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Childhood Trajectories of Paternal and Maternal Psychological Distress and Decision-making in Early Adolescence

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Abstract

Decision-making is important for adolescent wellbeing, and predictive of several other outcomes. While past research demonstrates the role of maternal psychological distress in adolescent decision-making, the role of paternal psychological distress remains relatively unexplored. This study examined the association between trajectories of paternal and maternal psychological distress, jointly modelled, in childhood and child decision-making in early adolescence. Using data from 9846 families of the Millennium Cohort Study, we identified paternal and maternal psychological distress trajectories across child ages 3–11 using joint group-based trajectory modelling and explored their associations with offspring decision-making at age 11 with multiple linear regression models. Paternal and maternal psychological distress was measured with the Kessler-6 scale, while adolescent decision-making was assessed using the Cambridge Gambling Task. We identified 2 trajectories for fathers ('low distress' and 'moderate-increasing distress') and 4 for mothers ('minimal distress', 'low distress', 'moderate-increasing distress' and 'severe distress'). When jointly modelled, paternal and maternal trajectories predicted decision-making in fully adjusted models. Compared to the 'low distress' paternal trajectory, the 'moderate-increasing distress' paternal trajectory was associated with less delay aversion, although this effect disappeared when examining only two-parent biological families. Compared to the 'minimal distress' maternal trajectory, the 'moderate-increasing distress' trajectory predicted slower deliberation time, whereas the 'severe distress' trajectory predicted greater risk-taking. There were no gender differences in these paths. Consistently moderate and high levels of maternal distress during childhood are associated with increased decision latency and greater risk-taking, respectively, in early adolescence.

Keywords Adolescent decision-making · Group-based trajectory modelling · Maternal psychological distress · Millennium Cohort Study · Paternal psychological distress

Highlights

- Across child ages 3–11 years, we identified 2 trajectories for paternal and 4 for maternal psychological distress.
- Adolescents (11-year-olds) of fathers with 'moderate-increasing distress' displayed less delay aversion in a computerised, decision-making task.
- In the same task, adolescents of mothers with 'moderate-increasing distress' had slower deliberation time.
- Adolescents of mothers with 'severe distress' showed greater risk-taking.

Numerous studies have demonstrated that maternal depression has adverse and long- term effects on children, impacting their emotional, behavioural, social, and cognitive outcomes (Chae et al., 2020; Choe et al., 2023; Goodman et al., 2011). While genetic links have been shown to underpin some of these relationships (Sullivan et al., 2000), environmental pathways are also present. Depressed mothers are likely to use harsh parenting practices, which impede children's opportunities to learn and develop in a healthy manner (Kuckertz et al., 2018).

Research has also explored whether maternal depression might be associated with offspring decision-making.

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Decision-making is the process by which, through the use of cognitive skills individuals select the best course of action in each situation for them, after considering possible outcomes (Zois et al., 2014). If decision-making were a spectrum, those on one end would exhibit high riskiness, impulsivity, and reward-seeking, while those on the other end, would display risk and reward avoidance. Compared to adults, adolescents are generally shown to follow more risky decision-making strategies (Somerville et al., 2010). Nonetheless, variation and individual differences are present. Studies looking at adolescents with familial risk of depression (who had one parent depressed) have found them to be more risk-avoidant, compared to their peers (Mannie et al., 2015), or have identified neural patterns associated with diminished response to reward (McCabe et al., 2012). Parents (and adults in general) with depression are often less sensitive to reward and tend to adopt conservative decision-making strategies (Halahakoon et al., 2020), a characteristic which they appear to 'pass on' to their offspring.

Nevertheless, one limitation of these studies is that they do not offer insight into how the course of maternal depressive symptoms might be linked to child decision-making. Within the adult population, the prevalence, severity and stability of depressive symptoms vary, with some individuals experiencing, for instance, short-term and mild episodes, while others face long-term and severe difficulties (Musliner et al., 2016). Existing research supports that adolescents with mothers in the latter category are at higher risk for adverse outcomes (such as poor executive functions, cognitive, and social skills) than adolescents whose mothers experience milder forms of depression (Chae et al., 2020; Choe et al., 2023). It is possible that the more severe the maternal symptoms are, the greater the challenges (e.g., harsh parenting) that children face and, consequently, the greater the negative impacts on their development.

To our knowledge, one study has assessed how trajectories of maternal psychological distress might be related to child decision-making. Specifically, Flouri et al. (2017), using data from the Millennium Cohort Study, the data also used in the current study, identified 4 trajectories of maternal psychological distress across child ages 3–11 and examined their association with offspring decision-making at age 11. Psychological distress consists of symptoms of anxiety and depression and describes someone's overall emotional state at a given time (Drapeau et al., 2010). High levels of psychological distress may suggest an underlying psychiatric condition and interfere with how effectively a person copes with their daily life (Drapeau et al., 2010). The four trajectories of psychological distress identified in that study included: "consistently low distress", "moderate-accelerating distress", "moderate-decelerating distress", and "chronic severe distress". Their results revealed that daughters of mothers with chronic and severe distress displayed more risk- taking behaviours than daughters of mothers with consistently low distress. This finding came in contrast to the research indicating that children of depressed mothers are risk- avoidant (Mannie et al., 2015). For sons, there were no differences.

