

Confidence of paternity, divorce, and investment in children by Albuquerque Men

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**ABSTRACT**

Using a sample of men living in Albuquerque, New Mexico (USA), we examine the relationship between paternity confidence and men's investment in children. An evolutionary perspective suggests that all else being equal, men will invest less in children who are less likely to be theirs. In humans, men may reduce their investment in a child in two ways: indirectly, by ending their relationship with the child's mother and ceasing to cohabit with the child (e.g., divorce), and directly, by allocating less time and fewer resources to the child. In this paper, we test two hypotheses regarding the effect of paternity confidence on investment in children: 1) men will be more likely to divorce women if they suspect or are sure that they are not the father of their wife's child; and 2) controlling for divorce, men will reduce direct investments in low paternity confidence children relative to high paternity confidence children. The first hypothesis is supported by the data. The second hypothesis was supported for two out of three measures of paternal investment we examined; low paternity confidence reduces the time men spend with a child in a group with other children or adults, and it reduces extensive involvement with the child's educational progress; there was no effect of low paternity confidence on the amount of time men spend with children in one-on-one interactions. Overall, these results suggest paternity confidence plays an important role in shaping men's relationships with women and with their putative genetic children.

**KEY WORDS:** paternity confidence; paternal investment; union dissolution; parental care

## 1. Introduction

Asymmetry of parental investment is a fundamental feature of sexual reproduction. In the vast majority of species, female gametes are larger than male gametes, and provide the initial energy plant for development. Moreover, when investment extends beyond the initial energetic inputs into gametes, it is often the female that provides the extra care or resources. In some cases, however, males do provide substantial inputs into offspring, rarely more than females but sometimes as much as females. Therefore, across species, paternal care is much more variable than maternal care. For examples, while among birds and mammals most females engage in extensive parental investment, male care of offspring is rather rare among mammals, common in birds, and highly variable among fish (Clutton-Brock, 1991). Males are predicted to provide less parental investment for putative genetic offspring who are unlikely to be their actual offspring (e.g., Alexander, 1974; Trivers, 1972; Xia, 1992). Among humans, many historical, anecdotal, ethnographic, and literary examples suggest that men tend to abandon children whom they believe are not theirs (e.g., Rudavsky, 1999; Wilson, 1987). Western legal tradition recognizes that men should not be held responsible for putative children who are in fact not theirs (Wilson, 1987), and American men who do not pay child support often cite suspected nonpaternity as justification (Dubey, 1995). Beliefs about paternity and men's responsibility for children vary greatly cross-culturally (e.g., Beckerman et al., 1998; Hrdy, 2000; Levine, 1987), though men in many different cultures pay great attention to paternity (e.g., Betzig, 1989; Daly and Wilson, 1988).

The distinctions between actual paternity, nonpaternity, and paternity confidence are often confounded or overlooked in the literature. *Paternity* refers to the actual likelihood that a man is (or is not) the biological father of a particular child. *Nonpaternity* is the exclusion of

paternity, and refers to the likelihood that a man is not the genetic father of a particular child. Modern paternity tests do not prove paternity; rather, they demonstrate nonpaternity, by demonstrating that a given man is exceedingly unlikely to have fathered a particular child. (For further details on paternity tests and the calculation of nonpaternity see Pena and Chakraborty, 1994; Gjertson et al., 1988; Jeffreys et al., 1991; and Mickey et al., 1986.) In contrast, *paternity confidence* refers to a man's internal (not necessarily conscious or articulated) assessment of his paternity.

The mechanics of internal fertilization and live birth mean that while women are always sure of maternity, men can never be fully positive of paternity. Men must rely instead on indirect cues such as mate fidelity or child resemblance to assess whether they are likely to be the father of a particular child (e.g., Davis and Daly, 1997). For this reason, most research on paternity confidence has focused primarily on men's resemblance to children and their ability to detect it (e.g., Brédart and French, 1999; Bressan and Dal Martello, 2002; Bressan and Grassi, 2004; Burch and Gallop, 2000; Christenfeld and Hill, 1995; Daly and Wilson, 1982; McLain et al., 2000; Oda et al., 2002; Platek et al., 2002; Platek et al., 2003; Regalski and Gaulin, 1993; Volk and Quinsey, 2002; see, however, Brédart and French, 1999 and Pagel, 1997 for arguments suggesting why paternal resemblance might not evolve, since signaling paternity also signals nonpaternity).

There is a paucity of data, however, on the determinants of female infidelity, on male perceptions of mate fidelity as a determinant of confidence of paternity, or on the implications of paternity confidence for male parental investment. With respect to male perceptions, Anderson et al. (2005) examined demographic correlates of paternity confidence, using data on men in Albuquerque, New Mexico, and found that men were more likely to report low paternity

confidence in a pregnancy if the man was not married to the child's mother, or if the pregnancy was unplanned. Both of these factors are likely to correlate to some extent with the potential for mate infidelity.

The prediction that males will invest less in offspring who are unlikely to be theirs has received limited empirical examination. For avian species, the prediction is generally met, although the effect is not as strong or as universal as originally predicted (Møller and Birkhead, 1993; Schwagmeyer et al., 1999; Whittingham and Dunn, 2001), and many of the avian studies have been criticized on methodological grounds (Kempnaers and Sheldon, 1997; Schwagmeyer and Mock, 1993; Sheldon, 2002). Among nonhuman primates, it has been questioned whether paternal care ever reflects paternity (Van Schaik and Paul, 1996).

Among humans, analyses of qualitative, cross-cultural data suggest that paternity confidence is positively associated with men's involvement with children, or with investment or inheritance from paternal kin (Diamond and Lorca, 1989; Flinn, 1981; Gaulin and Schlegel, 1980; Greene, 1979; Hartung, 1985; Kurland, 1979). Within societies, greater investment by matrilineal than patrilineal kin suggests significant levels of nonpaternity, or more precisely it suggests reduced levels of paternity confidence (Euler and Weitzel, 1996; Gaulin et al., 1997; McBurney et al., 2002; but see Pashos, 2000 for mixed results). Relatively little is known about rates of actual paternity cross-culturally (see Anderson, 2005 for a detailed analysis).

