm (physical abuse, sexual abuse, emotional abuse, emotional neglect, and physical neglect) and family dysfunction (household partner violence, household substance abuse, family mental illness, parental criminality, and parental separation). Four independent raters with knowledge and training regarding the definition of ACEs reviewed the information gathered above and generated a count score that summarized the total number of ACEs each study member had been exposed to. Reuben et al. (2016) reported that inter-rater agreement between the four raters ranged from kappa = 0.76 to 0.82, with an average of 0.79 across the full ACE count. Further details regarding the prospective ACE measure in the Dunedin Study are reported by Reuben et al. (2016).

Childhood Socioeconomic Status. Socioeconomic status (SES) in childhood was assessed at every time point from birth through to age 15 using the scale developed by Elley and Irving (1976). At each assessment phase, parents reported occupation information that was used to rate SES on a six-point scale that ranged from 1 (unskilled laborer) to 6 (professional) based on the education level and income associated with that occupation according to the New Zealand census. When occupation information was available for both parents, the highest SES level of the parents was used. Childhood SES scores were averaged across all ages to obtain an overall indicator of childhood exposure socioeconomic resources. As reported by Gregory et al. (2006), reliability estimates for childhood SES yielded a Cronbach's α = 0.92. Childhood SES is described in detail by Poulton et al. (2002) and Hancox et al. (2004).

Peer Delinquency. Peer delinquency was assessed via parent-report at age 13 and 15 using items derived from the Revised Problem Behavior Checklist (Quay, 1983; Quay & Peterson, 1993) in the same manner as previous research (Odgers et al., 2008; Ramrakha et al., 2007). The relevant items described engagement in delinquent behavior with peers, belonging to peer groups considered delinquent, or looking up to peers who are delinquent themselves. The response format was a 3-point Likert scale from 0 (no, doesn't apply) to 2 (yes, certainly applies), scores were then averaged with a higher score indicating a greater degree of peer delinquency. As item-level data were not available, reliability estimates for peer delinquency could not be calculated.

4.4. Procedure

The Dunedin Study employs similar research procedure throughout each assessment phase. Participants were brought into the research unit for a full day of individual data collection in which data is collected across various research domains, including mental health, cardiovascular risk, respiratory health, oral health, sexual and reproductive health, and psychosocial functioning. Trained examiners were involved in one research domain and were blind to data collected in other domains during that phase of assessment, or any data previously collected as part of the Dunedin Study. Importantly, examiners were also blind to

any relevant collateral information where that might interfere with assessment results. In order to remove barriers to participation, study members were reimbursed for any costs incurred as a result of their participation (e.g. travel costs, child care). Individuals nominated as informants (e.g. parents, spouses/partners, peers and teachers) were then mailed the relevant information required for their participation.

4.5. Data analyses

Given the complexity of the data obtained from the Dunedin Study with a relatively large number of variables measured at numerous timepoints, there was a pragmatic need for using more "categorical" than dimensional approaches to data analyses in order to address the research questions. Such an approach was informed by previous longitudinal psychopathy research (Klingzell et al., 2016). In doing so, we relied upon latent modelling techniques that accounted for measurement error in empirically deriving relevant groups for use in subsequent analyses. First, longitudinal latent class growth analysis (LCGA) in Mplus Version 8.7 was used to identify groups of participants who shared similar trajectories in the life outcome variables over time. Proportion of maximum transformation was used in order to place all outcome variables on an equivalent scale for inclusion in this model. Criminal convictions were excluded from these analyses as scores were so highly correlated (rs $>$ 0.93) over time that they were extremely unlikely to yield multiple trajectories and were contributing to convergence issues in the model. Full Information Maximum Likelihood (FIML) was used to estimate missing data under the assumption of missing at random or missing completely at random. N (and therefore missingness) for each variable included in the LPA and LCGA models is reported in Table S1. See Fig. 2 for a path model illustrating the LCGA model assessed.

Next, Latent Profile Analysis (LPA) was conducted in Mplus to identify groups of participants who shared similar psychopathy profiles using the aggregate boldness, meanness and disinhibition scores across the two timepoints assessed (i.e. age 18 and age 26). FIML was used to estimate scores for participants who did not have complete psychopathy data in order to retain these individuals in the analyses. See Fig. 3 for a path model illustrating the LPA model assessed.

