

Original Article

Direct investment by stepfathers can mitigate effects on educational outcomes but does not improve behavioural difficulties



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ABSTRACT

In contemporary developed populations, stepfather presence has been associated with detrimental effects on child development. However, the proximate mechanisms behind such effects are yet to be fully explored. From a behavioural ecological perspective, the negative effects associated with stepfathers may be due to the reduced quantity and quality of investments children receive within stepfather households. Here, we build on previous studies by investigating whether the effects of stepfather presence on child outcomes are driven by differences in maternal and partner (i.e., father or stepfather) direct investments. We use data from the Avon Longitudinal Study of Parents and Children to explore stepfather effects on children's educational achievement and behavioural difficulties at age 7. Our results indicate that, for educational achievement, stepfather effects are due to the lower levels of direct investments children receive. For behavioural difficulty, stepfather effects are due to multiple factors whereby stepfather presence is associated with greater difficulties independent of investment levels, and direct investments from stepfathers are ineffective. Our results suggest that the negative effects of stepfathers on child outcomes can be explained, in part, by the reduced quantity and the ineffectiveness of direct investments children receive from stepfathers. Furthermore, the effects of stepfather direct investments seem to vary between child outcomes.

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1. Introduction

1.1. Background

In contemporary developed populations, decades of research have identified stepfather presence to have negative effects on multiple child outcomes. Perhaps the most well-known example is the Cinderella Effect, where stepfather presence, compared to fathers, has been associated with significant increases in child mortality risk through homicide and accidental death (Daly & Wilson, 1980, 1994, 1998, 2001, 2005; Tooley, Karakis, Stokes, & Ozanne-Smith, 2006; Wilson, Daly, & Weghorst, 1980). This is clearly an extreme example regarding the negative effects of stepfathers, and stepfather-related child deaths in contemporary developed populations are rare in absolute terms. It is reasonable to assume that the majority of stepfathers do not intentionally harm or neglect their stepchildren. Nevertheless, the negative effects of stepfathers have been found for less extreme child outcomes. Children with stepfathers, compared to those with biological fathers, have been associated with lower levels of educational achievement (Dawson, 1991; Manning & Lamb, 2004; Thomson, Handon, & McLanahan, 1994), and greater levels of

behavioural difficulties (Amato & Rivera, 1999; Carlson, 2006; Dawson, 1991; Dunn et al., 1998; Hoffman, 2006; Lawson & Mace, 2010; Manning & Lamb, 2004; Thomson et al., 1994). This trend continues even when compared against children with single mothers, where children with stepfathers do worse in terms of accidental death (Tooley et al., 2006) educational achievement (Thomson et al., 1994), and behavioural difficulties (Carlson, 2006; Lawson & Mace, 2010) though results are less consistent (e.g., see Lancaster & Kaplan, 2000; Gennetian, 2005).

These findings are generally in line with expectations from an evolutionary perspective: Stepfathers are not related to their stepchildren, and do not gain any inclusive fitness benefits from investing in those children. Stepfather–child interactions are assumed to be driven purely by mating effort while father–child interactions are driven by a combination of mating and parenting effort (Anderson, Kaplan, & Lancaster, 1999a). Though some studies have found that married stepfathers invest in children as much as biological fathers (Berger, Carlson, Bzostek, & Osborne, 2008; Hofferth & Anderson, 2004), stepfathers have generally been found to invest less than fathers (Amato & Rivera, 1999; Anderson, Kaplan, & Lancaster, 1999b; Anderson et al., 1999a; Bronstein et al., 1994; Case & Paxson, 2001; Hofferth & Anderson, 2004; Lancaster & Kaplan, 2000; Lawson & Mace, 2009a; Thomson, McLanahan, & Curtin, 1992; Zvoch, 1999), perhaps reflecting the lack of parenting effort within stepfather–child interactions. We define investments as any effort

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directed towards the child for their benefit, be it resources or physical effort, which creates opportunity costs in any other behaviour. These lower levels of investment by stepfathers could, at least in part, explain why children with stepfathers do worse in developmental terms compared to children with fathers.