Fox and Bruce (2001) used a sample of men in Knoxville County, Tennessee (USA) to examine the relationship between confidence of paternity and a) a measure of men's affective involvement with children, and b) a composite fathering variable. They found a positive relationships for both outcomes, but paternity confidence was unrelated to several other measures of fathering (responsivity, harshness, and behavioral engagement). Unfortunately, Fox

and Bruce (2001) provide no substantive information on how they measured paternity confidence, making the interpretation and contextualization of their results difficult.<sup>1</sup>

No study has directly examined the quantitative relationship between actual paternity and investment in or involvement with children. In the current study, we propose to examine how self-reported paternity confidence influences men's investment in their putative genetic offspring. We will analyze how paternity confidence influences paternal investment indirectly, through the likelihood that men may abandon low paternity confidence children, and directly, through reduced direct male involvement with low paternity confidence children after controlling for divorce status.

### *1.1. Hypotheses*

We propose two routes through which low paternity confidence may reduce paternal investment. One route is through divorce or separation from the child's mother, which generally results in ceasing to live with the child. In many cultures, divorce results in reduced male investment in children from previous relationships (e.g., Amato, 1987; Anderson et al., 1999a; Anderson et al., 1999b; Hofferth and Anderson, 2003; Simpson, 1997; Teachman, 1991; Weiss and Willis, 1985; Weiss and Willis, 1993). This reduction in investment occurs in part because of reduced contact between men and children, but also because men have reallocated resources towards new avenues of mating effort, as well as perhaps into new children or stepchildren (Anderson, 2000). Divorce can be considered an indirect form of reduced investment in children, and results in our first hypothesis: 1) Men will be more likely to divorce women if they suspect or are sure that they are not the father of their partner's child.

Whether or not divorce has occurred, men may reduce direct investment in low paternity confidence children. Controlling for paternal coresidence in this analysis is crucial. We expect to

find an effect of paternity confidence on men's investments in children, above and beyond the effects of divorce on investment. This leads to our second hypothesis: 2) Controlling for divorce, men will reduce direct investments in low paternity confidence children relative to high paternity confidence children.

## **2. Method**

To test our hypotheses we will use self-reported data from a sample of men living in Albuquerque, New Mexico (USA), that were collected between 1990 and 1993. The Albuquerque Men dataset consists of two complementary interviews that were administered to participants recruited at the Bernalillo County (New Mexico) Motor Vehicle Division (MVD). The short interview took about seven minutes to administer; approximately 7,100 participants were given this interview in a private area at the MVD. All men who appeared to be over 18 years of age were considered eligible for initial contact.

On the basis of information obtained in the short interview, eligible participants were invited to participate in the long interview. The criteria for eligibility were: 1) being age 25 or over, and 2) having come to the MVD for the purpose of license origination, renewal or for a photo ID. If the subject agreed to participate in the long interview, an appointment was made to conduct the interview either in a mobile office vehicle, in an office at the University of New Mexico, or at the subject's home. Interviews were conducted in private by trained student interviewers. Approximately 1,325 men participated in long interviews, for which they were paid \$30. The long interviews took from two to six hours to administer. (For further details on the long interview methodology, see Kaplan et al., 1998.)

The long interview was designed to collect retrospective data on, among other things, each respondent's marital, reproductive, and parenting histories. Men were asked about their reproductive and parenting behavior in the context of married, cohabiting, and casual relationships. Actual paternity was not measured (e.g., through genetic analysis), but paternity confidence was. For each pregnancy men reported, they were asked, "Are you certain that you are the father of this pregnancy?" and given the choice of answering yes (certain he is the father), no (certain he is not the father), or uncertain (may or may not be the father). These responses were recoded into a dichotomous variable for low paternity confidence, which was scored as one if a man indicated any doubts that the offspring might be his (uncertain he is the father or certain he is not the father), and zero if he expressed no doubts. Albuquerque men reported low paternity confidence in 49 of 3,066 (1.46%) pregnancies attributed to them (Anderson et al., 2005).

Nonresponse rates for paternity confidence were relatively high, which is not surprising given the sensitive nature of paternity confidence. In fact, twice as many men refused to answer the question (102 pregnancies, or 3.04%) as volunteered low paternity confidence. Statistical analysis typically discards cases that are missing data for any variables under consideration, but in this instance we analyze those cases as a separate group, in order to determine if men who refuse to report paternity confidence exhibit lower parental investment, as might be the case if refusal actually reflects low confidence.<sup>2</sup> In a separate analysis of the Albuquerque Men dataset,

Anderson et al. (2005) found that both low and unstated paternity confidence status were predicted by a pregnancy being unplanned, suggesting that low and unstated paternity confidence are similar. However, there were also key differences: low paternity confidence, but not unstated paternity confidence, was significantly associated with unmarried couples, while unstated paternity confidence, but not low paternity confidence, was significantly associated with

Hispanic ethnicity. Anderson et al. (2005) also found that both low and unstated paternity confidence were positive predictors of pregnancies ending in an elective abortion, but only unstated paternity confidence predicted pregnancies ending in miscarriage/stillbirth. Thus, while there are similarities between low paternity confidence and unstated paternity confidence, they are not identical. For this reason, we divide men's children into three groups: these in which men have high paternity confidence, low paternity confidence, or unstated paternity confidence.

