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ABSTRACT

If Looks Could Heal: Child Health and Paternal Investment*

Data from the first two waves of the Fragile Family and Child Wellbeing study indicate that infants who look like their father at birth are healthier one year later. The reason is such father-child resemblance induces a father to spend more time engaged in positive parenting. An extra day (per month) of time-investment by a typical visiting father enhances child health by just over 10% of a standard deviation. This estimate is not biased by the effect of child health on father-involvement or omitted maternal ability, thereby eliminating endogeneity biases that plague existing studies. The result has implications regarding the role of a father's time in enhancing child health, especially in fragile families.

JEL Classification: I12, J12, J13

Keywords: child health, nonresident father, father-child resemblance

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1 Introduction

Income inequality in the US increased substantially since the 1990's. Many dispute the underlying causes, but few can disagree that single-parent households tend to fall at the bottom of the distribution. Further, children in these households are at a disadvantage, which likely affects them throughout their lives.

On December 10, 2014, the White House held a summit on Early Education. The key recommendation emphatically endorsed investing in early childhood development (including health). According to one speaker, "[t]he way parents interact with their children, the amount of time they spend with them and the resources they have . . . greatly affect their children's potential for leading flourishing lives" (Heckman, 2014). Time inputs of both parents appear to be even more important than money investments in producing quality children (Del Boca et al., 2014). In this regard, the prevalence of children currently living in low-income single mother homes is of concern. In 2016, 17.2 million (nearly 25%) children under age 18 were living only with a mother and 40% of those lived below the poverty line (U.S. Census Bureau, 2016). These children are more likely to be food insecure (Nord et al., 2005), and have less access to parental investment especially from absentee fathers (Jones & Mosher, 2013). But, as will be explained, the impact of nonresident father-involvement on child health has not been adequately studied. In this paper, we consider whether early investments by nonresident fathers improve child health. Determining this is important given that child health is strongly linked to future education, adult health and eventual labor market success (Case et al., 2005; Currie, 2009; Campbell et al., 2014).

The 'parent-child family' model of Jacobson (2000) explains that parents allocate material and time inputs to the production of child health, in addition to their own health, in order to maximize the family's utility. Bolin et al. (2002) extend the model to consider, *inter alia*, the effects of family policies on child health when parents are divorced. Their model implies that greater nonresident father contact (via joint custody) or child support would raise the amount of child health. Frequent contact likely provides more parental time to supervise children, manage harmful exposures, gather information and attend to their health needs, and share parenting tasks. Nonresident fathers might also be attentive and careful in child interaction to prevent health problems and thereby secure future visiting opportunities (Nepomnyaschy & Donnelly, 2015). Child support may increase the mother's ability to purchase more or better health inputs, and also increase father visitation (Del Boca & Ribero, 2001). An alternative perspective is a visiting father might stir up conflict or put strain on a mother's economic resources. This in turn affects parenting practices and maternal depression (Slade, 2013), which makes children more susceptible to health problems or emotional distress.

A growing empirical literature finds that children in single-mother families have lower health than children in two-parent families (e.g. Angel & Worobey, 1988; Bramlett & Blumberg, 2007; Harknett, 2009). However, studies regarding the impact of nonresident fathers' involvement are scarce and provide mixed conclusions. Menning & Stewart (2008) find nonresident father contact is related to a greater risk of adolescent obesity. Yet, somewhat contradictory, other studies find that frequent visitation is related to fewer food acquisition problems in households with 0-17 year old children (Garasky & Stewart, 2007) and healthier adolescent eating habits (Stewart & Menning, 2009). For kindergarten children, Hofferth & Pinzon (2011) find no effect of nonresidential fathers' child support payments and contact on child health after parental separation. At the same time, Baughman (2014) shows child support lowers the odds of poor health for children 2-15 years old. When children are 1-5 years old, Nepomnyaschy & Donnelly (2015) find nonresident father engagement insignificantly affects injury risk (similar to Hofferth & Pinzon, 2011); however, their cooperative parenting behavior lowers such risk.

Simply controlling for demographic and socioeconomic factors limits these studies' facility to control for several possible sources of endogeneity bias. First, poor child health may either deter or induce nonresident father involvement rather than the reverse in which father involvement augments child health. For example, Reichman et al. (2004) find child health may lead to marital dissolution, and hence lower father involvement. Also, Hofferth & Pinzon (2011) find child health problems lower financial support. Ignoring such reverse causation creates an ambiguous estimation bias. Second, a protective, self-reliant and competent mother may discourage ('gatekeep') father engagement in child-rearing activities (Allen & Hawkins, 1999; Gaertner et al., 2007); or a mother's time in child care may be a substitute for a father's time (Pailhe & Solaz, 2008). Such maternal factors if ignored can cause a downward bias. Third, a mother who views herself as the sole contributor to her child's health may more likely understate a father's participation while a mother who merely wishes the father participated more might overstate it. So, mother-reported paternal investment may be measured with error, which can create a downward bias. The overall bias is ambiguous, making it difficult for existing studies to ascertain the causal impact of nonresident fathers on child health.

We introduce a unique approach, with roots in evolutionary sociobiology, to infer the causal impact of nonresident father-involvement on child health. To do so, we make use of an *a priori* unexpected observation in the Fragile Families and Child Wellbeing data. We find infants born out of wedlock who look like their father at birth (as assessed by both parents in separate and private interviews)[1] have better overall health one-year later, but not at birth. Further, we determine the underlying mechanism for better child health one year after birth in response to father-child resemblance is father involvement, in particular the amount of time a father invests in his purported child. We find the average nonresident father spends about 2.5 days (per month) longer in parenting activities when the child resembles him. Consistent with several studies from evolutionary sociobiology (e.g. Platek et al., 2002, 2003, 2004; Volk & Quinsey, 2002, 2007), father-child resemblance encourages paternal time-investment, perhaps because doubtful males respond to paternity uncertainty. There is little or no evidence to support other potential mechanisms such as a father's economic provision, his involvement in shared parenting, or maternal parenting. These results support using father-child resemblance as an instrument for the time a father invests in the child to establish a causal link between father's time investment and child health. The validity of the father-child resemblance variable is supported by conducting placebo checks under conditions where such a variable is irrelevant to paternal investment. We find fathers' time-investment

[1] Alvergne et al. (2010) show that actual resemblance to the father is consistent when both parents report father-child facial similarity in private. Still, we consider other definitions of father-child resemblance.

significantly improves child health in single-mother families. Based on a linear combination of five child health indicators, each extra day of time-investment increases child health by over 0.1 standard deviations. It also decreases the probability a child will have reportedly 'poor' health by 2 percentage points. Thus, promoting nonresident father time-investment could be a key strategy to reduce child health disparities and thereby secure a greater chance of future educational and career success for children in single-mother families.

The next section presents the literature relating child resemblance to paternal investment. In section 3, we describe the data and define key variables. In section 4, we estimate the impact of father-child resemblance on child health and father investment, deduce the mechanism through which such resemblance operates, and provide checks for robustness. Finally, section 5 provides a conclusion.

2 Child resemblance and paternal investment

Evolutionary theory predicts parents will provide preferential care to genetically related children to advance their genetic success (Hamilton, 1963; Trivers, 1972; Alexander, 1974). Investments in unrelated children are deemed wasteful since they reduce investment in genetically related offspring. Indeed, stepchildren and adoptees tend to receive less parental investment and greater mistreatment (e.g. Bertram (1975) for evidence on lions; Daly & Wilson (1996), Case & Paxson (2001), and Gibson (2009) for evidence on humans). Similar differential treatment prevails when males suspect infidelity. Evidence based on both animals and humans indicate that males invest in parental care in response to paternity certainty (birds: Moller & Birkhead (1993); fish: Neff & Gross (2001); nonhuman primates: Buchan et al (2003); Langos et al. (2013); humans: Fox & Bruce (2001); Anderson et al. (2007)).