Nonetheless, it is also true that stepfathers are generally found to provide and care for their stepchildren (Anderson et al., 1999a, 1999b; Bronstein et al., 1994; Case & Paxson, 2001; Hofferth & Anderson, 2004; Lancaster & Kaplan, 2000; Zvoch, 1999). If stepfather effects are driven simply through lower levels of investments by stepfathers, we would expect children's developmental outcomes to be better in stepfather households compared to single-mother households. As discussed, this is not always the case. These findings suggest there may be other factors associated with stepfather presence which are detrimental to aspects of child development, which may be directly or indirectly related to stepfather presence. Stepfather presence is undoubtedly linked to multiple confounding factors which are often difficult to disentangle, leading us to question whether stepfather effects are simply down to stepfathers. This is an inherent problem in the numerous cross-sectional studies that have explored this topic.

One possible confounder associated with stepfather presence is the differences in the overall levels of investments children receive. First, as discussed above, stepfathers are found to invest less than fathers. While non-resident fathers may continue to provide investments into their children, the levels of investments have been found to be significantly lower compared to resident fathers (Anderson et al., 1999a, 1999b; Gibson-Davis, 2008). In addition, stepfather presence has been associated with a further reduction in the involvement by non-resident fathers (Christensen & Rettig, 1996; Furstenberg, Morgan, & Allison, 1987; Juby, Billette, Laplante, & Le Bourdais, 2007). Therefore, children living with stepfathers may receive lower levels of investments from “male figures” overall compared to children living with biological fathers or single mothers. Secondly, maternal investment levels have been found to be lower in stepfather households compared to father-present or single-mother households (Amato & Rivera, 1999; Lawson & Mace, 2009a). Mothers within stepfather households may be diverting attention away from their children and redirecting it to their new partners as mating effort. Children may receive lower levels of investment not only from “male figures,” but also from their mothers, meaning the overall investments they receive may be reduced in stepfather households.

Another possible confounder associated with stepfather presence is the differences in the quality or the efficacy of investments children receive. Parenting is often viewed to be less of a responsibility for stepfathers than fathers, with less involvement, less warmth and fewer disciplinary interactions (Fine, 1996). Stepfathers are more likely to have a disengaged parenting style (Fine, 1996), and stepfather presence may be associated with greater negligence (Tooley et al., 2006). It is therefore possible that the quality of investments children receive from stepfathers is lower: For instance, an hour under the care of a father has more benefit to a child than an hour under the care of a stepfather.

Thus the negative effects of stepfathers could, at least in part, be driven by the differences in the quantity and quality of investments children receive, which may or may not be directly related to stepfathers. However, only a small number of studies control for various aspects of investments while exploring the effects of stepfather presence. Of these, most have found that stepfather presence is still associated with negative effects on children's behaviour and/or educational achievement (Amato & Rivera, 1999; Carlson, 2006; Flouri, 2008; Thomson et al., 1994), suggesting that lower levels of investments do not drive all of the negative stepfather effects. However, the investment controls used within these studies vary, from controlling for within-household investments by mothers and their partners (fathers or stepfathers) (Amato & Rivera, 1999; Thomson et al., 1994), investments by mothers and biological fathers (present or absent in household) (Carlson, 2006), and investments by father figures (fathers, absent fathers or stepfathers) (Flouri, 2008). Maternal, paternal

and stepfather investments are not explored separately, leaving the possibility that some other aspect of investment may be driving the stepfather effect. This concern is strongest for studies which do not fully control for within-household investments by mothers and their partners, as investment levels are known to differ significantly between father and stepfather households.

Rather than focus on stepfather presence, a handful of studies have explored the effect of stepfather investments on child outcomes. For instance, a retrospective study of university students found that perceived involvement from stepfathers had a weak but positive association with adolescent well-being (Schwartz & Finley, 2006). Another study found that, though children in stepfather households had lower levels of educational achievement in general, stepfathers' educational involvement had a positive effect on children's educational achievement (Nord & West, 2001). In contrast, Vogt Yuan and Hamilton (2006) found that direct investment activities by stepfathers did not have a significant effect on behavioural problems and depression in adolescents after controlling for maternal and paternal (non-resident) investment, though emotional closeness between stepfathers and stepchildren did predict higher levels of adolescent well-being. Similarly, Bronstein et al. (1994) found that, while controlling for non-resident father involvement, direct stepfather investment was not associated with any effects on child outcomes. However, supportive parenting behaviour provided by stepfathers was associated with reduced behavioural difficulties. Within this limited literature on stepfather investments, there is conflicting evidence on whether direct investments by stepfathers have positive effects on child outcomes, though the quality of stepfather-child relationships seems to have positive associations with emotional and behavioural outcomes. However, the majority of these studies concentrated solely on the effect of stepfathers without comparison to fathers. It is still unclear whether investments from stepfathers are as beneficial for children as investments from fathers, and whether the ineffectiveness of stepfather investments could be contributing to the negative effects of stepfather presence.