For both the LCGA and LPA models, we relied upon the Bayesian information criterion (BIC), the Lo–Mendell–Rubin (LMR), and Bootstrap Likelihood Ratio Test (BLRT) statistics to evaluate the optimal number of classes/profiles to retain. The model with the smallest BIC was preferred, while a significant LMR Chi-Square and BLRT ($p < 0.05$) indicated that the current model is preferred over the model with one fewer class. However, models in which one class had fewer than 5% of the sample were not considered viable solutions (Weller et al., 2020). Entropy values greater than 0.70 were considered to indicate sufficient classification quality (Nagin & Nagin, 2005). For the model identified as having the preferred number of classes, estimated class trajectories were examined to determine whether they were consistent with theoretical expectations. Moreover, class/profile membership based on posterior probabilities were saved. This variable was used for further validation of the classes against relevant criteria, as well as for subsequent analyses.

Resulting class membership from the selected model from both the LCGA and LPA models were then used to manually create groups that represent the joint occurrence of psychopathy and life outcomes over time. Specifically, individuals who were observed to share similar combinations across their psychopathy profiles and success class were assigned as members of the same group. Multivariate Analysis of Variance (MANOVA) was conducted in SPSS Version 32 with the identified combined psychopathy and life outcome groups as the fixed factor and the antecedent environmental variables as the dependent variables. This analysis was employed to determine whether there were statistically significant group differences in antecedent environmental variables, particularly between the successful and unsuccessful high psychopathy groups. Wilks' Lambda was examined to determine the significance of the overall model. Univariate analyses were subsequently examined and Tukey's HSD post-hoc tests were conducted to establish the nature of any identified group differences.

5. Results

5.1. Longitudinal latent class growth analyses

In order to identify distinct groups of individuals with shared trajectories in the four life outcomes across time, LCGA models ranging from one to five classes were estimated. We modelled the four life-outcome variables simultaneously using a multivariate (parallel-process) LCGA. Each outcome was entered as a series of observed repeated measures across ages 26–45 and represented by latent growth factors (intercept, linear slope and quadratic slope) for that outcome; the LCGA then classified individuals on the basis of the joint means of these latent growth factors. Both linear and quadratic models were estimated in order to identify growth curve that best fit the observed trajectories in life outcomes over time. Based on consideration of BIC in conjunction with adequate entropy and significant LMR test statistics, the three-class quadratic model was accepted. Average posterior probabilities for assigned classes were 0.94 ("successful" group), 0.93 (moderate "success" group) and 0.96 ("unsuccessful" group) and entropy was 0.87, indicating excellent classification. Most likely class membership was used in subsequent analyses. Classification uncertainty was not adjusted for and is noted as a limitation. The three classes were observed to demonstrate patterns of trajectories across four variables broadly depicting "successful" ($N = 478$), moderate ($N = 459$) and "unsuccessful" ($N = 56$) life outcomes. Analyses of Variance (ANOVAs) were then conducted to further validate the identified classes against criminal convictions and meanness scores. The results were consistent with theoretical expectations whereby the "successful" group had the lowest average meanness scores and number of criminal convictions, the "unsuccessful" group displayed the highest average meanness scores and conviction rates, and the moderate group falling between the two across the timepoints assessed. As these results are not the primary focus of this investigation, a comprehensive description of these results is presented in the Online Supplemental Material and will not be repeated here.

5.2. Latent profile analyses

In order to identify distinct groups of individuals with similar triarchic psychopathy profiles across ages 18 and 26, LPA models ranging from one to six classes were estimated. While it would have been preferable to treat the psychopathy domains in a dimensional manner as there is no evidence for psychopathy as a categorical construct (e.g., Edens et al., 2011; Walters et al., 2008), from a pragmatic approach and in keeping with a previous analytic framework (Klingzell et al., 2016) it was necessary to identify pertinent psychopathy groups.