Doubtful males can use a child's resemblance as a cue of genetic relatedness (Alexander, 1974; Daly & Wilson, 1998; Volk & Quinsey, 2002)[2] in lieu of relatively costly paternity testing.[3] This is possible because parent-child resemblance is sufficiently present in children for it to be detected from as early as birth (Porter et al., 1984; McLain et al., 2000; Alvergne et al., 2007; Kaminski et al., 2010). Experiment-based evidence of paternal involvement corroborates this. For example, based on video images of children ages 4 to 72 months, Volk & Quinsey (2002, 2007) find a man is more prone than a woman to adopt a child looking like him. Similarly, based on pictures morphed with at least 25% of respondent's facial traits, Platek et al. (2002, 2003, 2004) find men (but not women) hypothetically spend more time, adopt, or provide financial support to toddlers similar to themselves. Moreover, according to Platek et al. (2004, 2005), neurocognitive processes drive these gender differences. Studies on actual biological parents also support that men use resemblance as a paternity cue (e.g. Apicella & Marlowe, 2004; Alvergne et al., 2009). Even fathers convicted of family violence

[2] Even recent studies on nonhuman primates (e.g Parr et al., 2010; Pfefferle et al, 2014) find evidence that facial similarities are used to detect kinship.

[3] Based on the Fragile Family and Child Wellbeing data, we estimate the prevalence of paternity testing is at most 7% among unmarried families. This estimate comprises the number of cases where paternity was established through court *and* the number of cases where DNA results were pending as at 1-year follow-up.

treat children better based on similar facial likeness (Burch & Gallup, 2000). Finally, with respect to the reliability of reported resemblance, Alvergne et al. (2010) present three key findings on children as young as 3 months. First, resemblance is consistent when reported in private by each parent. Second, both parents are more likely to report father-child similarity when the child actually resembles the father (as determined by external judges). Third, actual facial likeness predicts paternal investment.

To conclude, many evolutionary sociobiology studies support using father-child resemblance to explain a putative father's investment. Because women do not need facial resemblance cues to decide whether to provide care, we expect baby looks affect child developmental outcomes only through a father's investments.[4] As we indicated above, when data are collected in private and separately from each parent, reported resemblance is reliable and matches actual resemblance.

3 Data and variable descriptions

We base our empirical analysis on data from the Fragile Families and Child Wellbeing (FFCW) study. The study follows children born (between 1998 and 2000) to parents in large U.S. cities. Births to unmarried parents are oversampled to assess living conditions and wellbeing of children in such families.[5] Mothers and putative fathers were separately interviewed within the first three days of birth and then at four follow-ups.[6] Our study uses data from both parents' interviews at birth, and then from the mother's interview at one-year follow-up. We focus on the first year of birth because that period is crucial for a nonresident father to create and maintain a bond with a child (Cheadle et al., 2010). We rely on mothers' reports because many fathers were lost by 1-year follow-up (about 30% of all births). This precludes concern of attrition bias due to father non-response.

We focus on unmarried families in which a newborn resides with the mother and the father lives elsewhere one year later.[7] In such fragile families, infidelity and sexual distrust abound (Hill, 2007); and so, paternal confidence may be relatively low (Anderson et al., 2006). Paternity may be less of an issue in traditional or cohabiting families, as fathers are already spending much time there in child investment than in single-mother families. Therefore, single-mother families are an appropriate setting for this study. Thus, our results should only be generalized to those at-risk families, which is an important group when considering policies related to US poverty (Vance, 2016).

[4]We will verify this by conducting placebo checks to show that father-child resemblance has no significant effect on child health in a sample of fathers whose involvement is restricted by death or incarceration and in a sample of two-parent families. We will also show its insignificant effect on maternal parenting channels.

[5]See Reichman et al. (2001) for more detail information about the design of the FFCW sample.

[6]Mothers were asked to identify and locate the father by providing his visiting schedules or to pass on interviewer's business card to the father (FFCW User Guide).

[7]We explore the possibility of sample selection issues in section 4.4 and find robust results. We also exclude cases where the mother reported the father was deceased, unknown, incarcerated at 1-year follow-up, has never seen the child, or is mandated (through a child support agreement) to visit the child. We later employ some of these excluded cases for validity testing.

3.1 Baby looks measure

The FFCW collects baby looks data only at birth from both parents' responses to the question: "Who does the baby looks like?" While resemblance may change over time (Alvergne et al., 2007), assessing resemblance at birth is key because that is when fathers decide paternity. A total of 715 unmarried and non-cohabiting parents responded to this question.[8] We classify a baby as resembling the father if *both* parents separately reported in private that the baby looks either wholly or partially like the father.[9] This includes situations when one parent says the baby looks only like the father and the other indicates the baby looks like both parents. This classification aligns with Platek et al. (2003) who find men invest in children with at least 25% of their facial traits. Defining father-child resemblance to occur when both parents agree is consistent with Alvergne et al. (2010) who find that both parents are likely to see father-child resemblance when the child actually resembles the father. Of the 715 parents nearly two-thirds (n = 456) agree on whether the baby looks like or does not look like the father. This is our estimation sample.[10] Of these 456 observations, 56% (n=255) agree the child resembles the father, and 44% (n =201) agree the child does not resemble the father. Table 1 presents summary statistics for the rest of the variables in the estimation sample. Note from column (3) that, except in a few cases at the 10% level, the characteristics of the estimation sample are not significantly different from those in which parents disagree on resemblance (column 4). In section 4.4, we discuss potential selection issues from choosing our sample in this way.

3.2 Child health indicators

The FFCW data provide mother-reported (subjective) general child health on a five-point scale ranging from 1=excellent to 5=poor, a variable used in other studies such as Case et al. (2002) and Currie & Stabile (2003). Due to the low proportion of children in the poor, fair and good categories, we reclassify child health status as 0=poor/fair/good, 1=very good and 2=excellent, with a frequency of 14.3%, 23.0% and 62.7%, respectively. We also use data on four specific health outcomes. These include: whether the child experienced an asthma episode/attack since birth; number of visits to a health care professional for illness since birth; number of emergency room visits since birth; and the longest stay in hospital. Asthma, in

[8]In two cities, this question was not asked because it was added to a later version of the survey during fielding, so that a further 97 observations are excluded. Generally, these observations are not significantly different in terms of overall child health, paternal investment and socioeconomic conditions. Missing values still exist for some of the variables listed in table 1. However, these are found to be missing completely at random (MCAR) based on Little (1988) MCAR test ($\chi^2 = 565.2$, $df = 589$, $p = 0.753$). Thus, analyses are conducted assuming no bias due to listwise deletion of missing values.

[9]In section 4.4, we find similar results for two alternative definitions of father-child resemblance: (1) both parents agree the child looks wholly like the father, and (2) father reports the child resembles him even when the mother diasgrees —although in this case measurement errors are more likely to occur.

[10]Our sample size is the highest attainable from the FFCW database, which is most suited for the purpose of this study. To our knowledge, it is also the largest sample ever used to analyze father-child resemblance effects. Moreover, our sample size is comparable to other IV studies such as Leonard (2008) and Van Ours (2004), and much greater than notable ones like Acemoglu et al. (2001).

particular, is a common and growing childhood chronic health illness that is associated with high health care utilization such as emergency room visits and hospitalization (Akinbami, 2006). The specific child health measures (besides asthma) are not perfect as they may reflect both true health quality and access to health care or ability to afford more health care visits. Despite this, in our sample, all child health measures have statistically significant ($p < 0.01$) correlations in the expected direction.

Our main health variable is a composite health index, which summarizes the underlying commonalities among the above five child health indicators using principal component analysis.[11] This continuous composite health measure is effectively a linear combination of all the five (mean-centered) health indicators. It is scaled so that effects are reported in standard deviation units, where higher values indicate better health. We prefer to analyze this composite measure because it encompasses various dimensions of child health. However, we present results for each health indicator to check robustness. We also give consideration to related (behavioral) health outcomes (e.g. child temperament, maternal substance use) in section 4.4.

Table 1 indicates an average subjective child health of 1.5 and an asthma incidence of approximately 10%. Also, since birth, there were on average four health care visits for illness, less than two visits to emergency rooms and no more than a day stay in hospital. As summarized by the composite health index, children resembling their father have significantly more favorable health conditions, based on a simple test of the difference in means between columns (1) and (2).