1.2. Aims

Our aim in the current study is to explore whether stepfather effects are driven by the lower quantity and quality of direct investments associated with stepfather households. We use data from the Avon Longitudinal Study of Parents and Children (ALSPAC), which is a detailed longitudinal cohort study based in the old county of Avon in the UK. ALSPAC began with recruitment of pregnant women with expected delivery dates between the 1st April 1991 and 31st December 1992. 14,541 women were initially recruited, resulting in 13,988 children alive at 1 year of age. Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Further details on ALSPAC can be found in Boyd et al. (2012) and Fraser et al. (2012).

Previous work on ALSPAC by Lawson and Mace (2009b, 2010), focusing on sibling competition, simultaneously explored the effects of household structure on multiple child outcomes. They found that stepfather presence did not have a significant effect on children's educational achievement or IQ (Lawson & Mace, 2009b). In contrast, stepfather presence was associated with detrimental effects on children's behavioural difficulty, whereby children in stepfather households scored higher in behavioural difficulties compared to children in single-mother or father-present households. Further analysis suggested that children in stepfather households were more likely to score highly on hyperactivity (Lawson & Mace, 2010).

We build on previous studies on stepfather presence, particularly on Lawson and Mace (2010), by including measures of investments children receive from the mother and her partner (i.e., father or stepfather). Furthermore, we explore whether the effect of stepfather investments differ from paternal investments. First, we minimise the confounding effect of family disruption and single motherhood which

are inevitably linked to stepfather presence by selecting a subsample of ALSPAC families who have experienced relatively stable household structures. Second, we address missing responses to increase power and achieve more accurate estimates. Third, we include measures of maternal and father/stepfather direct investment levels within the household, defined here as investments provided to children via direct contact through behaviours such as general care-giving and play. We investigate whether: 1) Stepfather presence effects are removed if direct maternal investment levels within the household are controlled for; 2) Stepfather presence effects are removed if direct father/stepfather investment levels within the household are controlled for; and 3) Direct investments from stepfathers have a less positive effect on child outcomes compared to direct investments from fathers. This will help us determine whether stepfather effects are driven, at least in part, by the differences in the quantity and the quality of direct investments associated with stepfather households.

2. Methods

2.1. Data

As we are concerned with the effects of direct investments rather than household disruptions, the final sample is restricted to children who had the same father or stepfather present in the household between the ages of 3 years 11 months and 7 years. The importance here is that the same father or stepfather was reported to be present at all time points between 3 years 11 months and 7 years, so that children in both groups experienced stability in male presence.

To minimise the potential effects of family disruption and single motherhood associated with stepfather households, we aimed to select the earliest time-point for stepfathers entering the household. At the same time, we aimed to maximise the number of stepfather households within the sample. 3 years 11 months was the earliest time-point with a substantial number of stepfather households, where 289 mothers reported cohabitation with a stepfather. Note that many children in stepfather households are likely to have encountered stepfathers before the age of 3 years 11 months. Regarding cohabitation, data available from previous waves indicate that 36.3% of children in stepfather households lived with their stepfather by age 2 years 9 months, and 15.6% by age 1 year 9 months. We expect that these values would be higher for frequent contact between stepfathers and children.

The cut-off point of 7 years was chosen, as the last available measures of investments were at 5 years 5 months. We therefore required child outcomes measured after 5 years 5 months, and for father and stepfather presence to be stable up to that interval. 7 years

was the measurement occasion which maximised the sample size due to loss of stepfather households at older ages, with the biggest issue being non-response and drop-outs.

Finally, children from multiple births (i.e., twins, triplets etc.) were removed from the sample due to uncertainty with the interpretation of investment levels between the siblings. This left us with 246 stepfather households identified within 12895 households.