Based on consideration of BIC in conjunction with adequate entropy, significant LMR statistics, and class size the two-class psychopathy model was accepted with the identified classes deemed to be representative of a "high psychopathy" class ($N = 188$) and a "low psychopathy" class ($N = 804$). Relative to the "low psychopathy" class, the "high psychopathy" class was characterized by substantially elevated meanness ($d = 2.58$) and disinhibition ($d = 1.04$), and moderately elevated boldness ($d = 0.45$; see Fig. 4 and Table S3). Most likely class membership based on posterior probabilities were saved for use in subsequent analyses. Classification quality was acceptable, average posterior probabilities for assigned classes were 0.95 (low psychopathy) and 0.86 (high psychopathy) and entropy was 0.74. Classification uncertainty was not adjusted for and is noted as a limitation. A comprehensive description of these results is presented in the Online Supplemental Material.

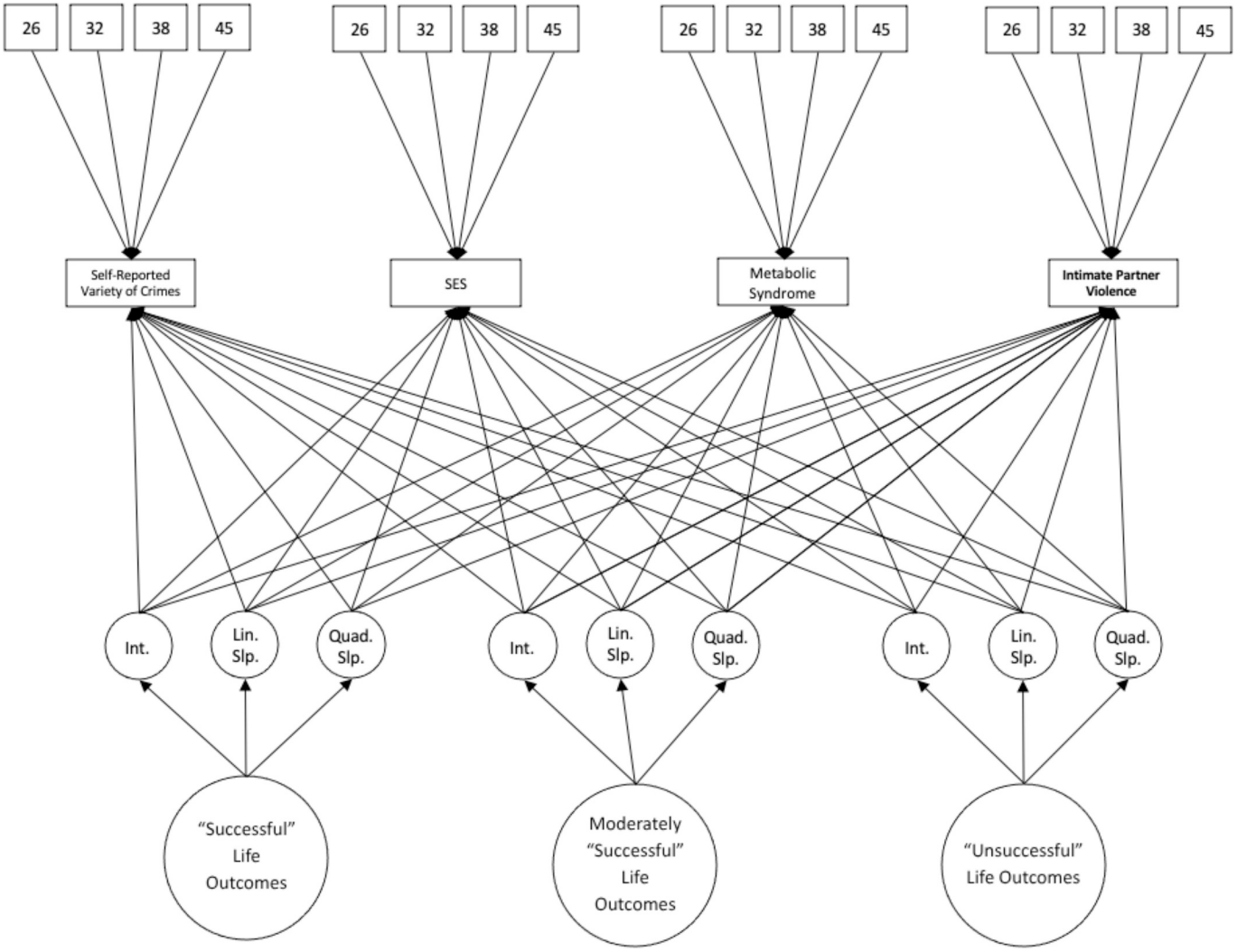


Fig. 2. Path Diagram of the LCGA Model Estimated to Identify Distinct Groups of Individuals with Shared Trajectories in the Life Outcome Variables Over the Four Time Points Assessed.

5.3. Creating combined psychopathy and life outcome groups

The life outcome class membership variable and psychopathy profile membership variables were used to manually create a categorical variable that represented the joint occurrence of psychopathy and life outcomes in the Dunedin Study sample in order to enable us to consider all possible outcomes.[2] The complete list of combined psychopathy and life outcome groups and associated *N* are presented in Table S4.

5.4. Multivariate analysis of variance (MANOVA)

In order to determine whether there were statistically significant differences in antecedent environmental factors across the identified group representing the joint occurrence of psychopathy and life outcomes we conducted a one-way MANOVA. After determining whether the overall model was significant, the number of univariate analyses in the model were used to identify an appropriate significance level to control