The current analysis includes only the live-born putative biological children attributed to the respondents; step, adoptive and foster children are excluded from the analysis, as are pregnancies that did not result in live birth. We use two sub-samples of these data to examine the consequences of paternity confidence for children. The divorce sample looks at the probability of divorce using an event history dataset containing 22,677 person-years contributed by 2,582 putative genetic children. Each child contributes one year for each year of life, from birth up until age 10 or until his parents divorce, whichever comes first. (Because the sample includes unmarried as well as unmarried couples, we will use the terms "divorce" and "union dissolution" interchangeably to refer to the cessation of a sexual relationship which involved a pregnancy; the couple's legal marital status will be controlled for in multivariate analysis.) These data were reported by 1,101 men, and our statistical analysis will control for multiple observations per respondent (through the "cluster" option in Stata). Because these data are censored for some children (e.g., children who under age 10 at the time of interview and whose parents have not divorced may yet experience divorce before age 10), we use Cox proportional hazards analysis to model the probability of divorce occurring within a given year. This statistical method controls for censoring by analyzing the probability of divorce separately for each year a child is at risk of experiencing parental divorce, while controlling for multiple observations per child, and multiple

children contributed per respondent. Cox proportional hazards modeling thus models how long it takes for an event to occur; in this case, the event in question is the divorce or separation of a child's parents.

We will also control, using multivariate analysis, for numerous background characteristics that are likely to influence the probability of divorce. These include the respondent's age in each risk year, his logged income that year (in 1990 dollars), his education (in years), the child's mother's education (in years), the calendar year of the risk year, whether or not the couple was legally married at the time, the number of children the couple had together, the respondent's ethnicity (Anglo,<sup>3</sup> Hispanic, or other), and the child's gender.

A second sub-sample of the Albuquerque Men dataset will be used to examine paternal investment in children, using three retrospective measures of men's involvement with children ages 5 through 12. For each putative biological child, respondents were asked to provide direct estimates of two kinds of time involvement. The first question asked, "When he/she was between 5 and 12 years old, in a typical week, how many hours did you spend with him/her in one-on-one interaction?", and the second asked (for the same age interval) "In a typical week, how many hours did you spend with this child in a group with other children or adults?" The frequency of each type of interaction was rated on a five point scale: 1 (never), 2 (0 to 2 hours per week), 3 (3 to 5 hours per week), 4 (6 to 15 hours per week) or 5 (16 or more hours a week). Because this is an ordinal variable, representing a nonlinear distribution of hours spent with children, the time involvement variables will be analyzed using ordered logistic regression. This technique is similar to logistic regression, except that it allows for multiple ordinal outcome levels rather than only two. The dataset used for the analysis contains time involvement data on 2,581 children

parented by 973 men; the multivariate analyses will control for multiple observations (children) per respondent, using the “cluster” option in STATA.

The third paternal involvement variable we will use comes from the question, asked for ages 5 – 12, “How involved were you with his/her educational progress (his/her schooling)?” This was coded as three levels (“little or not at all involved,” “moderately involved,” and “helped him/her extensively with his/her work”). Relatively few people responded to the first two categories, and the variable was recoded as a dichotomous variable measuring one if the respondent was extensively involved with the child’s education progress (his/her schooling), and zero if the respondent was not extensively involved (i.e., collapsing “little or not at all involved” and “moderately involved”). This measure of paternal investment is available for 1,984 children, who were parented by 778 respondents.

Again, multivariate regression models will be used multivariate analysis to control for the effects of background variables while adjusting for multiple observations per respondent. The background variables include the respondent’s age, logged income (converted to 1990 dollars), and education; the child’s mother’s education; the calendar year; whether the couple was legally married; the number of children the couple had together; the respondent’s ethnicity; and the child’s gender. Variables that may vary over time (age, income, calendar year, legal marital status, and number of children) are evaluated with respect to the child’s fifth year of life. All analyses are performed using Stata SE v. 8.2.

There are a few potential biases in the dataset that must be acknowledged. These are retrospective data, and are thus subject to recall error. Men tend to underreport fertility relative to women in retrospective reports (e.g., Becker, 1996), and furthermore men may underreport low

paternity confidence children, since they may not consider them theirs, or may not have been informed about them in the first place.

Our measure of paternity confidence relies on a man's willingness and ability to articulate whether or not he believes he is the genetic father of a putative child. However, some men who claim they are certain they fathered a child may actually have low paternity confidence. Additionally, paternity confidence is not necessarily consciously calculated. Our measure, which relies on self-report, may not reflect true paternity confidence in every instance. The relative rarity of low paternity confidence (about 1.3% of children in the dataset) may weaken our statistical results as well, if too few low paternity confidence children are observed to provide sufficient statistical power. Despite these potential limitations, the Albuquerque Men dataset is the only one we know of that can address questions on the consequences of paternity confidence for children, both in terms of parental divorce and direct paternal investment.

### **3. Results**

#### *3. 1. Divorce*

Table 1 presents descriptive statistics, by level of paternity confidence, for the variables used in the analysis of divorce. For this table only, each variable is assessed for the focal child's year of birth. The final column of the table presents the F statistic and  $p$  value associated with an analysis of variance for each variable, indicating whether there is significant variation across different levels of paternity confidence.

Neither the man's age nor his logged income at the time the child was born varies significantly by confidence of paternity. The education level of each parent is highly significant, with men whose paternity confidence is unstated having less education than other men, and mothers of high paternity confidence children having more education than other women.

Children whose paternity confidence is unstated tend to be born in earlier calendar years than other children, while children whose paternity confidence is low are more likely to have parents who are unmarried at the time of their birth. Low paternity confidence children have the fewest siblings and unstated paternity confidence children have the most. Ethnicity varies by confidence of paternity, with Anglos the least likely not to state paternity confidence, and Hispanics the most. There is no significant variation by men of other ethnicities (reflecting their relative scarcity in the dataset), nor does the child's gender vary significantly by paternity confidence. (For further details on the demographic correlates of paternity confidence among Albuquerque Men, see Anderson et al., 2005.)