The Role of Fathers

In recent years, there has been a great amount of interest in the role of fathers in child development. Emerging evidence shows that, even after accounting for maternal depression, fathers' depression can influence child development. Paternal depression has been linked to emotional, behavioural, and cognitive child outcomes (Fredriksen et al., 2019; Gutierrez Galve et al., 2015), although some research indicates that the associations may be bidirectional (Sifaki et al., 2021).

There are few studies exploring whether paternal depression is associated with decision making in children but their results are mixed. Specifically, while one found no effects (Kujawa et al., 2015), another (Freeman et al., 2023) found that paternal depression predicted increased activation to reward anticipation in 9–10-year-old children. One limitation of both those studies however is that they did not explore how the course of paternal symptoms may predict child decision-making. It is possible, for example, that long-lasting symptoms or symptoms experienced during a particular child age may be most impactful. Addressing this research gap can help us to understand better the development of adolescent decision-making and the reasons why some youth may be more or less risk-avoidant than others. Furthermore, it can help us broaden the existing knowledge on family processes and, specifically, how paternal depression relates to child outcomes.

Research suggests that, overall, men experience lower levels of depressive symptoms and psychological distress than women and are less likely to fall into trajectories characterised by severe symptoms (Musliner et al., 2016). Therefore, it is unclear if the effects of paternal trajectories on child and adolescent decision-making would be similar to the effects of maternal trajectories. However, like mothers, fathers with elevated symptoms show poor-quality parenting practices (Giallo et al., 2015). Giallo et al. (2015) studied trajectories of paternal psychological distress spanning infancy until age 9 years. Two trajectories emerged: (1) low symptoms and (2) high and increasing symptoms. While that study did not explore associations with child outcomes, it examined how these trajectories may predict parenting practices. It was shown that fathers in the 'high and increasing' symptoms trajectory had lower warmth and

higher hostility towards their offspring. These findings imply that paternal trajectories may relate to child outcomes through poor parenting practices.

The Current Study

The current research, using data from the UK's Millennium Cohort Study (MCS), aimed to identify trajectories of paternal and maternal psychological distress through childhood (from age 3 to age 11 years) and examine how these trajectories may predict offspring decision-making at age 11. Decision-making was measured through six outcomes derived from a computerised task. Joint group-based trajectory modelling for these two related longitudinal outcomes was used to allow for dynamic linkages across all trajectory groups. Given that past research suggests different pathways to be in place for boys and girls (Flouri et al., 2017), the moderating role of the child's gender was also examined.

Based on past research, we hypothesised the following:

(1) Mothers would be more likely to fall into trajectories characterised by severe and persistent symptoms, compared to fathers.
(2) Both paternal and maternal trajectories would predict adolescent decision-making. Due to the mixed findings regarding the direction of the effect of maternal depressive symptoms on adolescent decision-making (i.e., whether they lead to more or less risky decision-making), we did not speculate on the direction of the effects.
(3) Maternal effects would be stronger for girls. Given the lack of research on paternal depression effects on adolescent decision-making, we did not hypothesise whether these effects would be stronger for boys or girls.

Finally, in our models we controlled for family and child variables that may confound the links between parental psychological distress and adolescent decision-making. We accounted for family income, parental education, parental age, and family biological status (whether parental separation had occurred through the duration of the study, across child ages 3–11 years). We selected these family covariates as low socio-economic status (Harvey & Blake, 2022), young parental age (Van Vugt et al., 2016), and parental separation (Jackson et al., 2016) have all been linked to increased adolescent riskiness. Moreover, we accounted for parenting, since poor-quality parenting is associated with diminished response to reward (Kujawa et al., 2015).

In addition, we included child sex, ethnicity, general cognitive ability, problem behaviour, and exact age at testing as covariates. Based on research findings, we anticipated that adolescents who are male (Lewis et al., 2022), older (Cauffman et al., 2010), have low internalising difficulties and high externalising difficulties (Sonuga-Barke et al., 2016) would be more risk-taking. We controlled for general cognitive ability, given that it predicts risk adjustment and quality of decision-making, two of the outcomes that are assessed in the current study (Flouri et al., 2019). Last, ethnicity was included, since children from certain ethnic groups (e.g., Asian children in the UK) tend to show less risk-taking than their peers (Hale & Viner, 2016).