3.3 Paternal investment

A priori we do not know which aspect of father involvement is impacted by father-child resemblance. As such, we consider three potential dimensions through which nonresident fathers' investment can occur: (1) economic provision, (2) direct time-investment, and (3) shared parental responsibilities. Each is measured based on mothers' reports.[12] Economic provision is measured in two ways. First, it is measured dichotomously by whether the father provided non-legally binding (informal) financial support in the past year.[13] Second, based on responses (ranging from '1=often' to '4=never') to six questions measuring how frequently fathers provide in-kind items (e.g. clothes, toys, medicine, food), we compute the average (reverse-coded) response for each mother. Table 1 shows that 34% of mothers reported the father provided financial support and the average in-kind support frequency is 2.3 with a

[11] A single principal component is extracted using the sample of 715 unmarried and non-cohabiting families (rather than the estimation sample n=456) to capitalize on the greater variation in the health measures. Note that we get virtually the same results if we standardize each child health indicator (when the order of the specific health outcomes are reversed), average them to create an index, and then normalize by the standard deviation of the index.

[12] Hernandez & Coley (2007) find that either mother's or father's reported reliable measures of father involvement in low-income families.

[13] We tried the amount of financial support, which we had to impute with the mid-point when a range is provided. It nevertheless suffers from reporting error as it may have been difficult for mothers to recall the exact amount. The result is similar to the dichotomous measure.

standard deviation of 0.9. Although the proportion of fathers providing financial support is not significantly higher for those resembling the child, in-kind support is significantly higher.

Fathers' direct time-investment is defined as the amount of time a nonresident father spends in active interaction with the child. We rely on two measures of a father's time-investment: (1) the number of days in the last month of father-child contact; and (2) the number of days in a typical week the father engages in positive parenting. Fathers' positive parenting involves performing playful, educational (e.g reading, singing nursery rhymes), and child care activities (e.g. change diapers, feeding, put child to bed).[14] Combining these two sets of father contact and parenting measures yields a single time-investment index of days per month in which the father performs positive parenting activities.[15] It reflects both frequency and content of visits. Hereafter, we refer to the unit of the index simply as 'days per month'. The index ranges from 0 to 30 days and has a mean and standard deviation of approximately 6 days and 8 days, respectively (table 1). Fathers' time-investment average nearly 2.5 days more when the child resembled him.

Fathers' participation in parenting responsibilities are especially related to father's sensitivity during interaction with an infant (Feldman, 2000). Fathers who assumed more maternal functions (child care and chores) have a more emotionally involved relationship with the child (Abraham et al., 2014). The extent fathers share parenting responsibilities is measured based on mothers' reports of how often fathers help with parenting tasks. The FFCW defines these tasks to be: looking after the child when the mother needs to do things, running errands (e.g. pick things up from store), taking the child to places (e.g. daycare or the doctor), and fixing/maintaining the home. Responses range from '1=often' to '4=never'. They are reverse coded and averaged (for each mother) to a create a variable (ranging from 1 to 4) that is increasing in frequency of shared tasks performed. Shared tasks frequency averages 2.3 with a standard deviation of 1.0, and is higher for infants resembling the father (table 1).

3.4 Control variables

Table 1 also presents summary statistics for family demographic and socioeconomic control variables. Unless otherwise specified, the controls are taken from FFCW baseline (at-birth) survey and measured in percentages. The variables unavailable at baseline, and therefore measured at 1-year follow-up, are appended with 'year 1'.

At the first follow-up, the children are approximately one year old, of which about 55% are boys. Some children were disabled (4.2%) or of low birth weight (11.4%); and just over 20% of births were covered by private health insurance, which indicates that some parents had better access to physicians and health care. The unmarried parents in this sample knew each other for typically 3.9 years before pregnancy (compared to 8 years for marrieds), 58.1% had a visiting or friendly relationship, and nearly one-fourth had other children together.

[14] Jones & Mosher (2013) use similar activities for children under 5 years to define father engagement in parenting over the last month. They are used in other surveys such as the Panel Study of Income Dynamics.

[15] We obtain this index by dividing the father's contact days/month (measure 1) by 7 days/week yielding contact weeks/month, which we then multiply by the average number of days/week engaged in each activity (measure 2) to generate the index denominated in activity days per month.

Parents were mainly black (nearly 70%); and about 25% of mothers gave birth as a teenager, whereas only about 15% of fathers were teenagers. Over a third of parents had kids in a previous relationship at baseline, and some mothers (about 12%) lived with a new partner when asked at 1-year follow-up. Fathers were more likely to be in very good/excellent health (70%) and to have at least high school education (62.7%) relative to mothers (63.6% and 57%, respectively). At the time the child was born, about 40% of fathers had an incarceration history, and just over 75% had a job. Mothers earned on average $242 weekly, when they last worked prior to birth; and almost one-third of them were homeowners. Nearly half (45.8%) of the mothers had received welfare prior to birth. At 1-year follow-up, mothers tended to have strong social support;[16] and 62.1% of children were regularly in the care of a non-parent (mainly mother's relatives or daycare for typically 40 hours per week).

Importantly, in most cases these sample characteristics do not differ significantly (at the 10% level) by father-child resemblance. An interesting difference, however, with ties to the literature on son preference (e.g. Dahl & Moretti, 2008), is that boys are more likely reported as resembling the father. These studies find fathers time allocation is generally higher for boys than girls. While little support for this exist in fragile families (Lundberg et al., 2007), we nonetheless control for child gender to identify resemblance effects on father's involvement. We also show later in section 4.2 there is little or no evidence that the effects of father child resemblance differ by child gender.

4 Empirical results

In this section, we explore how father-child resemblance relates to child health one-year post-birth. In addition, analysis at and prior to birth serves as a placebo test for instrument validity. Based on these relationships, we show father-child resemblance represents paternal investment. Next, we identify the specific paternal investment mechanisms through which father-child resemblance operates to impact child health. We then measure this impact using the 2SLS method.

4.1 Father-child resemblance and infant health

Effect of resemblance on health at one-year of age

We first estimate the relationship between at-birth father-child resemblance and child health one year later, holding constant the controls previously described. Later in section 4.4, we extend our analysis to other (behavioral) health outcomes. Note that as long as father-child resemblance is uncorrelated with unobservable factors in child health, our estimate represents a causal effect. Estimates are reported in column 1 of table 2 for each child health indicator. The first row shows that the effect of father-child resemblance on the computed composite

[16] Social support is measured as the average of mother's responses (yes = 1, no = 0) to whether she could count on someone to (1) loan her $200, (2) provide her a place to live, and (3) help with emergency child care, next year. The score ranges from 0 to 1 with higher scores indicating greater access to social support.

child health index is positive (0.297 standard deviations) and statistically significant. Rows 2 to 6 give results for the FFCW health measures as robustness checks. The 0.283 effect on latent subjective child health (row 2), expressed as a marginal probability effect, implies a child resembling the father is 5.4 percentage points (pp) less likely to report low health (good/fair/poor); 4 pp less likely to report very good health; and 9.4 pp more likely to report excellent health. Additionally, resembling the father reduces the incidence of child asthma episodes by 6.7 pp (row 3), decreases child visits to health practitioners for illness by 21.4% (row 4), cuts child visits to the emergency room by 23.5% (row 5), and decreases a child's longest stay in hospital by 54.7% (row 6). The magnitude for hospital stay should be interpreted with caution because several large outlier hospital days for children not resembling the father inflate the health gains for those resembling the father.[17]

It is possible that the effects of father-child resemblance on child health differ by child gender. Table 2 reports the estimated effects of father-child resemblance on each child health measure for boys (column 2) and girls (column 3), in addition to the differential effects (column 4). Using the composite child health measure (row 1), we find father-child resemblance significantly increases child health for both boys and girls but there is no differential effect by gender. Roughly similar results are obtained when examining each child health indicator separately. The effect of father-child resemblance on subjective child health is greater (and significant) for boys (row 2), but father-child resemblance has a greater (and significant) effect for girls when child health is denoted by visits for illness (row 4) and emergency visits (row 5). The difference in effects appears small for asthma (row 3) and hospital stay (row 6). However, again, the specific health effects do not significantly differ by gender.