[Table 1 about here]

Confidence of paternity is related to the probability of divorce, as illustrated in Figure 1, which shows life table survival curves to union dissolution following a birth. Men with high and unstated levels of paternity confidence in children have very similar survival curves, and both are unlikely to divorce following the birth of a child. Men with low paternity confidence are much more likely to experience union dissolution; less than half of these men are still in relationships with the child's mother when the child is four, as opposed to only 10% of men with high or unstated levels of paternity confidence.

[Figure 1 about here]

A multivariate Cox proportional hazards model of the probability of divorce is presented in Table 2. The coefficient is presented as a hazards ratio: values greater than 1.0 indicate the outcome is more likely to happen as the value of the independent variable increases, while values less than 1.0 indicate the outcome is less likely to happen as the value of the independent variable increases. All else being equal, divorce is less likely to occur following the birth of a

child if the man is older or more educated, the child's mother is more educated, or if the couple was legally married. Union dissolution is more likely to occur in recent calendar years. Income and the couple's previous fertility have no significant effect on union dissolution. With respect to ethnicity, Hispanics are significantly less likely to divorce than Anglos, but there is no significant difference between Anglos and other (non-Hispanic) ethnic groups. Additionally, the child's gender has no effect on parental divorce.

Consistent with the pattern depicted in Figure 1, low paternity confidence has a tremendous effect on the probability of divorce. All else being equal, union dissolution is 4.9 times more likely to occur following a child's birth if the man has low paternity confidence in a child than if he has high paternity confidence. The probability of union dissolution is not significantly different for children whose paternity confidence was unstated than children in whom men have high paternity confidence.

[Table 2 about here]

### *3.2. Investment in children*

Table 3 presents summary statistics, by paternity confidence, for the independent variables used in the analysis of investment in children ages 5 through 12. Overall, the pattern of significant variation is similar to those observed for divorce (Table 1). The respondent's age and income do not vary by paternity confidence. Unstated paternity confidence is associated with lower education for men, while high paternity confidence is associated with more highly educated women. Low paternity confidence is more common in more recent calendar years, among unmarried couples, and among couples with fewer children. Unstated paternity confidence is least common among Anglos and most common among Hispanics. Paternity

confidence does not vary significantly for other ethnic groups, nor is it associated with the child's gender.

[Table 3 about here]

Time involvement with children, as measured retrospectively for children ages 5 through 12, varies greatly by paternity confidence (Figures 2 – 4). The relative frequencies of the time men spend with a child in one-on-one interactions is plotted by paternity confidence in Figure 2, for 2,581 children (2,522 high paternity confidence, 28 low paternity confidence, and 31 unstated paternity confidence). For high paternity confidence children, the modal level of time involvement (28.5% of children) is 0 to 2 hours per week, although essentially the same proportion of men (27.8%) interact with children for 3 to 5 hours per week. Men's interaction with low paternity confidence children concentrates at the low end of the distribution, with 46.6% of men reporting that they never interact with these children. The modal interaction for children whose paternity confidence is unstated is higher, with 41.9% clustered at 0 to 2 hours per week. For all three groups, only about 10% of men report spending 16 or more hours per week alone with their children.

Wilcoxon rank-sum tests, used because the dependent variable is neither continuous nor normally distributed, suggest that these distributions are significantly different. The median time spent one-on-one with high paternity confidence children is significantly greater than the median for low paternity confidence children ( $z = 2.357, p = 0.0184$ ) and for children whose paternity confidence is unstated ( $z = 2.753, p = 0.0059$ ). The medians for low and unstated paternity confidence children were not significantly different ( $z = -0.300, p = 0.7644$ ). Thus, men spend more time one-on-one with high paternity confidence children than with children whose paternity confidence is low or unstated.

[Figure 2 about here]

The amount of time men report spending with a child in a group with other children or adults is shown in Figure 3 for 2,581 children (2,522 high paternity confidence, 28 low paternity confidence, and 31 unstated paternity confidence). The modal level of involvement for both high and unstated paternity confidence children is the highest level, 16 or more hours a week (61.1% and 83.9% of children, respectively). The mode for low paternity confidence children is 6 to 15 hours per week (35.7%), although substantial fractions of men report either spending 16 or more hours per week (28.6%) or never spending time (25.0%) with low paternity confidence children. According the Wilcoxon rank-sum tests, the medians for these distributions are all significantly different from each other ( $z = 3.396, p = 0.0001$  for high versus low paternity confidence;  $z = -2.126, p = 0.0335$  for high versus unstated paternity confidence, and  $z = -3.869, p = 0.0001$  for low versus unstated paternity confidence).

[Figure 3 about here]

Lastly, Figure 4 depicts the proportion of men who reported being extensively involved in a child's education, for 1,984 children (1,939 high paternity confidence, 24 low paternity confidence, and 21 unstated paternity confidence). Men with high paternity confidence report extensive involvement with 60.4% of children, as do 66.7% of men with unstated paternity confidence; in an analysis of variance, these mean proportions were not significantly different ( $F = 0.34, p = 0.5620$ ). Men are extensively involved with schooling for only 29.2% of low paternity confidence children, which is significantly less than the level of involvement with either high ( $F = 9.71, p = 0.0019$ ) or unstated ( $F = 7.04, p = 0.0111$ ) paternity confidence children.

[Figure 4 about here]

For all three measures of paternal investment, low paternity confidence children receive the least investment. The patterns depicted in these figures are intriguing, but might be influenced by many intervening factors. Since low paternity confidence children are more likely to have parents who are no longer together (Table 2), we will use multivariate analysis to explore the relationship between paternity confidence and men's involvement with children, controlling for the effects of divorce and other background factors.