familywise error across the seven univariate tests. Specifically, univariate F tests were evaluated using a Bonferroni-adjusted alpha of $\alpha = 0.05/7 = 0.007$. Post-hoc pairwise comparisons were conducted with Tukey HSD and are reported at the Tukey nominal level ($p < 0.05$). The MANOVA results are presented in Table 1.

The overall MANOVA model was significant, Wilk's $\lambda = 0.77$, F (35, 3758.94) = 6.98, $p < 0.001$, $\eta^2 = 0.05$, indicating that there was statistically significant difference in environmental antecedent variables between different groups of individuals who share similar trajectories of psychopathy and life outcomes over time. Follow-up univariate analyses found that these differences were present in all antecedent variables except inconsistent discipline (all F's > 4.47, all p's < 0.001, all η^2s > 0.02).

In examining the MANOVA results, we were especially interested in comparing differences in the environmental antecedent variables across the high psychopathy groups, particularly across "successful" and "unsuccessful" life-outcome trajectories, so these are outlined in detail below. Additional moderate to low psychopathy comparisons did not directly pertain to the research question and are therefore described in the Online Supplemental Material.

As expected, some aspects of the parent-child relationship did appear to differ meaningfully between the high psychopathy groups, particularly the "successful" psychopathy and "unsuccessful" psychopathy groups. Specifically, the "unsuccessful" psychopathy group experienced significantly less sensitive parent-child interactions compared with the

[2] In our original data analysis plan as per our registered concept paper, we intended to conduct a joint latent class analysis with the resulting psychopathy and life outcome classes. However, as this was not possible, we resorted to manually creating the joint psychopathy and life outcome groups.

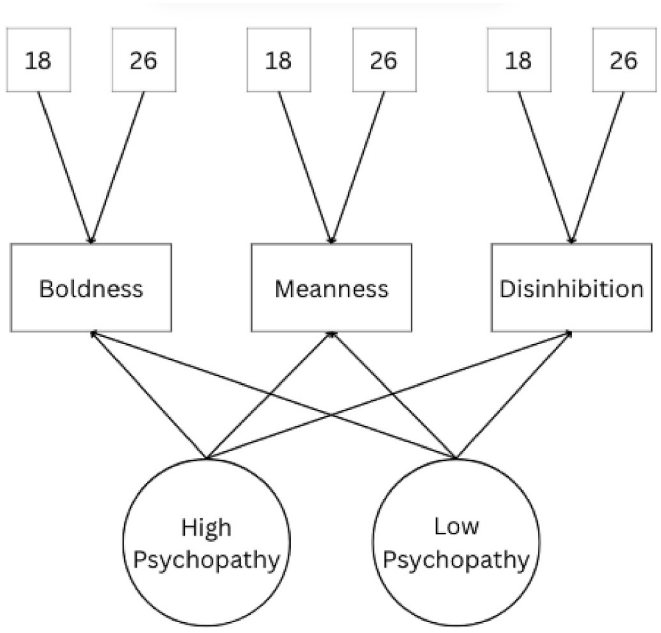


Fig. 3. Path Diagram of the LPA Model Estimated to Identify Distinct Groups of Individuals with Shared Triarchic Psychopathy Profiles across Ages 18 and 26.