2.2. Variables

We investigate stepfather effects on two outcomes at around age 7; *school test score* and *behavioural difficulty score (BDS)*. School test scores were calculated for children based on the Key Stage 1 Standard Assessment Tasks in Mathematics and English, which is a standard exam administered by teachers at the end of Year 2 in the British state educational system. The combined scores were standardised to range from 0 to 15, and higher test scores are assumed to equate to higher educational achievement. Educational achievement in childhood, specifically reading and maths abilities, has been positively associated with school completion, later educational attainment and adult economic success (Bynner & Joshi, 2002; Gregg & Machin, 2001). Behavioural difficulty scores are derived from the Strength and Difficulties Questionnaire (Goodman, 1997), measuring hyperactivity, emotional symptoms, conduct problems and peer problems. This questionnaire was completed by the child's mother; she was asked to rate "how true" various statements were relating to her child's behaviour. Each child could score a maximum of 40 points, and lower scores are assumed to indicate better socio-emotional development. Behavioural difficulties in childhood have been linked to psychiatric disorders as well as economic, health and social issues in later life (Champion, Goodall, & Rutter, 1995; Goodman, 1997).

The main predictors of interest are 1) *stepfather presence*, which indicates whether the mother's partner in the household is the father or the stepfather, 2) *mother's investment score* (mother score), which is a combined score based on the self-reported frequencies of various play & caretaking activities with the focal child, and 3) *partner's investment score* (partner score), which is a combined score based on the mother-reported frequencies of various play and caretaking activities by the mother's partner (i.e., father or stepfather). Specifically, mother and partner scores were collected when children were 4 years 9 months and 5 years 5 months, where mothers reported if they or their partners carried out the specified activities "never, rarely, sometimes or often" (see Table 1 for activities measured and descriptives). These scores were standardised into a scale ranging from 0 to 10, and an average score for the mother and partner was calculated based on the two measurements. We take

Table 1
Descriptive statistics of parenting activities for mothers, fathers and stepfathers. The sample criteria consist of mothers who reported having the same partner between 3 years 11 months and 7 years, who completed the parenting questionnaires fully. Columns show the % of mothers, fathers and stepfathers reported to take part in the specific activity *often*. The last row displays the mean parenting score for mothers, fathers and stepfathers.

Activities:	4 years 9 months % reported "Often"			5 years 5 months % reported "Often"		
	Mother (N = 8759)	Father (N = 6856)	Stepfather (N = 182)	Mother (N = 8308)	Partner (N = 6531)	Stepfather (N = 167)
Bathe/shower child	83.78	38.90	31.32	82.50	32.00	27.54
Make things with child	41.90	23.60	21.43	34.50	17.06	14.97
Sing to child	46.66	16.67	9.34	36.22	12.31	8.38
Read to child	80.45	52.26	34.07	78.35	47.82	31.14
Play with toys	50.41	41.47	36.81	38.43	33.10	27.54
Cuddle	96.40	85.84	72.53	96.20	82.82	66.47
Active play with child	25.63	43.74	38.46	20.62	37.45	33.53
Take to park/playground	31.96	23.98	22.53	25.47	19.55	20.36
Put child to bed	83.65	53.59	45.60	84.16	48.95	44.31
Take swimming	31.16	18.39	13.19	30.15	15.82	8.98
Draw/paint with child	38.00	15.24	13.74	26.73	10.38	13.77
Prepare food for child	93.34	30.12	37.91	93.60	27.21	32.93
	Mean(sd)	Mean(sd)	Mean(sd)	Mean(sd)	Mean(sd)	Mean(sd)
Parenting Score (Range: 0–10)	8.34 (1.01)	6.93 (1.54)	6.62 (1.61)	8.12 (1.01)	6.66 (1.54)	6.36 (1.69)

these scores to be a proxy of the mother and partner's direct investment levels: Caretaking by adults such as feeding and washing addresses the basic needs of young children, and the absence of such caretaking is often presented as neglect which negatively affect child development (Hildyard & Wolfe, 2002), whilst play, both supervised by and involving adults, has been identified as a necessity for optimal child development (Ginsburg, 2007). Therefore, basic caretaking and other activities which encourage and involve play are likely to be a significant aspect of direct investments in childhood. The main strength of the mother and partner scores is that they are based on behaviours directed towards children, and are likely to be a more accurate representation of direct investments compared to other possible proxies such as presence, proximity or emotional closeness. Further information on mother and partner scores can be found in Lawson and Mace (2009a).

In all analyses, we include controls of children's age at the time of measurement (in months), number of siblings in the household, home ownership, reported financial difficulty and household income, which was measured at or around age 7. We also include mother's age at birth (in years), child's sex, child's ethnicity and mother's level of education, which was measured at birth of the cohort child. Finally, we include maternal employment and partner employment which is based on employment status between 3 years 11 months and 7 years, whereby employment was categorised into never, some and constant (Table 2).