Ordered logistic models of the time men spend one-on-one with children are presented in Table 4. There are two models in the table. Model 1 does not control for parental divorce or separation, and model 2 adds a variable indicating whether the man in a relationship with the child's mother when the child was 5 years old. Many of the control variables in Model 1 have significant effects on men's involvement with children. The mother's education, the calendar year, being legally married, being Hispanic, and the child being male all have significant positive effects on men's involvement with children, while the number of children the couple has together has a significantly negative effect on men's one-on-one interactions with a child. Men spend marginally more time with children if they were ever legally married to the child's mother. The man's age, income and education, and well as being of other (non-Anglo, non-Hispanic) ethnicity, were not significant predictors of the time spent alone with children. All else being equal, men spend significantly less time with low paternity confidence children than with high paternity confidence children, while unstated paternity confidence has no significant effect.

Relationship status, when added (Model 2), has a significant effect; not surprisingly, men spend less time with children if they are no longer in a relationship with the child's mother. The effect of low paternity confidence loses statistical significance. Thus, the reduction in time spent

one-on-one with low paternity confidence children observed in Figure 2 is apparently a result of the parents being divorced.

[Table 4 about here]

Table 5 presents multivariate ordered logistic models of the time men spent with a child in a group with other children or adults, for children ages 5 through 12. Among the background variables in Model 1, having been legally married and being Hispanic both have significant, positive effects on group time involvement with children, while being of non-Anglo, non-Hispanic ethnicity has a marginally significant negative effect on time spent with children. Men spend significantly less time in a group with low paternity confidence than high paternity confidence children, and they spend more time (though the effect is only marginally significant) with children whose paternity confidence is unstated than with high paternity confidence children. These results reflect the patterns depicted in Figure 3. Furthermore, these patterns remain after controlling for whether the parents divorced or broke up by the time the child was five years old (Model 2). Divorce has a significantly negative effect on time involvement in a group with children, but even controlling for this, men report spending significantly less time with low paternity confidence children, and significantly more time with unstated paternity confidence children.

[Table 5 about here]

Lastly, Table 6 presents logistic regression models of the probability that men were extensively involved with children's educational progress between ages 5 and 12. Model 1 shows that the education of the respondent and of the child's mother have significantly positive effects on educational involvement, as do being legally married or being Hispanic (Model 1). The calendar year has a marginally significant negative effect, while the respondent's income has a

marginally significant positive effect. Controlling for these background factors, men are significantly less likely to be extensively involved with the schooling of low paternity confidence children than high paternity confidence children. Children whose paternity confidence is unstated are not significantly different from high paternity confidence children. The effect of low paternity confidence on educational involvement persists after parental relationship status is added to the model (Model 2). Although divorce has a significantly negative effect on being extensively involved with schooling, men are still less likely to report high educational involvement with low paternity confidence children. The effect of unstated paternity confidence remains nonsignificant after divorce is added to the model.

[Table 6 about here]

#### **4. Discussion**

In this paper, we used data from a sample of men living in Albuquerque, New Mexico, to examine whether men's assessment of paternity confidence impacts their relationships with the mothers of their putative children, as well as with the children themselves. We examined outcomes for three types of children: children in whom men had high paternity confidence, low paternity confidence, or whose paternity confidence was unstated.

Our first hypothesis, that men would be more likely to divorce women after the birth of a child if they have low paternity confidence in that child, was supported. We found that low paternity confidence is significantly associated with higher probability of divorce, although unstated paternity confidence has no significant effect.

Our second hypothesis was that men would invest less in low paternity confidence children, above and beyond the effect that divorce would have in reducing their investment in

such children. We examined three measures of investment in children, all assessed retrospectively for children ages 5 through 12: the time men spend with a child in one-on-one interactions, the time spent with a child in a group, and whether or not the man was extensively involved in the child's educational progress. We found no effect of paternity confidence on the time spent one-on-one with a child, once divorce was controlled for. Divorce has a significant negative effect on the time spent alone with a child, and as we had already established, low paternity confidence children are more likely to experience parental divorce. Thus, paternity confidence has an indirect effect on time involvement with children alone, by increasing the probability that a child's parents will divorce, rather than a direct effect above and beyond the effects of divorce on investment.

Paternity confidence has significant effects on the amount of time men report spending with a child in a group. Controlling for divorce, men spend less time with a child and others if the child is a low paternity confidence child. However, men report spending more time with the child and others if the child's paternity confidence is unstated. This result suggests that men prefer to interact with children whose paternity confidence is unstated in groups (perhaps with the child's high paternity confidence siblings). We report elsewhere (Anderson et al., 2005) that men are more likely not to state paternity confidence if they are Hispanic or if the pregnancy was unplanned. Perhaps these are children whose paternity confidence is reduced, but men are unwilling to acknowledge that fact or to divorce the children's mothers; they remain with the mothers, but preferentially interact with these children primarily when others are present rather than one-on-one.

Our last measure of investment in children, whether men were involved in the children's schooling, was significantly reduced for low paternity confidence children with divorce

controlled for. Unstated paternity confidence had no significant effect on men's involvement with children's schooling.

While unstated paternity confidence might be a form of low paternity confidence, the results do not strongly support this suggestion, as these two types of paternity confidence are associated with different outcomes. While low paternity confidence has a positive impact on the probability of divorce, unstated paternity confidence has no effect. With respect to paternal involvement, men spend more time with a child and others if the child's paternity confidence is unstated than if it is a high paternity confidence child. If men have several children by a woman, and only one of them is a low paternity confidence child, they may suffer greater fitness costs from abandoning all of these children than remaining with the mother and investing in the set of mixed paternity confidence children. (See MacDougall-Shackleton and Robertson, 1998 and Whittingham et al., 1992 for a similar argument with respect to avian clutches.) Thus, although these men have one child whose paternity is unsure, they nonetheless have committed themselves to staying with that family (since unstated paternity confidence does not predict divorce), and to interacting with the child of dubious parentage when others are present as much as possible. This argument is weakened, however, by the fact that the number of children a couple has together does not predict unstated paternity confidence among Albuquerque men (Anderson et al., 2005). A related interpretation is that men might invest in low paternity confidence children as a form of mating effort, similar to investment in step children (e.g., Anderson et al., 1999a; Anderson, 2000). However, this seems less plausible, as the presence of a low paternity confidence child would surely undermine the man's confidence of the likelihood of producing future high paternity confidence children with the same woman.