Effect of resemblance on health at birth and before: a placebo test

So far, we have taken our resemblance variable as exogenous because it is based on *both* the purported father's *and* mother's consistent responses at birth, each obtained independent of the other. But, it is possible for both parents to respond positively (or negatively) to father-child resemblance for reasons related to child health one year after birth. For example, a mother might specify a father resembles the child in order to entice the purported father to invest in the child, regardless of whether the child is his. Alternatively, resemblance to the father might be harder to detect for poorly formed babies with lasting health problems. In these cases, a father's alleged resemblance would not be exogenous since it would then be correlated with an unobservable component of child health.

We follow Kuehnle (2014) and perform an instrument placebo-test to determine whether father-child resemblance is related to child health *not* one year after the child is born, but instead at an earlier time during pregnancy or at-birth. At such times, father-child resem-

[17] Removing the observations with outlier days of hospital stay from the sample reduced the -0.547 coefficient to -0.060. Doing so, however, had little or no effect on the coefficients for the other health variables, which are not similarly affected by those observations. In addition, we also checked whether father-child resemblance affects overnight hospital stays. The effect is 0.1 pp ($p = 0.972$). This implies resemblance has no effect on the incidence of hospitalization. One interpretation is that resemblance affects the intensive margin in terms of the severity of injury/illness as indicated by a child's longest stay in hospital.

blance could not have an effect on child health. Thus, one would be suspect if earlier child health indicators correlate with our resemblance measure. We consider: low birth weight, prenatal maternal health, prenatal substance use, whether doctor was seen during the first trimester, and disability.[18] Table 3 shows the effect of father-child resemblance on each of the binary prenatal/at-birth child health variables, holding constant the controls (in table 1) excluding mother's health, low birth weight and disability. We find in all cases that the estimated resemblance effects are statistically insignificant. These results support instrument validity and hence the causal effect of father-child resemblance on child health, one-year post-birth.

An implication of resemblance raising health one-year later, but not at birth

As explained in section 2, evolutionary theory predicts doubtful fathers use father-child resemblance as a cue of genetic relatedness to decide whether to invest in a child. These investments may explain why resemblance enhances child health one-year later, but not at birth. To validate such paternal investment, we now examine the effect of father-child resemblance on child health in two samples in which father-child resemblance is unlikely to matter as a paternity cue. Finding no effect of resemblance on child health in these samples serves as a placebo test to help substantiate father investment as a causal factor.

First, we extract from the FFCW database a sample of nonresident fathers (n = 63) whose involvement is restricted because they died or were incarcerated.[19] We regress the composite child health index on father-child resemblance and an incarceration dummy, without the controls listed in table 1 due to the small sample size. The estimated father-child resemblance effect (0.087 standard deviations, s.e.= 0.279) is small and statistically insignificant compared to the corresponding estimate in the main sample (when no controls are used) of 0.231 standard deviations (s.e. = 0.095). Second, we extract an FFCW sample of stable two-parent families (n = 1105).[20] In such families, paternal confidence is relatively high and hence, father-child resemblance is unlikely to matter to a father's decision to invest. Again, we find the effect of resemblance on the composite child health index (using the controls in table 1) is statistically insignificant (0.044 standard deviations, s.e. = 0.056). These two samples provide indirect evidence that paternal investment is a key link between father-child resemblance and child health.

[18]Disability is only reported by the mother at 1-year follow-up (because they were interviewed within the first three days of birth), so it is possible some disabilities may not have been present at birth. We would have liked to use other indicators of fetal health such as gestational age and mother's BMI during pregnancy, but they were not available.

[19]The event of death or incarceration is determined at the time of the one-year follow-up interview. So, it is possible that some fathers were involved for some time prior to the event.

[20]Two-parent families include a mother, the putative father and their children living in the same household over the first two waves of the FFCW study.

4.2 Father-child resemblance and paternal investment mechanisms

The previous findings suggest at-birth father-child resemblance enhances child health because a father invests more in a child that looks like him. We now explore the probable avenues through which such investments take place. Later in section 4.4, we also examine other plausible parenting channels and find little evidence supporting them. The FFCW data offer four possible ways fathers can invest in their children. We attempt to rule out some of these avenues to better isolate the underlying investment mechanism through which father-child resemblance operates. To do so, we regress each of four types of paternal investment on father-child resemblance and report the results in table 4 (column 1). Even after controlling for a number of parental and child characteristics (in table 1), we find fathers react positively to father-child resemblance; however, not equally for each type of investment. A child resembling the father increases the father's frequency of in-kind support (row 2), his time-investment (row 3), and his sharing in parental tasks (row 4), but the effect on financial support (row 1), though positive, is not statistically significant. In-kind support frequency increases by 0.17 (or about 7% — effect divided by variable's mean), time-investment increases by 2.5 days per month (or about 40%), and shared responsibility increases by 0.24 (or about 10%) when a child resembles the father. Resemblance better explains a father's time-investment ($F = 11.5$, partial $r^2 = 2.5\%$), compared to a father's shared responsibility ($F = 5.7$, partial $r^2 = 1.4\%$) and his in-kind support ($F = 3.5$, partial $r^2 = 0.9\%$). These results are consistent with the nonresident fathers in our sample using resemblance to assess paternity, and from this deciding whether to devote non-pecuniary investment resources, especially time, in their reputed child.

It is possible that fathers choose to respond differently to father-child resemblance depending on child gender. For instance, if fathers already have a son preference (Dahl & Moretti, 2008; Mammen, 2011), they may prefer to invest more time in boys than girls when there is father-child resemblance. Table 4 provides the estimated effects of father-child resemblance on each dimension of paternal investment for boys (column 2) and girls (column 3), as well as the differential effects (column 4). The estimates suggest that father-child resemblance increases a father's in-kind support frequency (albeit insignificantly in row 2) and his time-investment (row 3) by the same extent for boys and girls. However, father-child resemblance appears to have a greater (and significant) effect on financial support (row 1) and shared parental tasks (row 4) for girls. Still, we cannot reject the equality of any coefficients by gender. We find no compelling evidence that fathers' investment response to father-child resemblance differ by gender. These results are consistent with Lundberg et al.'s (2007) finding of little evidence that child gender matters to father involvement one year after birth in unmarried families.

Given an F-statistic that exceeds 10 for the overall effect of father-child resemblance on father's time-investment (against the null that father-child resemblance is irrelevant), we now use father-child resemblance as an instrumental variable (IV) to determine whether father's time-investment augments child health.[21] Ascertaining this link alleviates endogeneity issues

[21] The fact that father-child resemblance explains little variation in shared tasks and financial/in-kind support does not necessarily invalidate their importance to child health. Father-child resemblance may be only one of many exogenous sources of variation in these factors that also relate to child health.

plaguing earlier research alluded to in the introduction that attempts to estimate the causal effect of a nonresident father's time on child health.

4.3 Measuring the health benefits of father's time-investment

If at-birth father-child resemblance works through father's time-investments, then fathers who invest more (spend more time doing positive parenting) should have healthier children.[22] To quantify this possible path to better child health, we specify the production function for child health in family i (H_i) as:

$$H_i = \alpha_1 I_i + \boldsymbol{\alpha_2'} \boldsymbol{X}_i + \epsilon_i \qquad (1)$$

where I_i is at-birth father time-investment, $\boldsymbol{X}_i$ is the vector of demographic/socioeconomic controls (listed in table 1) with the first element being one, and ϵ_i is an error term containing unobservable health factors. The constant coefficient α_1 is a measure of the general impact of paternal time-investment on child health.[23] As discussed in the introduction, standard estimation can result in biased estimates due to endogeneity. Nevertheless, for comparison, we present standard estimates of α_1 in table 5, column 1.

The first row of column 1 shows the impact of father's time-investment on the composite child health index. It is statistically insignificant. The second to sixth rows present the impact of the father time-investment variable on the separate health measures, again indicating no statistical significance. These results imply fathers' time-investments provide little or no child health benefits, and is consistent with Amato & Gilbreth's (1999) and Hofferth & Pinzon's (2011) findings that contact frequency is unrelated to child health and general wellbeing. However, these results may be unreliable given the concerns about father investment being endogenous, namely $\mathrm{E}[\epsilon_i | I_i, \boldsymbol{X}_i] \neq 0$. Hence, we use a two-stage IV approach to quantify the health impact of father's time.