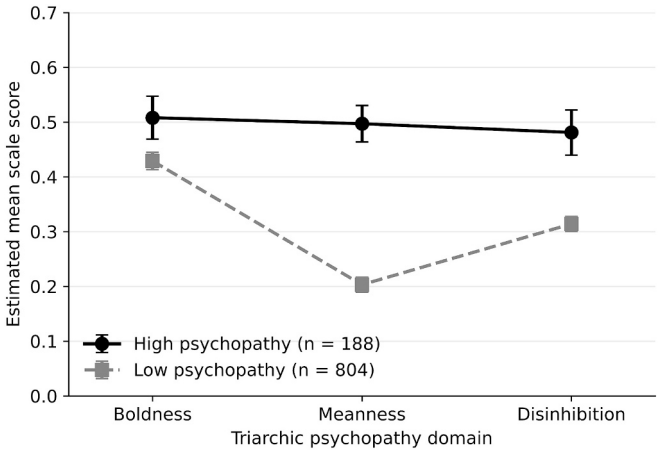


Fig. 4. Estimated Triarchic Psychopathy Domain Means for the Two Latent Psychopathy Profiles. Note. Estimated means from the two-class latent profile analysis of MPQ-Tri Boldness, Meanness and Disinhibition scores, each averaged across ages 18 and 26. Error bars are 95% confidence intervals. Class sizes are based on most likely class membership.

"successful" psychopathy group at a medium effect size. Similarly, the "unsuccessful" psychopathy group were exposed to harsh discipline to a greater extent than the "successful" psychopathy group at a medium effect size, however this difference was not statistically significant. Harsh discipline was found to differ between the "moderately successful" and "successful" groups who were high in psychopathy. Contrary to hypothesized associations, no significant group differences were found among the high psychopathy groups with respect to inconsistent discipline and parental attachment. Consistent with expectations, aspects of the broader family environment also appeared to differ significantly between the high psychopathy groups. In particular, the "unsuccessful" psychopathy group had the highest mean ACE scores across all six groups, this was significantly higher than the "successful" psychopathy group. With respect to childhood SES, the "successful" psychopathy group had a significantly higher mean than the "unsuccessful" psychopathy group, again, at a medium effect size. Finally, examining peer relationships and consistent with hypotheses, the "unsuccessful" psychopathy group were found to have significantly higher average peer delinquency scores compared with "successful" psychopathy groups with the effect size in the medium range.

6. Discussion

The current findings indicate, as hypothesized, that there are meaningful differences among high psychopathy individuals with respect their environment in early life, and that these developmental antecedents have an influence on life outcomes. More specifically, the findings indicate that less sensitive parent-child interactions, exposure to a greater number of ACEs, lower childhood SES and greater peer delinquency are all early environmental factors prevalent in individuals high in psychopathy who have poorer life outcomes later in life, to a greater extent than for those high in psychopathy who have comparably more favorable outcomes. From the perspective of the moderated-expression model, and consistent with the Steinert et al. (2017) hypotheses, this indicates that these environmental factors may moderate the relationship between psychopathy and later life outcomes, and therefore could be important in helping to explain some "successful" versus "unsuccessful" manifestations of the disorder.