To the best of our knowledge, no previous study has provided an in-depth examination of the relationship between paternity confidence, divorce, and paternal investment. Fox and Bruce (2001) report that paternity confidence had a significant effect on several measures of paternal involvement for a sample of men in Tennessee, but they provide little information about the measurement of paternity confidence, or the characteristics associated with it. They do include marital status as a control variable, but do not examine whether paternity confidence contributes to the likelihood of parents divorcing. Our study is the first to simultaneously examine divorce and paternal investment as outcomes of paternity confidence.

A few methodological comments on our study may assist future researchers interested in examining the topic of paternity confidence. First, in our sample, more men declined to answer questions on paternity confidence than answered that they actually had low paternity confidence. We have shown that this non-response is not random; it is possibly related to low paternity confidence, but the interpretation is not straightforward. Second, rates of low paternity confidence in our sample were relatively low (only 1.3% of children). Thus, a relatively large number of men must be sampled in order to obtain sufficient number of low paternity confidence cases to attain statistical significance. (Fox and Bruce [2001] had 208 men in their sample, but they do not state how many children the men had, nor do they provide any descriptive statistics regarding their measure of paternity confidence.)

Perhaps the most significant problem with this study is the difficulty in determining the direction of causal effects. It is possible that women may decide to have extramarital relations because they are married to a low investing man or because they are contemplating divorce. Thus, low paternal investment (or signs thereof) or low likelihood of relationship stability may *cause low paternity confidence* rather than low confidence causing marital dissolution and

reduced investment. Future research should attempt to control for such selection biases, perhaps through longitudinal research.

In conclusion, we have examined the relationship between paternity confidence, divorce, and men's investment in children. Men are significantly more likely to divorce women after the birth of a child if they have low paternity confidence in that child, thus indirectly reducing investment in that child. Controlling for divorce, low paternity confidence results in an additional reduction in time spent with the child and others, and with reduced likelihood of being extensively involved with the child's schooling, although there is no additional effect of paternity confidence on the time spent alone with a child, above and beyond the effect of divorce on this outcome. We conclude that paternity confidence plays an important role in influencing men's relationships with the women who bear their children and with the children themselves.

## Notes

1. Fox and Bruce discuss the operationalization of their variable as follows: "*Paternity certitude* measures the certainty with which a man feels he is the biological progenitor of his child. This construct is measured using two items that load on one factor, with a Cronbach's alpha of .76" (2001, p. 398, italics in original). No further details of how the variable was measured are provided, nor are any descriptive statistics given for this variable.

2. Anderson et al. (2005) report that of 85 men with more than one pregnancy who declined to answer the paternity confidence question for at least one pregnancy, only six refused to answer the paternity confidence question for all pregnancies. The other 79 men (92.9%) willingly answered the paternity confidence question for at least some pregnancies, indicating that they did not object to the question itself, just answering it for certain pregnancies.

3. In New Mexico, the term "Anglo" refers to all individuals of non-Hispanic European descent, regardless of whether or not they are of Anglo-Saxon heritage. Most Hispanics in our sample were born in the United States and are not recent immigrants. The sample used in the divorce analysis contains 631 Anglo men (1,491 children), 326 Hispanic men (975 children), and 43 men of other or undefined ethnicities (116 children). The sample used in the analyses of time involvement with children contains 608 Anglo men (1,512 children), 320 Hispanic men (956 children), and 41 men of other or undefined ethnicities (113 children).

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Table 1. Descriptive statistics for variables used to predict union dissolution, by paternity confidence

	Paternity Confidence						F	<i>p</i>
	High		Low		Unstated			
	<i>Mean</i>	<i>Std. dev.</i>	<i>Mean</i>	<i>Std. dev.</i>	<i>Mean</i>	<i>Std. dev.</i>		
Respondent's age	28.56	5.87	27.16	5.98	28.38	6.33	0.92	0.4000
Logged income (in 1990 dollars)	9.87	1.61	9.45	2.59	9.65	0.73	1.39	0.2490
Respondent's education (years)	15.70	3.53	15.28	4.06	10.26	4.02	39.6	0.0000
Mother's education (years)	13.99	3.71	11.91	3.49	11.82	4.22	10.54	0.0000
Calendar year of pregnancy	1962.70	12.61	1965.00	13.73	1955.00	12.90	6.81	0.0011
Couple ever legally married	0.98	0.14	0.78	0.42	0.97	0.17	29.74	0.0000
Number of children the couple has together	1.16	1.44	0.75	0.98	2.65	2.46	19.01	0.0000
Respondent is Anglo	0.58	0.49	0.69	0.47	0.06	0.24	19.98	0.0000
Respondent is Hispanic	0.37	0.48	0.31	0.47	0.94	0.24	23.92	0.0000
Respondent is other ethnicity	0.05	0.21	0.00	0.00	0.00	0.00	1.59	0.2035
Child is male	0.52	0.50	0.63	0.49	0.59	0.50	1.05	0.3484
N	2,516		32		34			

Note: statistics calculated for the focal child's year of birth

Table 2. Cox proportional hazards analysis of the probability of union dissolution within ten years following a birth