To derive causal effects, we utilize father-child resemblance as an instrument for father time-investment. As explained, the evolutionary sociobiology literature discussed in section 2 motivates the use of father-child resemblance as an IV. Moreover, subsections 4.1 and 4.2 provide results that support both the relevance and validity of using the father-child resemblance measure. Hence, the first-stage in the IV approach is:

$$I_i = \beta_1 R_i + \boldsymbol{\beta_2'} \boldsymbol{X}_i + \upsilon_i \qquad (2)$$

where I_i and $\boldsymbol{X}_i$ are as already defined, R_i is father-child resemblance, and υ_i is an error term. The second-stage is given by equation 1, where now I_i is determined by equation 2. This approach identifies the causal effect of fathers' time-investment for those fathers whose time is affected by child resemblance. In fact, we only identify the effect for those fathers

[22] We do not present results for financial support, in-kind support and shared parental tasks because in table 4 they have an F-statistic (square of the t-value for the coefficient on father-child resemblance) much lower than 10, the rule-of-thumb acceptable for a variable to serve as a strong instrument.

[23] Since we found little evidence for heterogeneous effects of father-child resemblance by child gender (although partly due to the limited statistical power of the data), we proceed assuming homogeneous effects.

who respond to the presence (absence) of father-child resemblance by raising (lowering) time-investment —these fathers are the so-called 'compliers'. To show this, figure 1 provides the empirical cumulative distribution functions (CDF) for paternal time-investment by whether father-child resemblance exists, as well as the differences in the CDFs (gray dotted line). The CDF for no father-child resemblance (thin dashed line) lies above the CDF for father-child resemblance (thick line). That is, at any given level of time-investment, a father with no resemblance to his child is likely to invest less than a father resembling his child. Such evidence supports a key assumption (individual-level monotonicity) for identifying a causal effect for compliers (Angrist & Imbens, 1995). Since the IV estimate of α_1 is a weighted average, where weights are the fraction of fathers switched by father-child resemblance from one level of time-investment to another, like Angrist & Imbens (1995) we can examine the differences in the CDFs (which are proportional to the weights) to infer the characteristics of the group contributing more to our IV estimate. As such, figure 1 indicates that fathers with relatively low time-investments contribute more to our IV estimate. Based on the FFCW baseline data, these fathers are significantly more likely to have employment, children of another mother, or an incarceration history.

Estimated effects of father time-investment on all child health measures are presented in column 2 of table 5. Accounting for endogeneity using father-child resemblance as an instrument yields significant effects of time-investment on child health.[24] Unlike the zero-effects for the non-IV case (column 1), we find that an additional activity day (per month) of fathers' time-investment (induced by father-child resemblance) implies a 0.117 standard deviation increase in composite child health. In regard to subjective child health, this one extra activity day per month raises child health by 0.089 units, which implies a 2.1 pp reduction in the probability of low health and a 2.8 pp increase in the probability of excellent health (not reported in table). When we consider more specific health outcomes, as robustness checks, we also find consistent evidence of health gains: lower probability of asthma episodes (by 2.7 pp), visits to health practitioners for illness (by 5.4%), visits to the emergency room (by 9.1%), and length of hospital stays (by 22.3%). Although we are cautious about interpreting the effect magnitude for hospital stay because of outlier hospital days that inflate the health benefits in favor of children resembling their father, we generally find important positive effects of fathers' time-investment on child health.

To put the effects on overall child health in context, nearly an extra week per month in which a visiting father engages in positive parenting activities can provide the same gains in composite health (0.554) or subjective general health (0.514) as the presence of a social

[24] The large difference between the non-IV and IV estimates suggest the influence of endogeneity. In fact, the statistically significant and negative estimated correlation (-0.614) between the unobservables of health and father involvement (υ_i, ϵ_i) in the IV ordered probit specification for subjective child health reveals that omitted variables may be at play. The omitted variable is possibly unobserved maternal ability. That is, the degree of mothers' self-reliance or protective (gatekeeping) behavior is negatively related to father involvement. Attenuation bias due to measurement error in mother-reported father involvement is also likely to have contributed to the large difference in non-IV and IV estimates. Moreover, since IV only estimates the effect for the complier population, the presence of population heterogeneity may also explain the large difference in estimates as well.

father (mother's new partner).[25] This would require the typical *visiting* father (who performs activities in about 8 days/mo.) to be involved for up to 15 days/mo., relative to the 20 activity days of the typical social father. In another context, if a typical visiting father engages with the child all weekends (about 9 days/mo.), the resulting 2.1 pp decline in low child health would be half the effect of doubling household income (Case et al. (2002) report -4 pp for children ages 0-3 years).

4.4 Robustness checks

Sample selection

Our sample consists of out of wedlock mothers who remain unmarried one year post-birth and reside with their child. A potential problem is that this sample selection may be driven by father-child resemblance if such a paternity cue causes doubtful fathers to cohabit or marry. Thus, our sample would exclude those fathers who would have been single absent the paternity cue. To examine this possibility, we augment our sample of mother-only families to include all other family types. Then, we estimate the effect of father-child resemblance on fathers' decision to move-in (i.e. either cohabit or marry). Table 6, column (1), reports a statistically insignificant effect of 0.4 pp on the probability of moving-in. Further, we assess the impact of a father resembling the child in mother-only and other family settings by interacting child-resemblance with family setting status. Columns (2) and (3) report resemblance effects of 2.185 and 0.246 respectively for mother-only families, but no significant effects for other family types. Moreover, the ratio of the two estimates (0.246/2.185) for mother-only families provides a 0.113 IV estimate, about the same as that reported for composite health in table 5, column (2). Thus, there is no significant evidence that father-child resemblance affects family composition, but even if so, the results remain qualitatively the same.

Another potentially complicating selection problem is our sample may over-represent couples who are more cooperative or less conflictual as manifested by their consistent responses to whether the child looks like the father. To assess this possibility, we provide four pieces of evidence. First, we note that the fraction of mother-only families in our sample who agree on baby looks is 64% which is comparable to the 66% for two-parent families. Second, we compare our sample of couples who agree on baby looks (column (3) of table 1) to those who disagree (the excluded cases in column (4) of table 1). Though not foolproof, if all observed characteristics are similar between the two groups, we suspect they are also comparable with respect to relationship compatibility. This comparison yields virtually no significant differences. Particularly relevant are at-birth relationship status (i.e. cohabiting or visiting/friends) and whether parents already share a child together. However, there is a marginally significant ($p = 0.093$) difference in the number of years parents have known each other prior to pregnancy, albeit only 0.6 years lower for the sample of couples who

[25] Bzostek (2008) also finds child health benefits of a social father in fragile families. Social fathers may be able to bond with young children more than older ones, who tend to fare worse in step-father families (Case & Paxson, 2001).

agree on baby looks. Third, we augment the estimation sample to include couples who disagree about baby looks (i.e. n = 715). Then, we include in our regressions a dummy for whether couples disagree about baby looks and another for whether couples agree on father-child resemblance, where the omitted category is those couples who agree on no father-child resemblance. Table 7 confirms that the estimated father-child resemblance effects on time-investment and composite child health (of 2.756 and 0.291 respectively) are robust to this particular selectivity issue. Fourth, we use retrospective data collected at birth to create two scales, relationship conflict and supportiveness.[26] Table 8, columns (1) and (2), shows neither scale is significantly related to whether couples agree on resemblance. Further, controlling for these scales in columns (3) to (6) does not significantly alter our findings. This means at-birth relationship quality also does not appear to confound the relationship between child health and at-birth resemblance.

Alternative versions of the IV

To minimize measurement error, we eliminated families whose purported father reported the child looks like him but the mother disagreed. However, it is not unreasonable to argue observations on such families may be relevant if fathers allocate their time based on their beliefs independent of whether the mother agrees. For robustness, we check whether adding these observations alters our results. In doing so, we expect OLS estimation will be negatively biased if the true effect of father-child resemblance on paternal investment and child health is positive because of potential measurement errors. Column (2) of table 9 provides the results from a version of the instrument (IV2) that includes fathers' reported resemblance to the child when the mother disagrees, while column (1) reproduces the main findings from the original instrument (IV1). We find smaller resemblance effects on father time-investment (1.864) and overall child health (0.207), but they remain statistically significant. Moreover, the IV estimate of 0.108 (i.e. 0.207/1.864) is similar to the main estimate (0.117).