Contrary to our hypotheses, harsh and inconsistent discipline as well as parent attachment did not differ significantly across the "successful" and "unsuccessful" high psychopathy groups. Such findings are inconsistent with previous research which has shown that the parent-child relationship does influence the relationship between psychopathy and important criminal and interpersonal outcomes (e.g. Edens et al., 2008; Silva & Stattin, 2016). Given that the parent-child relationship was assessed by an independent observer, these unexpected findings may reflect a difference in the reporter's perspective of the parent-child relationship. For example, it may be that parents and children rated the parent-child relationship as more positive than a more objective rater, which could explain why the parent-child relationship appeared to differ meaningfully in one instance and not the others. Given the relatively poor internal consistency of the inconsistent delinquency scale, it is possible that the null findings in this regard reflect the limited psychometric properties of this scale. Alternatively, these findings may of course suggest that characteristics of the parent-child relationship may not be as important in explaining the relationship between psychopathy and later life outcomes as other factors related to family dysfunction, socioeconomic background and peer delinquency. As research examining the role of environmental factors from a moderated-expression perspective remains scarce, further research is needed to clarify the role of the parent-child relationships in the expression of psychopathic traits. Moreover, it may be valuable for such research to consider the influence of the informant on the findings.

Although not the primary focus of the current investigation, there relatively few significant differences in the antecedent variables within each life outcome class across the various levels of psychopathy. This finding suggests that environmental antecedents are likely linked to life outcomes regardless of whether people are psychopathic, and that this relationship is not unique to the context of psychopathic life success. This is consistent with the prior research outlined above that indicated the antecedents examined here are important in determining life outcomes in the general population (Allen et al., 2015; Andersen et al., 2022; Assink et al., 2015; Bellis et al., 2019; Farrington et al., 2017; Milaniak & Jaffee, 2019; Moffitt & Caspi, 2001; Poulton et al., 2002; Schurer et al., 2019; Scott & Manczak, 2021), thus we can infer that the same aspects of a nurturing environment are important in high psychopathy individuals as for the rest of the population.

7. General theoretical implications

Firstly, these findings imply that there are distinct identifiable groups with respect to the joint occurrence of psychopathy and life

Table 1
MANOVA Results: Group Differences in Environmental Antecedent Variables.

	"Successful" psychopathy	Moderately "successful" psychopathy	"Unsuccessful" psychopathy	"Successful" non-psychopathy	Moderately "successful" non-psychopathy	"Unsuccessful" non-psychopathy	F Value	*df*	η^2	d**
Less sensitive PCIs	0.46 (1.16)[a]	0.52 (1.24) [a]	1.39 (2.44) [b]	0.37 (1.06) [a]	0.60 (1.49) [a]	0.27 (1.03) [ab]	4.47*	5	0.02	0.52
Harsh discipline	1.50 (1.67) [a]	2.70 (3.38) [bc]	2.54 (2.33) [ac]	1.66 (1.98) [a]	1.93 (2.20) [ab]	4.03 (5.96) [c]	6.14*	5	0.03	0.53
Inconsistent discipline	2.80 (1.10) [ab]	3.24 (1.15) [b]	2.76 (1.07) [ab]	2.76 (1.12) [a]	2.76 (1.14) [a]	2.73 (1.25) [ab]	2.65	5	0.01	−0.04
Parent attachment	20.05 (5.98) [bc]	19.49 (5.41) [c]	18.14 (5.39) [c]	22.42 (4.44) [a]	21.38 (4.60) [b]	20.50 (5.48) [abc]	10.57*	5	0.06	−0.33
Childhood SES	4.00 (0.97) [a]	3.17 (0.98) [b]	3.31 (1.09) [b]	4.17 (1.09) [a]	3.54 (1.07) [b]	3.31 (0.92) [b]	21.58*	5	0.11	−0.68
ACEs	1.11 (1.25) [ab]	1.59 (1.49) [bc]	1.97 (1.61) [c]	0.81 (1.03) [a]	1.23 (1.45) [b]	1.07 (1.10) [abc]	10.46*	5	0.06	0.61
Peer delinquency	0.10 (0.16) [b]	0.13 (0.18) [b]	0.24 (0.28) [c]	0.05 (0.09) [a]	0.09 (0.13) [b]	0.17 (0.13) [bc]	16.68*	5	0.09	0.65

Note. Mean (standard deviation); different superscripts ([a], [b], [c]) denote significant ($p < 0.05$) between-group differences in Tukey HSD post-hoc test homogenous subsets comparisons; * $p \leq 0.007$, **Cohen's *d* for the comparison between the 'unsuccessful' and 'successful' psychopathy groups (pooled *SD*); positive values indicate higher scores in the 'unsuccessful' psychopathy group."; PCIs = parent-child interactions; SES = childhood socioeconomic status; ACEs = adverse childhood experiences.