Table 2

Descriptive statistics of all variables included in analyses. Analysis-specific variables are those specific to models for each child outcome. Analysis-general variables were used in all models.

N = 12895	Range	Mean	SD	N	%
<i>Analysis-Specific Variables</i>					
<i>School Test Score</i>					
Test Score	0–15	9.16	3.75	10426	–
Age (months)	78–101	88.38	3.75	10476	–
<i>Behavioural Difficulty Score</i>					
Behavioural Difficulty Score	0–31	7.48	4.76	7832	–
Age (months)	80–101	81.44	3.74	7844	–
<i>Analysis-General Variables</i>					
<i>Sex of Child</i>					
Male (ref)	–	–	–	6652	51.60
Female	–	–	–	6240	48.40
<i>Ethnicity of Child</i>					
White (ref)	–	–	–	10712	94.91
Other	–	–	–	574	5.09
Number of Siblings in Household	0–11	1.37	0.88	7735	–
Mother's Age at Birth of Child	15–44	27.99	4.97	12894	–
<i>Mother's Education Level</i>					
O-Level/Equiv. (ref)	–	–	–	7489	64.47
A-Level	–	–	–	2625	22.60
Degree	–	–	–	1503	12.94
<i>Mother's Employment</i>					
Never	–	–	–	9509	–
Some	–	–	–	2341	24.62
Constant	–	–	–	2561	26.93
<i>Partner's Employment</i>					
Never	–	–	–	4607	48.45
Some	–	–	–	9192	–
Constant	–	–	–	457	4.97
<i>Home Ownership</i>					
Renting (ref)	–	–	–	687	7.47
Owned	–	–	–	8048	87.55
<i>Financial Difficulty</i>					
Average Weekly Income	0–15	2.08	3.03	7708	–
<£200 p/wk (ref)	–	–	–	8906	–
£200 to £399 p/wk	–	–	–	1559	17.51
>£400 p/wk	–	–	–	4064	45.63
<i>Stepfather</i>					
Father (ref)	–	–	–	3283	36.86
Stepfather	–	–	–	7729	–
<i>Mother Score</i>					
Mother Score	2.22–10	8.24	0.96	7483	96.82
<i>Partner Score</i>					
Partner Score	0–10	6.68	1.56	246	3.18

2.2. Analyses

First, as found previously in the full ALSPAC sample (Lawson & Mace, 2009a), we carried out checks to see if our particular subsample showed the same pattern where partner scores were lower for stepfathers than fathers, and that mother scores were lower if her partner was the child's stepfather rather than father. We then carried out multiple imputations of missing values with chained equations using the `-mi impute chained-` command in STATA SE 12. Multiple imputations assume that missing information is missing at random based on the predictors entered into the model. This assumption is likely to hold in the current dataset and methods: In ALSPAC, the risk of non-response has been identified to be higher for households with male cohort children and lower socio-economic status (Boyd et al., 2012). In our current analyses, we include information on sex of child and multiple predictors of socio-economic status. The appropriate number of imputations was determined using methods outlined in White, Royston, and Wood (2011), which resulted in carrying out 100 imputations. Whilst this number of imputations may seem large especially as some recommend as little as 5 (Allison, 2000), others have argued that more imputations are necessary for accuracy and consistency, and 100 imputations have been noted as acceptable (White et al., 2011). The main benefits of imputations are that it permits use of all available information in the final sample, increasing efficiency, as well as reducing bias in estimations and standard errors. For further information on missing data and multiple imputations, see Sterne (2009) and Schafer and Graham (2002).

For school test score, we ran normal linear regressions due to the normal distribution of the outcomes. For behavioural difficulty score, we ran Poisson regressions due to the Poisson distribution with no overdispersion of the outcome. For each of the three outcomes, we ran 5 models: The first, along with the controls, only included stepfather presence. This is analogous to most other papers exploring stepfather effects on child outcomes. To this base model, we added mother's investment score, partner's investment score, and mother and partner's investment score. This controls for the associated differences in within-household direct investment levels between father and stepfather presence. Finally, we added an interaction term between stepfather presence and partner score. This allows us to investigate whether direct investments from stepfathers differ in its effect on child outcomes from fathers. Note that mother score, partner score, children's age, and mother's age at birth were mean centred to ease interpretation of the results, where the intercept is modelled at the average point of these values rather than the improbable or unlikely "0" value.