We also included in our original sample couples who report partial resemblance (i.e. child looks like both parents). However, doing so might bias our results if those couples are also more willing to compromise or if they find it harder to detect resemblance, which may directly relate to child health. We test this possibility by dropping cases where either parent reports partial, but not full resemblance to the father (IV2). Based on IV2, the estimated resemblance effects shown in table 9, column (2) are 2.219 for father time-investment and 0.264 for composite child health, with an implied IV effect of 0.119. Since these estimates compare favorably to those reported for IV1 in column (1), it appears our results are robust to this possible problem.

[26]We are cautious about the use of these scales as responses may have been elicited from observing child resemblance. The relationship conflict scale is constructed from averaging couples' responses to questions asking how often they argue about sex, the pregnancy, money, faithfulness etc. The supportiveness scale is similarly constructed from five questions asking how often the other parent is fair and willing to compromise, loving and affectionate, encouraging etc.

Other parenting and health outcomes

Earlier we presented evidence that paternal time-investment explains the effect of father-child resemblance on child health. Here, we check whether such resemblance might be associated with other parenting outcomes that may in turn affect child health. Table 10 presents these outcomes as reported by the mother at 1-year follow-up. The first two outcomes relate to dimensions of a father's parenting that involve the use of spanking as well as cooperating with the mother in parenting (e.g. respects schedules, can be counted on). We find no significant effect of father-child resemblance in either case. Regarding maternal parenting, if a mother likes/dislikes the father, her child's resemblance to him might influence the manner in which she treats the child. Any such treatment may be reflected in her time-investment, aggravation in parenting (e.g. feels trapped by duties), and use of spanking. Rows 3-6 report no statistically significant effects of father-child resemblance on these outcomes, though the coefficient signs indicate beneficial effects. Additionally, the positive effect on baby's grandmother moving in is not significant. Thus, we find no strong support for these parenting outcomes as the mechanisms through which resemblance affects child health. Overall evidence reaffirms that father-child resemblance likely operates through fathers' time-investments.

We have focused on child (physical) health outcomes, but resemblance may plausibly be related to behavioral health and maternal health outcomes. For instance, a father's involvement might disrupt the home environment causing emotional distress or provide an opportunity for the mother to invest in her own health. Based on rows 7-8, we find no statistically significant evidence linking father-child resemblance to mothers' self-reported health and depression, despite the gains implied by the coefficient signs. Similarly, rows 9-11 show that any resemblance-induced paternal involvement does not appear to assist with maternal substance use and breastfeeding, nor does it significantly affect a child's temperamental behavior.

Assessing the exclusion restriction

Our IV estimates rely on father-child resemblance affecting child health only through father's time-investment. While the FFCW data provide paternal investment channels and other parenting channels, there are potentially unobserved means by which father-child resemblance may independently impact child health (e.g. the quality of the father-child interaction). To explore this possibility, we estimate the impact of father-child resemblance on child health in a small FFCW sample ($n = 39$) of nonresident fathers whose visitations are restricted by court order (as part of their child support agreement). Although these fathers are forced to provide financial support and time, they can still choose to be involved in other ways. The estimated relationship between father-child resemblance and the composite child health index in this sample should therefore measure the combined effects of these other causal pathways. We find, without controls, no significant relationship (-0.092, s.e. $= 0.321$). Regardless of this suggestive evidence and others we have presented, we cannot definitively rule out intermediate channels other than time-investment, though we believe time-investment to be a key channel.

5 Conclusion

Early childhood development is an important precursor for future success. Children in single-parent households are most vulnerable. Parental inputs are potentially crucial. But current research yields ambiguous results regarding many of these inputs. This study uses father-child resemblance to show the importance of fathers' investment in child health. The idea is that, due to paternity uncertainty, a man assesses genetic relatedness based on whether the child resembles him and uses this information to direct investment resources to the child. This prediction is supported in experimental studies based on animal/human families in evolution-related disciplines, but to date has not been used in economic research. We employ rich US national data on unmarried families with nonresident fathers taken from the first two waves of the Fragile Family and Child Wellbeing (FFCW) study. This data is appropriate since paternity uncertainty is more likely to prevail among fragile families.

We find a child's health indicators improve when the child looks like the father. We also find father-child resemblance acts as a paternity cue used by men especially for making time-investment decisions. IV estimation confirms a statistically significant and positive impact of fathers' time-investment on child health. One possible explanation is that frequent father visits allow for greater parental time for care-giving and supervision, and for information gathering about child health and economic needs.

This study supports policies for encouraging nonresident fathers to engage in frequent positive parenting to improve early childhood health. However, because father-child resemblance is not manipulable, it cannot serve as a policy tool to achieve the desired changes in nonresident father's time. Nevertheless, since our complier analysis (in section 4.3) suggests that nonresident fathers with relatively low time-investment are more responsive to father-child resemblance, appropriate policies can be designed and targeted at increasing their involvement to achieve improvements in child health. As such, greater efforts could be made to encourage these fathers to frequently engage their children through parenting classes, health education, and job training to enhance earnings.

It is unclear to what extent our finding that paternal time-investment improves child health in at-risk families can be generalized. Similar evidence in another family setting is found by Case & Paxson (2001) who, while concluding maternal primacy in child care, find nonresident fathers' regular contact protects the health investments of children living with step-fathers. Nevertheless, the health benefits we find may be due to the specific circumstances and behavioral traits of parents in at-risk families. Although at the very least our findings can inform policies related to US poverty, it is useful for future research to explore whether similar child health gains from paternal time-investment can be realized in more intact families.

Table 1: Summary statistics by reported father-child resemblance (FCR)

Variables	(1) Estimation sample FCR (n=255)	(2) Estimation sample No FCR (n=201)	(3) Estimation sample Overall (n=456)	(4) Excluded cases (n=259)
Subjective child health (0-2)	1.55 (0.68)	1.40 (0.79)*	1.50 (0.73)	1.52 (0.72)
Asthma episodes/attacks	8.3	12.4	10.1	10.9
No. of health care visits for illness	3.5 (3.9)	4.3 (6.2)	3.8 (5.1)	3.6 (5.1)
No. of emergency room visits	1.6 (2.4)	1.8 (2.4)	1.7 (2.4)	1.4 (2.0)
Longest stay in hospital (days)	0.7 (1.8)	1.4 (7.5)	1.0 (5.2)	0.7 (3.4)
Composite child health index	0.1 (0.9)	−0.1(1.1)*	0.0 (1.0)	0.0 (1.0)
Financial support	36.8	31.5	34.4	31.5
In-kind support (1-4)	2.4 (0.9)	2.2 (0.9)*	2.3 (0.9)	2.2 (1.0)†
Father time-investment (days/mo.)	7.4 (8.8)	5.0 (7.1)**	6.3 (8.2)	5.7 (8.0)
Shared parental tasks (1-4)	2.4 (1.0)	2.1 (1.0)*	2.3 (1.0)	2.2 (1.1)
Control variables				
Child is boy	60.0	49.3*	55.3	53.3
Child age in months (year 1)	15.7 (3.5)	15.2 (3.4)	15.4 (3.5)	15.1 (3.5)
Child disabled (year 1)	4.3	4.0	4.2	3.1
Child Low birth weight	12.9	9.5	11.4	15.1
Child birth privately insured	20.0	22.9	21.3	18.5
Years mom knew dad pre-pregnancy	3.7 (4.0)	4.1 (4.7)	3.9 (4.3)	4.5 (4.6)†
Parent relations: cohabited [1]	38.4	31.3	35.3	32.4
Parent relations: visiting/friends [1]	55.7	61.2	58.1	59.4
Parents have other kids together	22.7	26.9	24.6	29.7
Father race: Black [2]	67.1	72.6	69.5	66.0
Father race: Hispanic [2]	18.4	17.9	18.2	20.8
Father teenager	14.5	15.4	14.9	10.8
Father has kids with other mother	33.1	42.8*	37.4	39.0
Father's health: excellent/very good	73.2	65.7†	70.0	72.2
Father's education: high school [3]	44.3	39.3	42.1	44.7
Father's education: >high school [3]	21.2	19.9	20.6	22.0
Father ever incarcerated	42.5	36.8	40.0	38.5
Father employed	78.7	74.1	76.7	74.5
Mother's race: Black [2]	65.5	69.7	67.3	66.8
Mother's race: Hispanic [2]	19.6	17.9	18.9	17.8
Mother teenager	25.1	27.4	26.1	24.7
Mother has kids with other father	42.7	37.3	40.3	38.6
Mother lives w/ new partner (year 1)	12.2	11.5	11.9	9.3
Mother's health: excellent/very good	65.9	60.7	63.6	66.8
Mother's education: high school [3]	32.9	30.8	32.0	31.7
Mother's education: >high school [3]	26.3	23.4	25.0	27.0
Mother's weekly earnings ('00)	2.46 (1.43)	2.37 (1.40)	2.42 (1.42)	2.43 (1.46)
Mother owns home	30.7	30.5	30.6	35.4
Mother on welfare/TANF	46.7	44.8	45.8	50.2
Mother's social support (year 1)	0.83 (0.31)	0.84 (0.28)	0.83 (0.30)	0.85 (0.29)
Non-parental caregiver (year 1)	62.0	62.2	62.1	62.9