Methods

Participants

Data from the UK's Millennium Cohort Study (MCS) were used for the present investigation (https://www.cls.ioe.ac.uk/mcs). The MCS is an on-going population-based longitudinal study including information on 19,243 UK families (19,517 children) who had a child born in 2000–2002. Information on the cohort children and their families is collected every few years. Participating families were selected disproportionately, so that all UK minority groups in England, and disadvantaged wards across the UK, are sufficiently represented (Plewis, 2007). Data are available for 7 sweeps, with the children being around age 17 at the most recent one. The current study uses data from sweeps 2–5, in which children aged around 3, 5, 7, and 11 years (when decision-making was first measured in MCS), respectively.

The number of participating families was 15,590 in sweep 2, 15,246 in sweep 3, 13,857 in sweep 4, and 13,287 in sweep 5 (Hansen, 2014). Ethical approval for MCS was gained from NHS Multi-Centre Ethics Committees, parents have given informed consent and children, at the age of 11, informed assent. The current study has also obtained ethical approval by the IOE Research Ethics Committee. Our analytic sample consists of 9846 children (50.1% female) and their families, selected based on the following criteria:

(1) Child was singleton or first-born twin or triplet (in case of multiple births).
(2) Child had decision-making scores at age 11.
(3) There was at least one psychological distress score for the father, across sweeps 2–5.
(4) There was at least one psychological distress score for the mother, across sweeps 2–5.

By assuring that, for each family, there was at least one valid psychological distress score for both the father and

mother, continuously single-parent families were excluded. The families participating in the MCS who did not fulfill these criteria ($n = 9397$) are referred to as the non-analytic sample.

Procedure

In all sweeps, data collection took place at the families' homes. Parental information was collected through face-to-face interviews, as well as through self-completed questionnaires. Children were also asked to self-complete questionnaires. For the collection of cognitive measures (including decision-making), they were asked to do some computerised tasks.

Measures

Across sweeps 2–5, *paternal* and *maternal psychological distress* were assessed during home interviews with the 6-item Kessler Psychological Distress scale (K-6), a self-administered questionnaire with good psychometric properties (Kessler et al., 2002). K-6 measures non- specific distress experienced during the last month, with questions such as "During the past 30 days, about how often did you feel hopeless?" and "During the past 30 days, about how often did you feel that everything was an effort?". Participants rate the six items on a 5-point scale, ranging from "none of the time" to "all the time". Responses are added to create a total score, varying from 0 to 24, with higher values suggesting more severe symptoms. Cronbach's alpha, for fathers, was 0.81, 0.82, 0.84, and 0.86, across sweeps 2–5, respectively. For mothers, it was slightly higher; 0.86, 0.87, 0.87, and 0.89, across sweeps 2–5, respectively.

Child Decision-Making

Child decision-making was assessed by the Cambridge Gambling Task (CGT; Rogers et al., 1999). Children were presented with a row of ten boxes across the top of a screen, red or blue, the ratio of which varied. One of those boxes always contained a yellow token. Children were asked to choose the box colour in which they thought that the token was hidden. The tasks consisted of 5 stages, each of which involved a block of trials. The last 4 stages were the gambling stages. During those, participants were also given 100 points, which appeared in either ascending or descending order. They were asked to select a percentage of these points to bet on their colour decision. Depending on the actual location of the token, points were then added or extracted. The aim was to obtain as many points as possible. Six variables are obtained from this task: (1) *Deliberation time* refers to the mean time it took to make a box colour choice; (2) *Quality of decision-making* describes the mean number of trials in which children chose the most probable box colour; (3) *Delay aversion* shows the difference in percentage bet between the ascending and the descending conditions; (4) *Overall proportion bet* refers to the mean proportion of points bet across all trials; (5) *Risk adjustment* measures the extent at which children's betting behaviour was affected by the ratio of boxes (in other words, it indexes the tendency to stake higher bets on high-probability compared to low- probability trials); and (6) *Risk taking* describes the mean proportion of points bet on trials at which the most probable box colour was selected.

Family Covariates

The family covariates controlled for were *family poverty*, *family biological status, father's age at birth*, *parental education*, *parental reading frequency*, and *child-parent relationship quality* (Harvey & Blake, 2022; Jackson et al., 2016; Kujawa et al., 2015; Van Vugt et al., 2016). Due to high collinearity, only paternal age (and not maternal age) was controlled for. All parental variables were examined separately for both fathers and mothers. Family poverty was assessed by the mean number of sweeps (sweeps 2–5) in which the household income was below the 60% of the UK's median household income. Parental education was measured with a binary variable specifying whether the parent had a university degree by sweep 5 (age 11) or not. Parental reading frequency at age 3, used as an estimate of parental involvement, was measured with one-item asking caregivers how frequently they read to their child. Scores ranged from 1 (*every day*) to 6 (*not at all*). Child-parent relationship quality at age 3 was measured with Pianta's Child-Parent Relationship Scale (CPRS) Short Form, adapted from the Student-Teacher Relationship Scale (STRS; Pianta & Steinberg, 1992). It includes 15 items, self-reported by caregivers on a 1–5 Likert scale. Seven items correspond to the 'closeness' subscale ($\alpha = 0.68$), and 8 to the 'conflict' subscale ($\alpha = 0.78$). A total relationship score was created by reversing positively-worded items, with higher scores showing a better-quality relationship. Family biological status was measured with a binary variable demonstrating whether the household included two biological parents consistently across sweeps 2–5 (child age 3 to 11) or not.