outcomes, that represent vastly different manifestations of the disorder. Moreover, environmental factors, particularly those relating to family dysfunction, socioeconomic background and peer relationships may account for the various manifestations of psychopathy. Consistent with the moderated-expression model (Benning et al., 2018; Lilienfeld et al., 2015; Steinert et al., 2017), such factors may therefore shape the development of high psychopathy individuals towards maladaptive coping strategies that at least in part account for the poor outcomes they display later in life. Conversely, these results indicate that with a more positive early environment, psychopathic traits, although still detrimental in certain domains, might potentially manifest in more subtle ways (for example, unpleasant interpersonal dynamics or socially disruptive behavior) rather than in flagrant law-breaking or overt violence. The tendency for psychopathy research to focus primarily on criminal manifestations of the disorder has likely led researchers to overlook this aspect of the relationship. Peer delinquency is arguably the cleanest test of moderated expression among the antecedents investigated here given that it does not serve as a potential developmental cause of psychopathy, notably this showed one of the larger between-group differences. Although these findings require replication and elaboration in future research, the current study contributes to the accumulating body of research that suggests that the moderated-expression model affords greater understanding non-criminal expressions of the disorder. Such research will play an important role in the identification of risk and protective factors surrounding "successful" and "unsuccessful" psychopathy variants. This may be important in informing prevention and treatment approaches to improve individual life outcomes and reduce the burden of highly psychopathic individuals on society.

More broadly, these findings provide additional insight into the issue of defining "success" in the context of psychopathy. The domains assessed in this case can seemingly be considered observed indicators used to infer the underlying latent success of individuals, with SES appearing to produce the most variability on trajectories over time. While this expanded definition of success builds upon existing knowledge surrounding psychopathy, an exclusive focus on crime appears to still be an adequate, though imperfect proxy of the overall functioning of high-psychopathy individuals. Despite this, it is important to recognise multiple perspectives on "success" and it remains important that researchers continue to expand upon the various manifestations of the disorder wherever practicable. Our definition here reflects a Western, individualistic perspective. Other theoretical lenses may yield very different operationalisations. For example, a moral perspective might treat psychopathy as constituting "unsuccess", a developmental perspective might define success in terms of parenting quality, while an evolutionary perspective might regard reproduction (passing on one's genes) as success on its own.

8. Broader implications

Beyond the theoretical implications, these findings have clear implications for prevention and intervention. First, the results indicate that reducing social inequities (for example, through enhanced welfare support, affordable housing and access to paid parental leave) could lower the risk of adverse outcomes among individuals high in psychopathic traits. Second, early identification of at-risk children and delivery of targeted supports are promising strategies for psychopathy, similar models have been shown to be effective in addressing youth delinquency (see Farrington et al. (2016) for a comprehensive review). Such approaches should prioritise strengthening caregiver sensitivity and capacity to provide a safe and nurturing environments, alongside access to early childhood education or childcare for both developmental benefit and caregiver respite where needed. Prevention and intervention approaches guided by the current findings should be client-centred, focusing on meaningful outcomes that benefit individuals and society, rather than focusing narrowly on reducing delinquent behaviors.

9. Limitations

The current study was not without limitations. One such limitation is the approach to the measurement of psychopathy. The use of an archival dataset meant that we were constrained to the data available across the phases of the Dunedin Study. Although there is a wealth of relevant psychosocial data available in the study, no specific psychopathy measures had been administered. As a result, in order to assess psychopathy, we had to rely on the MPQ-Tri as the sole operationalization of the psychopathy domains which precluded the inclusion of additional operationalization's of psychopathy that rely on other methodological approaches (i.e. are not self-report), and perspectives of psychopathy. Nevertheless, research to date has generally supported the use of self-report questionnaires to index psychopathy (see Sellbom et al., 2018 for a review) and the triarchic model approach is appropriate for examinations pertaining to non-criminal psychopathy. Furthermore, the Dunedin Study has long fostered an environment in which participants can accurately report on delicate subject matter with confidentiality assurances, and research to date has established good validity of the MPQ-Tri scales in this and other samples (Brislin et al., 2015; Brislin et al., 2017; Garofalo et al., 2021;Veltman et al., 2023). Therefore, while future research may seek to build upon the current findings utilizing alternative operationalizations of psychopathy, the current study has utilized a valid assessment tool to examine the role of environmental variables within a uniquely rich dataset.