Notes: Excluded cases are couples who disagree on whether child looks like purported father. Values are sample means. Unit is percent unless otherwise indicated. Standard deviations in parenthesis. Variables measured at birth unless otherwise indicated. *Reference groups*: [1]hardly/never talk. [2]White. [3]Some high school or less. Symbols in column 2 indicate a significant mean difference between columns 1 and 2, whereas those in column 4 corresponds to columns 3 and 4. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 2: Effect of father-child resemblance on child health (reduced-form)

Child health	**Method**	**(1) FCR**	**(2) FCR×boy**	**(3) FCR×girl**	**(4) Diff.**
Composite child health	OLS	0.297**	0.301*	0.292*	0.009
		(0.101)	(0.137)	(0.148)	(0.201)
Subjective child health	OP	0.283*	0.364*	0.185	0.179
		(0.131)	(0.178)	(0.195)	(0.266)
Any asthma episodes	Probit	−0.067*	−0.068	−0.065†	−0.003
		(0.027)	(0.035)	(0.044)	(0.057)
Visits for illness	Poisson	−0.214†	−0.111	−0.329†	0.218
		(0.129)	(0.181)	(0.182)	(0.254)
Emergency room visits	Poisson	−0.235†	−0.089	−0.391†	0.302
		(0.121)	(0.148)	(0.207)	(0.260)
Length of hospital stay	Poisson	−0.547*	−0.536	−0.563	0.027
		(0.271)	(0.363)	(0.437)	(0.584)

Notes: Sample size n=456. FCR represents father-child resemblance. Diff. is differential effect. OP means ordered probit. Coefficients (× 100) in row 3 are marginal probability effects (measured in percentage points). The table reports estimates derived from running two separate regressions for each child health measure. The coefficients in column 1 come from regressing each child health measure on FCR, holding constant the controls (including a constant). The coefficients in columns 2-3 come from estimating: $H_i = \gamma_1 b_i R_i + \gamma_2 (1-b_i) R_i + \boldsymbol{\gamma_3'} \boldsymbol{X}_i + u_i$, where H_i is child health, R_i is father-child resemblance measure, b_i is a dummy for being a boy (included in the controls $\boldsymbol{X}_i$), and u_i is an error term. The coefficients γ_1 and γ_2 correspond to those in columns 2 and 3. Controls are the same as those listed in table 1. Robust standard errors in parentheses. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 3: Father-child resemblance effects on pre/at-birth child health

Dependent variable	**Method**	**Coefficient**	**P-value**
Low birth weight	Probit	0.036	0.231
Disability	Probit	0.006	0.779
At-birth maternal health	Probit	0.050	0.271
Prenatal substance use	Probit	0.032	0.413
Prenatal child care	Probit	0.008	0.841

Notes: Sample size n=456. All coefficient estimates ($\times$ 100) are marginal probability effects (measured in percentage points). Controls are the same as those listed in table 1 excluding maternal health, low birth weight and disability. Disability is reported by mother at 1-year follow-up, so it is possible some disabilities may not have been present at birth. Substance use measured based on whether mother during pregnancy drank alcohol at least once per month, smoked cigarettes, or used drugs.

Table 4: Effect of father-child resemblance on paternal investment (first-stage)

		(1)	**(2)**	**(3)**	**(4)**
Paternal Investment	**Method**	**FCR**	**FCR×boy**	**FCR×girl**	**Diff.**
Financial support	Probit	0.056	0.015	$0.102^{\dagger}$	-0.087
		(0.044)	(0.063)	(0.062)	(0.090)
In-kind support	OLS	$0.168^{\dagger}$	0.160	0.176	-0.016
		(0.089)	(0.128)	(0.122)	(0.176)
Father time-investment	OLS	2.533^{**}	2.345^{*}	2.739^{**}	-0.394
		(0.748)	(1.102)	(1.047)	(1.549)
Shared parental tasks	OLS	0.244^{*}	0.202	0.290^{*}	-0.088
		(0.102)	(0.142)	(0.145)	(0.201)

Notes: Sample size n=456. FCR is father-child resemblance. Diff. is differential effect. Coefficients (× 100) in row 1 are marginal probability effects (measured in percentage points). The table reports estimated coefficients and standard errors derived from running two separate regressions for each dimension of paternal investment. The coefficients in column 1 come from regressing paternal investment on FCR, holding constant the controls (including a constant). The coefficients in columns 2-3 come from estimating: $I_i = \gamma_1 b_i R_i + \gamma_2 (1 - b_i) R_i + \boldsymbol{\gamma_3'} \boldsymbol{X}_i + u_i$, where I_i is paternal investment, R_i is father-child resemblance measure, b_i is a dummy for being a boy (included in the controls $\boldsymbol{X}_i$), and u_i is an error term. The coefficients γ_1 and γ_2 correspond to those in columns 2 and 3. Controls are the same as those listed in table 1. Robust standard errors in parentheses. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 5: Health effects of father time-investment (second-stage)

Child health	**Method**	**(1) Non-IV**	**(2) IV**
Composite child health	Least Squares	0.008	0.117*
		(0.006)	(0.055)
Subjective child health	Ordered Probit	0.010	0.089**
		(0.008)	(0.029)
Any asthma episodes	Probit	−0.003	−0.027**
		(0.002)	(0.010)
Visits for illness	Poisson	−0.005	−0.054*
		(0.007)	(0.027)
Emergency room visits	Poisson	−0.002	−0.091*
		(0.007)	(0.040)
Length of hospital stay	Poisson	0.010	−0.223†
		(0.015)	(0.129)

Notes: Sample size n=456. The table reports estimated coefficients and standard errors derived from running separate regressions for different health outcomes and by whether an IV is used. The coefficients of row 1 indicate the change in the number of standard deviations of the composite health index due to one-extra activity day per month of father time-investment. The coefficients in row 2 are interpreted as the effect on latent child health due to one-extra activity day per month of father time-investment. The coefficients in row 3 are the marginal change in the probability of asthma due to an extra activity day per month of father time-investment. For rows 4-6, the coefficients (× 100) indicate the percentage effect of one-extra activity day per month of father time-investment on the indicated child health outcomes. The Poisson method used to estimate the coefficients in rows 4-5 assumes a multiplicative error. When the outcome variable is length of hospital stay (row 6), the Poisson method with multiplicative error did not converge to a solution, and we instead assume the less intuitively appealing additive error. Controls used in all regressions are the same as those listed in table 1. Robust standard errors in parentheses. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 6: Checks for robustness of main results to selecting a sample of mother-only families

Independent variable	**(1)** **Move-in**	**(2)** **Father time-investment**	**(3)** **Composite health index**
FCR	0.004	0.423	−0.001
	(0.015)	(0.367)	(0.050)
FCR × Mother-only		2.185**	0.246*
		(0.835)	(0.122)
Method	Probit	OLS	OLS