	<i>Hazards ratio</i>	<i>Std. error</i>	<i>p</i>
Respondent's age	0.942	0.014	0.000
Respondent's income (tens of thousands of 1990 \$)	1.033	0.053	0.522
Respondent's education (years)	0.941	0.024	0.016
Mother's education (years)	0.939	0.023	0.009
Calendar year	1.052	0.007	0.000
Couple ever legally married	0.313	0.083	0.000
Number of children the couple have together	0.939	0.072	0.413
Anglo (reference group)	—	—	—
Hispanic	0.620	0.104	0.004
Other ethnicity	1.158	0.349	0.626
Child is male	0.986	0.094	0.883
High paternity confidence (ref. group)	—	—	—
Low paternity confidence	4.935	1.417	0.000
Unstated paternity confidence	0.861	0.804	0.873
Chi-squared		173.35	
<i>p</i>		0.0000	

N = 22,677 person-years from 2,582 children parented by 1,000 men

Standard errors are adjusted to control for multiple children per respondent

Table 3. Descriptive statistics for variables used to predict time involvement with children ages 5 - 12, by paternity confidence

	Paternity Confidence						F	<i>p</i>
	High		Low		Unstated			
	<i>Mean</i>	<i>Std. dev.</i>	<i>Mean</i>	<i>Std. dev.</i>	<i>Mean</i>	<i>Std. dev.</i>		
Respondent's age	33.81	5.84	32.79	6.25	32.94	6.26	0.77	0.4613
Logged income	10.18	1.38	10.01	2.05	10.18	0.80	0.22	0.7998
Respondent's education (years)	15.71	3.54	15.38	4.26	10.35	4.29	34.9	0.0000
Mother's education (years)	14.05	3.66	12.38	3.34	12.16	3.92	6.99	0.0009
Calendar year	1967.36	11.92	1972.34	11.52	1959.71	11.82	8.92	0.0001
Couple ever legally married	0.98	0.13	0.79	0.41	0.97	0.18	25.7	0.0000
Number of children the couple has together	2.89	1.74	1.24	1.41	4.03	2.46	19.5	0.0000
Respondent is Anglo	0.59	0.49	0.62	0.49	0.06	0.25	18	0.0000
Respondent is Hispanic	0.36	0.48	0.38	0.49	0.94	0.25	21.9	0.0000
Respondent is other ethnicity	0.04	0.21	0.00	0.00	0.00	0.00	1.39	0.2490
Child is male	0.52	0.50	0.55	0.51	0.58	0.50	0.34	0.7142
N	2,547		29		31			

Note: Time-variant variables calculated for when child was five years old

Table 4. Ordered logistic models of time men spent with a child in one-on-one interactions, ages 5 - 12

	<b>Model 1</b>			<b>Model 2</b>		
	<i>Coeff</i>	<i>Std. error</i>	<i>p</i>	<i>Coeff</i>	<i>Std. error</i>	<i>p</i>
Respondent's age	0.007	0.009	0.456	0.012	0.009	0.189
Logged income	0.053	0.040	0.192	0.055	0.039	0.164
Respondent's education (years)	0.013	0.023	0.573	0.010	0.023	0.649
Mother's education (years)	0.058	0.023	0.012	0.042	0.024	0.072
Calendar year	0.012	0.005	0.013	0.014	0.005	0.004
Couple ever legally married	0.974	0.540	0.071	0.589	0.391	0.133
Number of children the couple has together	-0.281	0.042	0.000	-0.409	0.045	0.000
Anglo (reference group)	—	—	—	—	—	—
Respondent is Hispanic	0.366	0.149	0.014	0.422	0.149	0.005
Respondent is other ethnicity	-0.108	0.230	0.639	-0.055	0.231	0.812
Child is male	0.262	0.071	0.000	0.257	0.073	0.000
Respondent and child's mother divorced/broke up	—	—	—	-2.189	0.304	0.000
High paternity confidence (ref. group)	—	—	—	—	—	—
Low paternity confidence	-1.429	0.643	0.026	-0.736	0.624	0.238
Unstated paternity confidence	-0.717	0.620	0.247	-0.522	0.640	0.415
Chi-squared		107.99			167.36	
<i>p</i>		0.0000			0.0000	

N = 2,581 children parented by 973 men

Note: Time-variant variables calculated for when child was five years old

Table 5. Ordered logistic models of time men spent with a child in a group with others, ages 5 – 12

	<b>Model 1</b>			<b>Model 2</b>		
	<i>Coeff</i>	<i>Std. error</i>	<i>p</i>	<i>Coeff</i>	<i>Std. error</i>	<i>p</i>
Respondent's age	0.004	0.010	0.695	0.009	0.010	0.366
Logged income	-0.002	0.052	0.970	-0.002	0.050	0.964
Respondent's education (years)	-0.013	0.026	0.616	-0.017	0.026	0.503
Mother's education (years)	0.023	0.023	0.325	0.007	0.024	0.759
Calendar year	0.004	0.005	0.472	0.006	0.006	0.258
Couple ever legally married	1.102	0.554	0.047	0.786	0.471	0.095
Number of children the couple has together	0.047	0.068	0.487	-0.069	0.062	0.268
Anglo (reference group)	—	—	—	—	—	—
Respondent is Hispanic	0.355	0.171	0.038	0.412	0.172	0.017
Respondent is other ethnicity	-0.547	0.290	0.059	-0.490	0.279	0.080
Child is male	0.073	0.079	0.357	0.089	0.081	0.271
Respondent and child's mother divorced/broke up	—	—	—	-1.997	0.340	0.000
High paternity confidence (ref. group)	—	—	—	—	—	—
Low paternity confidence	-1.248	0.375	0.001	-0.764	0.338	0.024
Unstated paternity confidence	0.859	0.488	0.079	1.020	0.497	0.040
Chi-squared		39.82			79.67	
<i>p</i>		0.0000			0.0000	