Secondly, there were some limitations to our data analytical approach worthy of consideration. Parent-child interactions were observed at a single time point and for a limited period, which may have limited the accuracy of this measure. Our planned analyses violated the generally supported notion that psychopathy domains are best understood as dimensional constructs (Patrick, 2022; Sellbom & Drislane, 2021). Although imperfect, our data analytic approach was necessitated by practical considerations (and guided by previous approaches to examining longitudinal data in this field; e.g. Klingzell et al., 2016). A dimensional approach would have made it very difficult to adjudicate whether antecedent variables had an impact on those actually high on psychopathy. However, rather than relying on arbitrary cut offs for high psychopathy, we were guided by latent modelling techniques that accounted for measurement error in empirically deriving our groups. Classification uncertainty was not adjusted for in the model, though classification quality was sufficient across the two models. We were also unable to directly examine moderation effects, given that the environmental and psychopathy data were not available at overlapping timepoints. However, the observed differences in antecedent variables offer initial indications that these factors may play an important role in the expressions of psychopathy, these findings warrant further follow up with concurrent and repeated measures of psychopathic personality traits and early life environment. Path analytic approaches may serve as a complementary direction for future work.

Another limitation of this study was range restriction. Individuals in the "unsuccessful" life outcome class made up only 5.7% of the sample and were therefore under-represented in the sample compared with those with more "successful" outcomes. As a result, the "successful" psychopathy group was larger than the "unsuccessful" psychopathy group. Despite this disparity in representation, the findings were still consistent with what would be theoretically expected proportionally as 12% of those with "successful" life outcomes but 70% of those with "unsuccessful" life outcomes were in the high psychopathy group. Furthermore, the sample was appropriate for the research question as it was broadly representative of the general population and builds upon previous psychopathy literature in which unsuccessful individuals have typically been over-represented. Finally, it should be considered that the association between childhood SES and the adult outcome classes may partly reflect intergenerational continuity in SES.

10. Future directions

While the current study provides valuable insight into the role of environmental variables in the relationship between psychopathy and life outcomes across a range of life domains, further research is needed to replicate and extend these findings. In particular, while the current findings speak to differences in antecedent environmental variables across different manifestations of psychopathy that infer the possibility of a moderation relationship, we were unable to directly examine this question from moderation perspective due to the availability of environmental and psychopathy data at different rather than overlapping timepoints. Future studies that assess psychopathy and environmental variables at the same timepoints would be well-placed to examine the moderated-expression model whereby environmental factors are proposed to strengthen or weaken the psychopathy and life outcome relationship. Finally, although we selected range of variables that are broadly indicative of "success", they are by no means an exhaustive list of potentially meaningful life outcomes which may vary by context, individual values and culture. Future studies should expand on the life outcomes explored in the current work to include other potentially relevant indicators of success (e.g. having children could be considered an important indicator of success from an evolutionary perspective) such as subjective experiences of life satisfaction, and more general indicators of interpersonal functioning.

CRediT authorship contribution statement

Emma Veltman: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Formal analysis, Conceptualization. **Kostas A. Fanti:** Writing – review & editing, Supervision, Methodology. **Richie Poulton:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Sandhya Ramrakha:** Writing – review & editing, Methodology, Investigation, Data curation, Conceptualization. **Martin Sellbom:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization.

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Declaration of competing interest

There are no competing interests to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcrimjus.2026.102760.

Data availability statement

The Dunedin Study datasets reported here are not publicly available due to a lack of informed consent and ethical approval for public data sharing. The Dunedin study datasets are available on request by qualified scientists. Requests require a concept paper describing the purpose of data access, ethical approval at the applicant's university and provision for secure data access (https://dunedinstudy.otago.ac.nz/for-investigators). Secure access is offered at the Dunedin Study Otago Campus.

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