Child Covariates

The child covariates assessed include *sex*, *ethnicity*, *general cognitive ability*, *problem behaviour*, and *exact age at testing*, which was measured in months (Cauffman et al., 2010; Flouri et al., 2019; Hale & Viner, 2016; Lewis et al., 2022; Sonuga-Barke et al., 2016). Ethnicity was assessed with a set of dummy-coded variables, indicating whether the child was White, Mixed, Black, Indian, Pakistani/Bangladeshi or belonging to any other ethnic group. General

cognitive ability was evaluated at sweep 3 with the British Ability Scales II (BAS-II) sub-tests of Naming Vocabulary, Pattern Construction and Picture Similarities (Hill, 2005). Standardised scores ($M = 50$, $SD = 10$) were added to create a general ability construct.

Problem behaviour was measured with the Strengths and Difficulties Questionnaire (SDQ) total difficulties scale (Goodman, 2001). The SDQ was completed by the main caregiver at sweeps 2–5. It consists of 25 questions, answered on a scale ranging from 0 (not true) to 2 (certainly true). There are 5 sub-scales, consisting of 5 items each: emotional symptoms, conduct problems, hyperactivity/inattention, peer relations, and prosocial behaviour (the 'strengths' scale, which was not used in this study). For each sub-scale, the score ranges from 0 to 10, with higher scores suggesting more difficulties. A total score is created by adding all 4 scales, and ranges from 0 to 40. The mean number of sweeps in which the child experienced severe difficulties (total score above the clinical cut-off of 17) was calculated and used in the present study (Goodman, 2001). For emotional difficulties, Cronbach's alpha, across sweeps 2–5, equalled 0.52, 0.59, 0.69, and 0.70, respectively. For conduct problems, it was 0.67, 0.54, 0.59, and 0.61, respectively, while for hyperactivity/inattention, 0.71, 0.75, 0.76 and 0.79, respectively. For peer difficulties, it was 0.49, 0.52, 0.57, and 0.64, respectively.

Finally, a dummy-coded variable was used, which indicated whether testing proceeded smoothly or whether there were any factors that might have affected the child's performance (interruptions during the test, background noise, child fatigue, and technical issues) given these have been linked with poorer performance on the MCS cognitive tests (Atkinson, 2015).

Analytic Strategy

First, the analytic and non-analytic samples were compared to detect any sample selection bias. Furthermore, for the analytic sample, bivariate correlations were run to explore the links between the main study variables, which included paternal distress (sweeps 2–5), maternal distress (sweeps 2–5), and adolescent decision-making (sweep 5). Joint group-based trajectory modelling (GBTM; Nagin & Odgers, 2010) and multiple linear regression modelling were conducted in STATA to examine, respectively, trajectories of psychological distress across sweeps 2–5 and their effects on adolescent decision-making. GBTM is a finite mixture modelling application that uses trajectory groups as a statistical device for approximating unknown trajectories across members of the population. Here, joint trajectory modelling allows for the identification of separate group trajectories for fathers and mothers, as well as the estimation of the probability of membership in each group (Nagin & Odgers, 2010). Models were fitted with the STATA plug-in traj command (Jones & Nagin, 2013), and missing data were handled by FIML (FIML was used only for trajectory modelling). Since there were 4 assessment points, trajectories were fitted for zero-order, linear or quadratic relationships (Nagin & Odgers, 2010). To establish the best-fitting model, several criteria were applied. These involved: the lowest Bayesian Information Criterion (BIC) value, average posterior probabilities of assignment (AvePP) greater than 0.7, odds of correct classification greater than 5, a close correspondence between the estimated and the actual probability of group membership and, finally, reasonably narrow confidence intervals (Nagin & Odgers, 2010). Individuals were allocated to the group trajectory to which they had the highest probability of belonging.

Next, multiple linear regressions were run to investigate whether these paternal and maternal trajectory groups predicted each of the decision-making outcomes at age 11 years. Due to the high correlation between overall proportion bet and risk-taking (0.96), only risk-taking was examined. For any significant paths identified, we explored the moderating role of the child's gender, using interaction terms.