3. Results

3.1. Mother and partner's investment scores

A two-sample t-test with unequal variances showed that there is a significant difference in partner's investment scores between fathers (Mean \pm SD = 6.79 \pm 1.48, N = 6874) and stepfathers (Mean \pm SD = 6.45 \pm 1.54, N = 193) ($t_{202} = 3.04$, $d = 0.43$, $P = 0.003$), where the mean of fathers is significantly larger than the mean of stepfathers ($P = 0.001$). Furthermore, a two-sample t-test with unequal variances showed that there is a significant difference in the mother's investment score between father presence (Mean \pm SD = 8.25 \pm 0.94, N = 6891) and stepfather presence (Mean \pm SD = 8.07 \pm 1.08, N = 202) ($t_{202} = 2.29$, $d = 0.32$, $P = 0.023$), where the mean is significantly larger if fathers are present in the household rather than stepfathers ($P = 0.012$). These results confirmed that, as in the full ALSPAC sample, stepfathers in our subsample invest less than fathers, and that mothers in our subsample invest less when stepfathers are present in the household.

3.2. Main analyses

The full results of the interaction models with information on all control variables are available in the Supplementary material (S1), available on the journals website at www.ehbonline.org.

For school test score, stepfather presence was initially a significant predictor, where stepfathers in the household predicted a lower test score by -0.5 points (Table 3). This fell to -0.479 when controlling for mother score, although it retained significance at the $P \leq 0.05$ level. The inclusion of partner score dropped the negative stepfather presence effect to a greater degree to -0.476 , and stepfather presence was no longer a significant predictor of children's test scores. The inclusion of both mother score and partner score in the same model further dropped the coefficient of stepfather presence to -0.469 , and partner score was the only significant predictor of children's test score. The interaction between stepfather presence and partner score was not significant. Overall, this suggests that the negative effect associated with stepfather presence on children's educational achievement is primarily driven by the lower direct investment levels provided by stepfathers compared to fathers; the effects of direct investment do not differ whether it comes from the father or the stepfather.

For behavioural difficulty score, stepfather presence was associated with a 10.9% increase in behavioural difficulty scores of children if they had a stepfather in the household. Controlling for mother score did not alter this negative effect, whereby stepfather presence was still associated with an 11% increase in behavioural difficulty score. An inclusion of partner score reduced the negative effects of stepfather presence to a 10.1% increase in behavioural difficulty score, although stepfather presence still retained significance at the $P \leq 0.01$ level. Including both mother score and partner score lowered the negative effects further to 9.3%, but again it remained significant at the $P \leq 0.01$ level. An interaction between stepfather presence and partner score was significant, where the positive effect of partner score in reducing behavioural difficulties was not seen if the direct investments were provided by the stepfather (Fig. 1). Specifically, compared to children with fathers who invest at the mean level, children with high investing fathers ($+3$ partner score) had 12% lower BDS (IRR = 0.878, 95% CI = 0.869–0.896, $P \leq 0.001$) while children with low investing fathers (-3 father score) had 14% higher BDS (IRR = 1.139, 95% CI = 1.115–1.163, $P \leq 0.001$). In contrast, compared to children with stepfathers who invest at the mean level, there were no significant differences in BDS between children with high investing stepfathers ($+3$ partner score) (IRR = 1.014, 95% CI = 0.889–1.157, $P = 0.836$) and those with low investing stepfathers (-3 partner

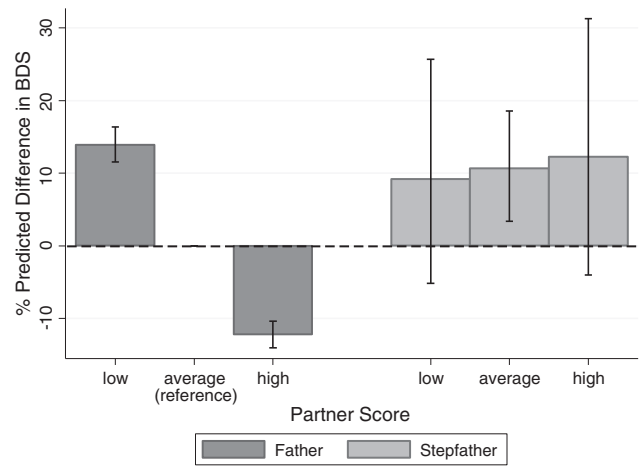


Fig. 1. Predicted difference in behavioural difficulty score, by partner score (mean-centred) and fathers/stepfathers. Low = -3 , average = 0 and high = 3. The reference point is the behavioural difficulty score for children with fathers who scored the average for partner score. Error bars show the 95% confidence intervals.