Notes: FCR is father-child resemblance. Sample size n=1855. Our sample of unmarried mother-only families is adjusted to include all other family types (at waves 1 and 2). Column (1) provides the marginal effect of FCR on the probability of moving-in (i.e. single at birth to cohabit or marry at 1-year follow-up). Controls for columns (1) and (2) are those listed in table 1, except at-birth living status. Estimates in columns (2) and (3) are first-stage and reduced-form effects, respectively, of father-child resemblance for mother-only families ('FCR × Mother-only' coefficient) and for other family types (FCR coefficient). Controls for columns (2) and (3) are those used for columns (1) and (2) *plus* at-birth living status. Robust standard errors in parentheses. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 7: Checks for robustness of main results to selecting a sample of couples who agree on baby looks

Independent variable	**(1) Father time-investment**	**(2) Composite health index**
Couples disagree on baby looks	0.659	0.171
	(0.724)	(0.105)
Father-child resemblance	2.756**	0.291**
	(0.745)	(0.100)

Notes: Sample size n=715. We use the full sample of unmarried mother-only families (that is, including those couples who disagree on whether child looks like purported father). Each column of estimates is derived from a separate OLS regression. The omitted category is 'no father-child resemblance'. Controls are those listed in table 1. Column 1 reports the first-stage effects, and column 2 reports the reduced-form effects. Robust standard errors in parentheses. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 8: Checks for robustness of results to other relationship quality indicators

	Couples agree on baby looks		**Father time-investment**		**Composite health index**	
Independ. var.	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Relationship conflict	-0.055		0.314		-0.095	
	(0.062)		(1.297)		(0.144)	
Supportiveness		0.041		2.336		0.220
		(0.724)		(1.537)		(0.178)
FCR			2.521^{**}	2.376^{**}	0.289^{**}	0.279^{**}
			(0.748)	(0.753)	(0.102)	(0.100)
Method	Probit		OLS		OLS	
Sample size	715		456		456	

Notes: FCR is father-child resemblance. Each column of estimates comes from running a separate regression. The coefficients on the scale variables (relationship conflict and supportiveness) in columns (1) and (2) are marginal probability effects. The relationship conflict scale is the average at-birth (reversed-coded) parental responses ('1=often', '3=never') to six questions regarding how often the other parent disagree about money, spending time, sex, pregnancy, alcohol/drug use, and being faithful. The supportiveness scale is the average at-birth (reversed-coded) parental responses ('1=often', '3=never') to five questions regarding how often the other parent is fair and willing to compromise, loving and affectionate, critical, abusing, and encouraging. Controls are those listed in table 1, in addition to the relationship conflict or supportiveness scale. Robust standard errors in parentheses. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 9: Checks for robustness of main results to different definitions of father-child resemblance

Outcome	(1) IV1	(2) IV2	(3) IV3
Father time-investment	2.533**	1.864**	2.219**
	(0.748)	(0.653)	(0.806)
Composite child health	0.297**	0.207*	0.264*
	(0.101)	(0.098)	(0.109)
Sample size	456	621	397

Notes: The table reports results for three versions of the resemblance instrument. IV1, our main instrument, is constructed from the consistent private responses of both parents regarding whether a child resembles (wholly or partially) the father (mean of IV2 is 0.56). IV2 modifies IV1 by adding cases (n=165) where the father believes the child resembles him when the mother disagrees (mean of IV2 is 0.67). IV3 modifies IV1 by dropping cases (n=59) where either parent reports partial resemblance to the father (mean of IV3 is 0.49). Each coefficient derives from a separate OLS regression. Row 1 reports the first-stage effects, and row 2 reports the reduced-form effects. Controls are the same as those listed in table 1. Robust standard errors in parentheses. $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 10: Effect of father-child resemblance on other parenting and health outcomes

Dependent variable	**Method**	**Coefficient**	**P-value**
Parenting outcome			
Paternal discipline: Any spanking	Probit	0.033	0.168
Cooperative parenting	OLS	0.028	0.638
Maternal time-investment	OLS	0.388	0.383
Maternal aggravation in parenting	OLS	−0.008	0.913
Maternal discipline: Any spanking	Probit	−0.053	0.213
: Spanking freq.	Ord. Probit	−0.131	0.305
Baby's grandmother moves-in	Probit	0.023	0.363
Maternal health outcome			
Overall health (excellent/very good)	Probit	0.071	0.116
Mental health: depression	Probit	−0.024	0.535
Behavioral health outcome			
Any maternal substance use	Probit	0.024	0.606
Breastfeeding	Probit	−0.025	0.580
Child emotionality & shyness	OLS	−0.075	0.332

Notes: Sample size n=456. The table report coefficients derived from running separate regressions for various parenting and health outcomes. Coefficients for the probit method are reported as marginal probability effects. Cooperative parenting averages mothers' (reverse-coded) responses (ranging from '1=always' to '3=rarely') to six questions regarding how often, for e.g. father acts like father she wants for child, can count on father to watch child, father respects schedules/rules for child etc. Maternal time-investment is defined similarly to paternal time-investment. Aggravation in parenting averages mothers' (reverse-coded) responses (ranging from '1=strongly disagree' to '3=strongly agree') to four questions regarding the extent she feels trapped by parental duties, being a parent harder than thought, child care more work than pleasure, and tired and worn out from raising family. Child emotionality and shyness averages mothers' (reverse-coded) responses (ranging from '1=least like' to '3=most like') to six questions regarding, for e.g., the extent child is shy, fusses and cries, sociable, upset easily etc. Controls are the same as those listed in table 1. Robust standard errors in parentheses.

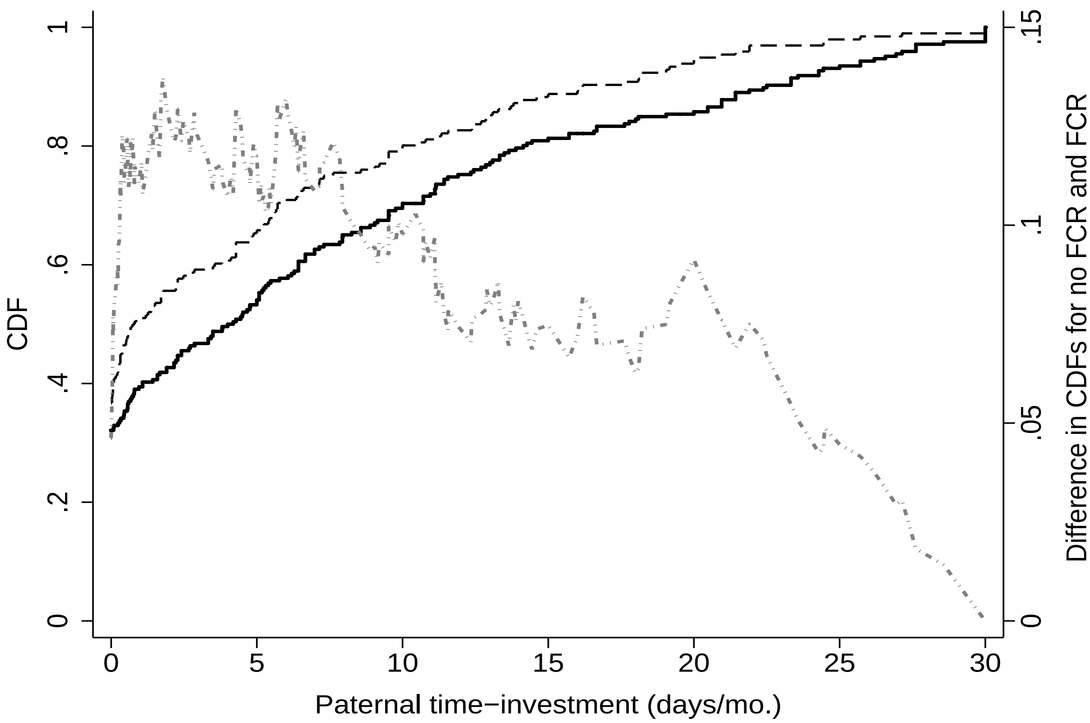

Figure 1: Paternal time-investment cumulative distribution function (CDF) by whether father-child resemblance is present (FCR) or absent (no FCR). The thick line is CDF for FCR. The thin dashed line is CDF for no FCR. The gray dotted line is CDF difference between no FCR and FCR.

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