To make maximum use of the available data, in our analytic sample we included families that might have been single-parented for some of the assessed sweeps (therefore missing parental psychological distress data for those sweeps). In those cases, parental psychological distress data were imputed and thus may not accurately reflect what the distress levels of those individuals would have been. Furthermore, we included families for which the parental figures in the household may have changed across sweeps (e.g., a biological parent left and a stepparent moved in). This means that, even though distress data throughout the study period are treated as belonging to the same person, this is not always the case. To account for these issues, and confirm the robustness of the findings, a sensitivity analysis was conducted, using a sample that included only 2-parent biological families, consistently across sweeps 2–5.

Little's test showed that our data were not missing completely at random (Little, 1988). For the regressions, missing data were handled by multiple imputation using chained equations (MICE; Royston, 2005). All variables with no missing values (including the dependent variables of the analysis, offspring decision-making outcomes) were used as predictors to fill the missing values of the remaining variables. 20 imputed datasets were generated and combined for the analysis using Rubin's rules. For decision-making, there were no missing data, as only cases with full outcome data were included in the analytic sample. For paternal psychological distress, missing data were 24.1, 23.6, 28.5, and 22.9% and for maternal psychological

distress, missing data were 13.6, 11.3, 13.1, and 6.5%, across sweeps 2–5, respectively. We note that missing data is greater for fathers than mothers as fathers are more likely than mothers to have stopped residing with the child. Our analytic sample includes families that became single-parented for some of the assessed sweeps (but not for all of them) and, in this case, children were more likely to live with their mother than their father. Last, to control for the over-sampling of disadvantaged groups, non-response, and attrition, trajectory and regression models were weighted using the svy STATA command (Hansen, 2014).

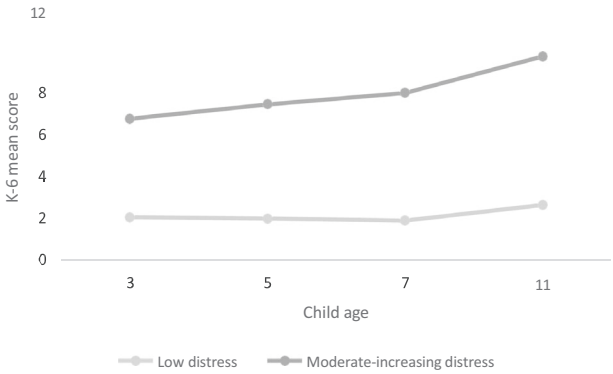

Fig. 1 Paternal distress trajectories

Results

Descriptive Statistics

Families in the analytic sample were generally more advantaged than those in the non- analytic sample, demonstrating some sample selection bias (Supplementary, Table S1). For instance, they were less likely to experience poverty and more likely to have two biological parents. Additionally, parents displayed lower psychological distress, were more likely to be university-educated and read more frequently to their children. Mothers had higher relationship quality with their children. Differences were also observed in decision- making outcomes, with children in the analytic sample presenting better decision-making strategies. Moreover, children in the analytic sample were more likely to be female and presented less problem behaviour. No differences were found regarding ethnicity.

Correlations

Correlations between the key study variables are displayed in Table S2 (Supplementary). The correlations between maternal and paternal psychological distress were all significant but weak, ranging from 0.12–0.21. The correlations between paternal distress and decision-making (0.0002–0.04) as well as between maternal distress and decision-making (0.006–0.04) were all weak, with some reaching statistical significance. The correlations between different decision-making outcomes were also low or very low (0.05–0.28) but were statistically significant.

Modelling Parallel Trajectories for Mothers and Fathers using Joint GBTM

Different models were tested using joint GBTM, with the number of trajectories for fathers and mothers ranging from 2 to 6. The model that met most of the set criteria included 2 trajectories for fathers and 4 trajectories for mothers. The 2 paternal trajectories were shaped to be quadratic and linear, respectively, while the 4 maternal trajectories were shaped to be quadratic, quadratic, linear, and zero-order, respectively. The BIC and AIC values were the lowest out of the models that achieved convergence; BIC = −146,489.62 ($N = 64{,}637$), BIC = −146,467.98 ($N = 9846$), and AIC = −146,385. Average posterior probabilities ranged from 0.83 to 0.96 and odds of correct classification were greater than 4.82.

Paternal trajectories are illustrated in Fig. 1. The first trajectory that emerged consisted of individuals (82.8%, 'low distress') who displayed low psychological distress across child ages 3–7. However, from age 7 to age 11 their distress scores slightly increased. Fathers in the second trajectory (17.2%, 'moderate-increasing distress') had moderate psychological distress that escalated continuously across sweeps.

Figure 2 presents the maternal trajectories. Those in the first trajectory (25.1%, 'minimal distress') experienced negligible psychological distress throughout. The second trajectory (59.5%, 'low distress') follows the same pattern, though distress scores were slightly higher. Mothers in the third trajectory (12.4%, 'moderate-increasing distress') experienced moderate and increasing psychological distress, while those in the fourth trajectory (3%, 'severe distress') showed severe, fluctuating difficulties.