score) (IRR = 0.986, 95% CI = 0.864–1.125, $P = 0.836$). Overall, this suggests that the negative effect associated with stepfather presence on children's socio-emotional development is partly driven by the ineffectiveness of direct investments from stepfathers. Furthermore, stepfather presence continued to be associated with detrimental effects on children's behavioural difficulties after controlling for within-household direct investments. This suggests that there are additional factors associated with stepfather presence which negatively impact children's socio-emotional development.

4. Discussion

4.1. Main findings

In the current study, we investigated whether the negative effects associated with stepfather presence were driven by the reduced quantity and quality of direct investments children receive within the household. We specifically explored if stepfather presence effects were driven by 1) levels of maternal direct investments, 2) differences in the levels of stepfather/father direct investments, and 3) differences in the effectiveness of stepfather/father direct investments.

For school test score, the negative effect of stepfather presence was reduced when mother score was added to the model, and the negative

Table 3
Results for the key predictors of interest on school test score and behavioural difficulty score.

	Presence		Mother Score		Partner Score		Both Scores		Interaction	
	B	SE	B	SE	B	SE	B	SE	B	SE
School Test Score										
Stepfather (ref: Father)	-0.500*	0.243	-0.479*	0.243	-0.476†	0.244	-0.469†	0.244	-0.458†	0.251
Mother Score	-	-	0.114**	0.044	-	-	0.067	0.046	0.067	0.047
Partner Score	-	-	-	-	0.119***	0.029	0.107***	0.031	0.106***	0.031
Stepfather * Partner Score	-	-	-	-	-	-	-	-	0.046	0.195
	IRR	95%CI	IRR	95%CI	IRR	95%CI	IRR	95%CI	IRR	95%CI
BDS										
Stepfather (ref: Father)	1.109**	1.037, 1.187	1.110**	1.025, 1.173	1.101**	1.029, 1.178	1.093**	1.021, 1.169	1.107**	1.034, 1.184
Mother Score	-	-	0.923***	0.914, 0.931	-	-	0.939***	0.930, 0.948	0.939***	0.930, 0.948
Partner Score	-	-	-	-	0.950***	0.943, 0.956	0.959***	0.952, 0.965	0.957***	0.951, 0.964
Stepfather * Partner Score	-	-	-	-	-	-	-	-	1.049*	1.003, 1.097

† $P \leq 0.10$.

* $P \leq 0.05$.

** $P \leq 0.01$.

*** $P \leq 0.001$.

effect of stepfather presence was reduced to a greater extent and lost its significance when partner score was added to the model. However, the positive effect of direct investment on children's educational achievement was the same whether it was provided by the father or stepfather. This suggests that the negative effect of stepfather presence on children's educational achievement is primarily due to the lower levels of direct investments children receive within stepfather households. Furthermore, stepfather investment itself has a positive effect, and the negative stepfather effect on educational achievement may be overcome if stepfathers are encouraged to interact more with their stepchildren. Our results differ from those of Lawson and Mace (2009b), who found that stepfather presence had no significant effect on educational achievement at age 4/5 years and 6/7 years. However, we believe this difference to be driven by sample size. Lawson and Mace (2009b) took a cross-sectional approach as we have done, but did not impute missing values. This left their analyses with a comparatively smaller sample size ($N = 3762$ for 4/5 years, $N = 4638$ for 6/7 years), potentially leading to lack of power through small numbers of stepfathers and less accurate estimates.

Secondly, for behavioural difficulty score, the negative effect of stepfather presence was not affected when mother score was added to the model. However, the negative effect of stepfather presence was reduced when partner score was added to the model, suggesting differences in investments between fathers and stepfathers partly drive the stepfather effect. Furthermore, direct investments provided by stepfathers had no beneficial effect on children's behavioural difficulty score. Overall, this suggests that the negative effect of stepfather presence on children's socio-emotional development is due to multiple factors:

First, unlike paternal direct investments, children's behaviour is unlikely to improve however much stepfathers invest in children. This could suggest that paternal direct investments may not be substitutable by stepfather investments for children's socio-emotional development. Reduced paternal investments, combined with the ineffectiveness of stepfather investments, are both likely to contribute to the higher levels of behavioural difficulties for children in stepfather households. Unlike with school test score, this suggests that the negative effect of stepfather presence on children's socio-emotional development is unlikely to be overcome even if stepfathers are encouraged to interact more with their stepchildren.