Multiple Regression Results

Multiple regression was used to investigate whether paternal and maternal trajectory groups predict offspring decision-making. The 'low distress' group for fathers and the 'minimal distress' group for mothers are the reference groups. Models were run first unadjusted and then adjusted for covariates and stratification variables.

Tables 1 and 2 present the results for the unadjusted and adjusted models, respectively.

In the unadjusted models, the "severe distress" maternal trajectory was linked to higher delay aversion and risk-taking scores, while the "moderate-increasing distress"

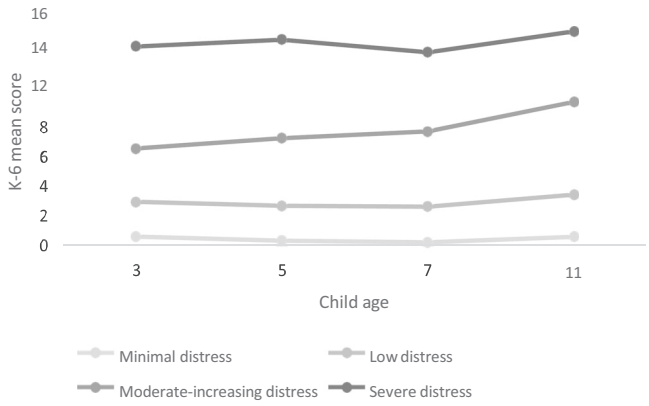

Fig. 2 Maternal distress trajectories

Table 1 Multiple regression results (unstandardised coefficients and standard errors) for the unadjusted models

	'Moderate-increasing distress' paternal trajectory	'Low distress' maternal trajectory	'Moderate-increasing distress' maternal trajectory	'Severe distress' maternal trajectory
	B (SE)	*B* (SE)	*B* (SE)	*B* (SE)
Delay aversion	−0.01 (0.007)	−0.006 (0.006)	0.008 (0.009)	0.04 (0.02)*
Deliberation time	−5.18 (36.02)	48.70 (31.31)	141.58 (46.49)**	70.04 (82.28)
Quality of decision-making	−0.004 (0.005)	0.0003 (0.004)	−0.02 (0.006)**	−0.03 (0.01)**
Risk adjustment	−0.04 (0.03)	0.01 (0.02)	−0.13 (0.04)***	−0.27 (0.07)***
Risk-taking	0.006 (0.005)	0.002 (0.004)	0.009 (0.006)	0.05 (0.01)***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 2 Multiple regression results (unstandardised coefficients and standard errors) for the adjusted models

	'Moderate-increasing distress' paternal trajectory	'Low distress' maternal trajectory	'Moderate-increasing distress' maternal trajectory	'Severe distress' maternal trajectory
	B (SE)	*B* (SE)	*B* (SE)	*B* (SE)
Delay aversion	−0.02 (0.007)*	−0.01 (0.006)	−0.006 (0.009)	0.02 (0.02)
Deliberation time	−19.52 (36.70)	55.51 (31.87)	120.57 (48.79)*	17.33 (85.20)
Quality of decision-making	0.002 (0.005)	0.003 (0.004)	−0.003 (0.006)	−0.003 (0.01)
Risk adjustment	0.01 (0.03)	0.03 (0.02)	−0.02 (0.04)	−0.05 (0.07)
Risk-taking	−0.001 (0.005)	−0.002 (0.004)	−0.004 (0.006)	0.03 (0.01)**

*$p < 0.05$; **$p < 0.01$

maternal trajectory was linked to higher deliberation time scores. Both of those trajectories were also related to lower scores in both quality of decision-making and risk adjustment. In the adjusted models, the "moderate-increasing distress" paternal trajectory was related to lower delay aversion scores, the "moderate-increasing distress" maternal trajectory was related to higher deliberation time scores, and the "severe distress" maternal trajectory was related to higher risk-taking scores.

Covariate effects, for the adjusted models, can be found in Table S3 (Supplementary). General cognitive ability predicted all outcomes, while age predicted all outcomes except risk-taking. More problem behaviour was associated with lower scores in risk adjustment and quality of decision-making. Lack of paternal and maternal higher education predicted longer deliberation time, and lower scores in risk adjustment and quality of decision-making. Not living in a 2-parent biological family was related to greater delay aversion and lower scores in quality of decision-making and risk adjustment. Family poverty predicted lower risk adjustment and higher risk-taking. Finally, less frequent paternal reading predicted lower quality of decision-making, while less frequent maternal reading predicted lower risk adjustment.

Moderation by Gender

Using interaction terms, we tested whether the child's gender moderates any of the significant relationships that were identified. Results showed no difference in patterns between boys and girls. Specifically, for delay aversion, there was no interaction between paternal 'moderate-increasing distress' and gender ($b = -0.002$, SE = 0.01, $p = 0.91$); for deliberation time, there was no interaction between maternal 'moderate-increasing distress' and gender ($b = 68.04$, SE = 78.98, $p = 0.39$); and finally, for risk-taking, there was no interaction between maternal 'severe distress' and gender ($b = 0.03$, SE = 0.02, $p = 0.12$).

Sensitivity Analysis

A sensitivity analysis was conducted to test whether findings remained robust for families with 2 biological parents across sweeps 2–5 (6056 families), compared to the full analytic sample (results for the unadjusted and adjusted models are shown in the Supplementary, Tables S4 and S5, respectively). In the adjusted models, the significant effects of maternal "moderate-increasing distress" on deliberation time ($b = 176.73$, SE = 66.34, $p = 0.008$) and maternal "severe distress" on risk-taking ($b = 0.05$, SE = 0.02, $p = 0.001$) remained. However, paternal "moderate-increasing distress" was no longer linked to delay aversion ($b = -0.009$, SE = 0.009, $p = 0.32$).

Discussion

This study aimed to identify parallel trajectories of paternal and maternal distress, across child ages 3–11 years, and to examine how they may relate to child decision- making at age 11. Two trajectories of paternal distress emerged: 'low distress' and "moderate-increasing distress'. For maternal distress, 4 trajectories were found: 'minimal distress', 'low distress', 'moderate-increasing distress', and 'severe distress'. In line with our hypothesis, both paternal and maternal trajectories predicted decision-making. Children of fathers in the 'moderate-increasing distress' trajectory had lower delay aversion scores than children of fathers in the 'low distress' trajectory. Furthermore, adolescents whose mothers belonged to the 'moderate-increasing distress' trajectory group had higher deliberation time scores (meaning that they took longer to make a box colour decision) than adolescents whose mothers belonged to the 'minimal distress' trajectory group. Additionally, the children of mothers in the 'severe distress' trajectory group had higher risk-taking scores than those whose mothers belonged in the 'minimal distress' trajectory group. Only the two maternal effects remained when analysing the sub-sample including only biological families. The associations found did not differ for boys and girls.

The paternal distress trajectories that we identified are similar to those described by Giallo et al. (2015), who explored paternal distress trajectories at child ages similar to those in our study. Neither study identified a paternal trajectory for severe and persistent difficulties; however, in our study, such a trajectory emerged for mothers. This was expected, reflecting that women experience higher levels of distress during their lifetime than men do (Drapeau et al., 2010; Musliner et al., 2016). It is also possible that men under-report their levels of distress due to, for example, cultural stigma (Drapeau et al., 2010).

Paternal and Maternal Distress Effects on Adolescent Decision-Making

Adolescence is a critical developmental stage, with most of the major mental health disorders having their onset then (Solmi et al., 2022). It is also a time of increased vulnerability to risks, including a heightened sensitivity to peer influence, which in turn has been linked to delinquency or substance abuse (Huijsmans et al., 2021; Leung et al., 2014). As children enter adolescence, their decision-making process becomes crucial for managing these risks. For example, adolescents prone to taking risks are more likely to engage in delinquency, substance abuse, problematic eating, and self-harm (Adjorlolo et al., 2018; De Bellis et al., 2013; Francesconi et al., 2020; Oldershaw et al., 2009). At the other end of the spectrum, high risk-avoidance is linked to depressive symptoms and is even considered to contribute to their emergence (Mannie et al., 2015). Therefore, determining the factors responsible for poor decision-making in adolescence can help in preventing other adverse outcomes.

Our results suggest that maternal, compared to paternal, psychological distress plays a greater role in adolescent decision-making. While in our main analysis an effect emerged for paternal distress, the sensitivity analysis showed that this was likely due to sample selection as the effect became nonsignificant when repeating the analysis in our sub- sample of continuously 2-parent biological families. In contrast, maternal paths remained significant throughout. This could be explained by the fact that, following parental separation, children are likely to continue living with their mother, not their father (Kalmijn, 2015).

Existing research on maternal distress has yielded mixed conclusions, with some studies linking it to greater risk-avoidance while others to greater risk-taking. In our study, an interesting pattern emerged. Our findings for offspring of mothers with 'moderate-increasing distress' suggest they are prone to risk-avoidance, while offspring of mothers with 'severe distress' are prone to risk-taking. The reasons for

this pattern are not clear. Possibly, different risk mechanisms are in place for the two groups; with environmental factors driving the effect in the 'moderate-increasing distress' group, while genetic factors are most important in the 'severe distress' group. Specifically, the 'moderate-increasing distress' group might have experienced stressful life events (e.g., divorce, loss of job/income) which are responsible for the rise in distress levels. Experiencing such stressful life events, unaccounted for in our study, is likely to have also had an impact on children's lives. For example, it has been directly associated with higher riskiness in adolescence (Do et al., 2022).