Second, stepfather presence was associated with detrimental effects on children's behavioural difficulties irrespective of within-household direct investment levels. Note that this does not necessarily mean stepfathers directly cause negative effects on children's socio-emotional development. While we took steps to minimise unobserved heterogeneity, stepfather households are inherently associated with greater family disruption which could be contributing to the detrimental effects. What our results suggest is that stepfather presence is associated with detrimental effects on children's behaviour, independent of the quality and quantity of direct investments within the household.

4.2. Limitations

In the current study, we tried to minimise confounds related to stepfather presence with our sample selection criteria which required that households were stable, and that stepfathers entered the household at a very young age. Furthermore, we included a wide range of controls in attempt to minimise such problems. Nonetheless, there is the possibility that our findings could be driven by other unexplored characteristics specifically associated with stepfather households. In particular, one aspect we were unable to explore was the effect of absent fathers on child development, which may influence or interact with stepfather presence. Unfortunately, detailed information on investments by absent fathers was unavailable in the current dataset. Furthermore, there are methodological issues with

perfect correlation between stepfather presence and father absence, meaning the effect of absent fathers cannot be analysed within the current framework where stepfather effects are compared against father-present households. Stepfather presence is usually met with the reduction in the involvement by non-resident fathers (Christensen & Rettig, 1996; Furstenberg et al., 1987; Juby et al., 2007), whose investment levels are already significantly lower than live-in fathers (Anderson et al., 1999a,b; Gibson-Davis, 2008). It may be that the negative effect of stepfather presence on behavioural difficulties (controlling for maternal and stepfather direct investments) is driven by the lack of investments by absent fathers. If so, this would complement our suggestion that paternal direct investments may be particularly important for children's socio-emotional development.

There is also a possibility that the effects attributed to the levels of stepfather investments may in fact be due to correlated levels of paternal investment from non-resident fathers. Recent studies suggest that there is no correlation between stepfather involvement and absent-father involvement within stepfather households (e.g., Jensen & Schafer, 2013; King, Thorsen, & Amato, 2014), while others have found that contact with non-resident fathers negatively correlate with the quality of stepfather-child relationships (e.g., McDonald & DeMaris, 2002). If the effects of stepfather investments are driven by the negative correlation with absent-father investments, we would expect high stepfather investments to have no, or even a negative, effect on child outcomes. In fact, we found the opposite result on educational achievement where stepfather investments were associated with a positive effect on test scores. Thus, it is unlikely that the effect of stepfather investments on educational attainment is driven by absent-father investments. In contrast, absent-father investments could be an important factor for behavioural difficulty, as stepfather investments were found to be ineffective. If so, this complements our suggestion that paternal direct investments may be particularly important for children's socio-emotional development. For future studies, researchers may be interested in investigating if and how stepfather effects are affected by absent fathers.

Despite these limitations, our findings highlight the potential influence of direct investments which contribute to the negative effects of stepfather presence regarding children's developmental outcomes. For school test score in particular, direct investment levels seem to drive stepfather effects, and other confounding factors specifically associated with stepfather presence are likely to be inconsequential. With behavioural difficulty score, stepfather presence effects persist even after controlling for investment levels. Therefore, it is possible that other confounding characteristics associated with stepfather households may be resulting in the observed detrimental effects on children's socio-emotional development.

Finally, it is important to note that our current sample of stepfather households is unusual in that stepfathers entered the household when children were very young, with household stability across time-points. While this allowed us to compare father and stepfather households, the negative effects on child outcomes associated with stepfather presence may be underestimated compared to the wider population.

4.3. Conclusions

The current study has shown that the differences in quantity and quality of investments between fathers and stepfathers within the household may explain, at least in part, why stepfather presence is associated with negative effects on child development. First, children may be receiving lower levels of direct investments within stepfather households. Second, for some aspects of development, the direct investments from stepfathers may be ineffective. Our findings suggest that, for children's educational achievement in particular, the negative effects associated with stepfather presence may be overcome if stepfathers are encouraged to interact more with their stepchildren.

However, for children's behavioural difficulties, encouraging stepfathers to interact with stepchildren is unlikely to have positive effects.

Supplementary Materials

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.evolhumbehav.2014.05.010>.

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