Another possibility relates to likely an important difference in the psychopathological profiles of the two groups. Particularly, mothers in the 'severe distress' trajectory likely have clinically relevant and long-lasting symptoms, meaning that perhaps they may have a chronic mental health disorder. Chronic disorders here could include depression but also conditions such as bipolar disorder and borderline personality disorder (Duffy et al., 2019; Zanarini et al., 2015), which can be lifelong (Saunders & Goodwin, 2010; Videler et al., 2019) and cause significant distress (Fertuck et al., 2016; Saunders & Goodwin, 2010). Not only are these disorders associated with impulsive decision-making and riskiness (Paret et al., 2017; Ramírez-Martín et al., 2020), but also the offspring of affected parents are shown to display high impulsivity and great reward sensitivity themselves, possibly due to genetic risks or environmental influences (Sanches et al., 2014; Singh et al., 2014).

Limitations

This study does have some limitations that should be considered. First, compared to the non-analytic sample, families in the analytic sample were more socio-economically privileged and parents experienced lower levels of psychological distress. This not only decreases the generalisability of the results, as they cannot be applied to families with different backgrounds, but also implies that relationships occurring between children and parents with more severe difficulties may not have been captured. Second, our findings are derived from a UK sample, and may not be generalisable to other countries or cultures. Third, trajectory modelling did not yield a group of fathers with clinical levels of distress. Consequently, it was not possible to explore how a father with clinical difficulties might influence his child's decision-making. Fourth, there were missing data for most predictors, including paternal psychological distress, though this issue was handled by FIML (in trajectory modelling) and multiple imputation (in regressions). Fifth, the effects that we identified were generally small; nonetheless, they still achieved statistical significance. Sixth, adolescent decision-making was measured through a computerised task. It is not possible to know how the observed effects would translate in 'real-word' outcomes (i.e., delinquency). Seventh, the internal consistency for some of our covariates, such as the SDQ, was quite low at the younger ages. Last, our interpretation of the relationships we uncovered is limited by the data we had available in MCS. It was not possible, for instance, to explore underlying psychopathologies in fathers and mothers, the course of child decision-making across the childhood years, and how stressful life events may shape both the course of parental psychological distress and the course of child decision-making.

Implications and Directions for Future Research

Despite these limitations, findings from this study can be useful in different ways, both for research and practice. To start with, they suggest that both paternal and maternal psychological distress may play a role in the development of adolescent decision-making, even if paternal distress does so to a lesser extent. Therefore, to promote healthy adolescent development, the well-being of both parents should be targeted. Forms of individual therapy, such as cognitive-behavioural therapy, acceptance commitment therapy, or even pharmacotherapy, could help parents who experience symptoms of depression and anxiety (Cuijpers et al., 2013; Gloster et al., 2020). In addition, given that mental health difficulties tend to co-occur for caregivers within families (Kiviruusu et al., 2020), negatively impacting their interparental relationship and as well as their parenting, treatment options such as couples' therapy could also be recommended by healthcare practitioners (Barbato & D'Avanzo, 2020). Our findings do also imply that adolescents of mothers with elevated depressive symptoms may respond differently to risk, depending on the pattern of maternal symptoms across time. Practitioners working with families in which mothers experience psychological distress should be mindful that the impact on children's decision-making may therefore depend on the mother's history of psychological distress. Family therapy interventions can help practitioners understand family dynamics, prevent child difficulties from developing, and support the well-being of all family members (Compas et al., 2009; Giannakopoulos et al., 2021).

Our findings also have implications for research and suggest future directions. For instance, it would be useful to explore how the relationships between parental distress and adolescent decision-making may present in families that are socio-economically or culturally diverse. It is also important, particularly for fathers, to understand what impact clinical levels of distress might have on their adolescents' decision-making. Finally, future research could investigate why and how paternal and maternal distress are linked to

adolescent decision-making. We speculate that parenting and environmental stressor exposure, as a mediator and confounder respectively, may play a role.

Conclusions

Overall, this study suggests that both father's and mother's psychological distress during childhood can impact their adolescent's decision-making. Poor decision-making contributes to the emergence of various other adverse outcomes, such as mental health difficulties or substance misuse; therefore, determining the factors responsible for its development is of great importance. Future research could attempt to further explore how and why parental distress is linked to adolescent decision-making. Such findings could not only inform current knowledge on child development but also shape policy and practice on how to support vulnerable families.

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Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval The Millennium Cohort Study gained ethical approval from the National Health Service (NHS) Multi-Centre Ethics Committees. The present study has received additional ethical approval from the UCL, Institute of Education's Ethics Committee, all in line with the standards of the 1964 Declaration of Helsinki.

Informed Consent The Millennium Cohort Study obtained informed consent for anonymized data collection and publication from participating adults (and children's legal guardians). At the age of 11, children also provided verbal assent.

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