N = 2,581 children parented by 973 men

Note: Time-variant variables calculated for when child was five years old

Table 6. Logistic models of whether men were extensively involved in children's educational progress, ages 5 – 12

	<b>Model 1</b>			<b>Model 2</b>		
	<i>Coeff</i>	<i>Std. error</i>	<i>p</i>	<i>Coeff</i>	<i>Std. error</i>	<i>p</i>
Intercept	18.573	12.701	0.144	17.970	13.051	0.169
Respondent's age	0.014	0.012	0.261	0.017	0.012	0.164
Logged income	0.075	0.041	0.069	0.073	0.041	0.077
Respondent's education (years)	0.082	0.028	0.004	0.080	0.028	0.004
Mother's education (years)	0.059	0.028	0.035	0.046	0.028	0.106
Calendar year	-0.012	0.007	0.078	-0.011	0.007	0.108
Couple ever legally married	1.014	0.459	0.027	0.664	0.451	0.141
Number of children the couple has together	-0.021	0.057	0.709	-0.111	0.062	0.073
Anglo (reference group)	—	—	—	—	—	—
Respondent is Hispanic	1.024	0.208	0.000	1.045	0.210	0.000
Respondent is other ethnicity	-0.243	0.373	0.514	-0.218	0.372	0.558
Child is male	0.027	0.095	0.776	0.019	0.096	0.846
Respondent and child's mother divorced/broke up	—	—	—	-1.242	0.263	0.000
High paternity confidence (ref. group)	—	—	—	—	—	—
Low paternity confidence	-1.214	0.460	0.008	-0.984	0.468	0.036
Unstated paternity confidence	0.269	1.027	0.793	0.395	1.032	0.702
Chi-squared		48.89			75.87	
<i>p</i>		0.0000			0.0000	

N = 1,984 children parented by 778 men

Standard errors are adjusted to control for multiple children per respondent

Figure 1. Time till union dissolution following a birth, by paternity confidence

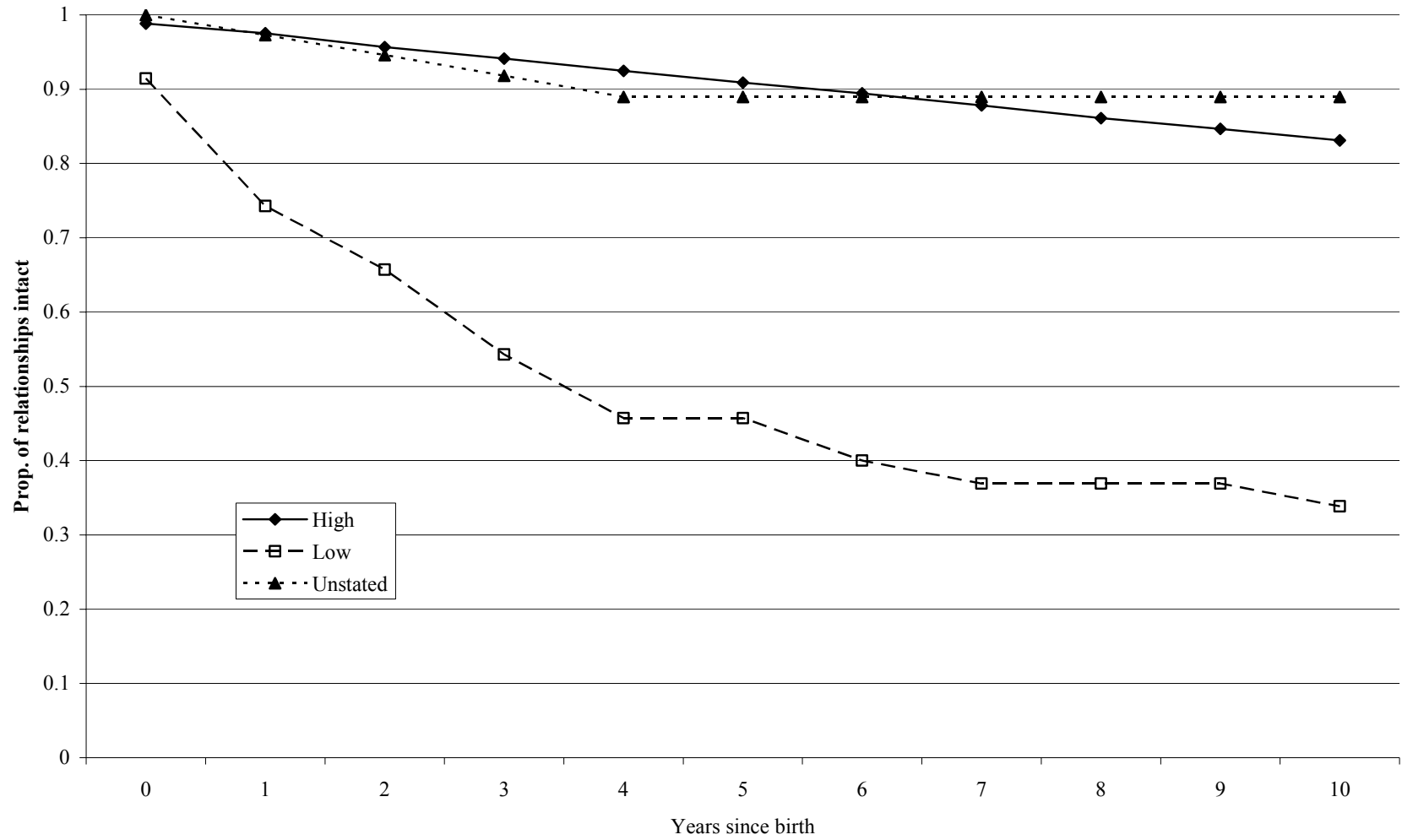


Figure 2. Frequency distribution of time men spend with a child in one-on-one interactions (ages 5-12), by paternity confidence

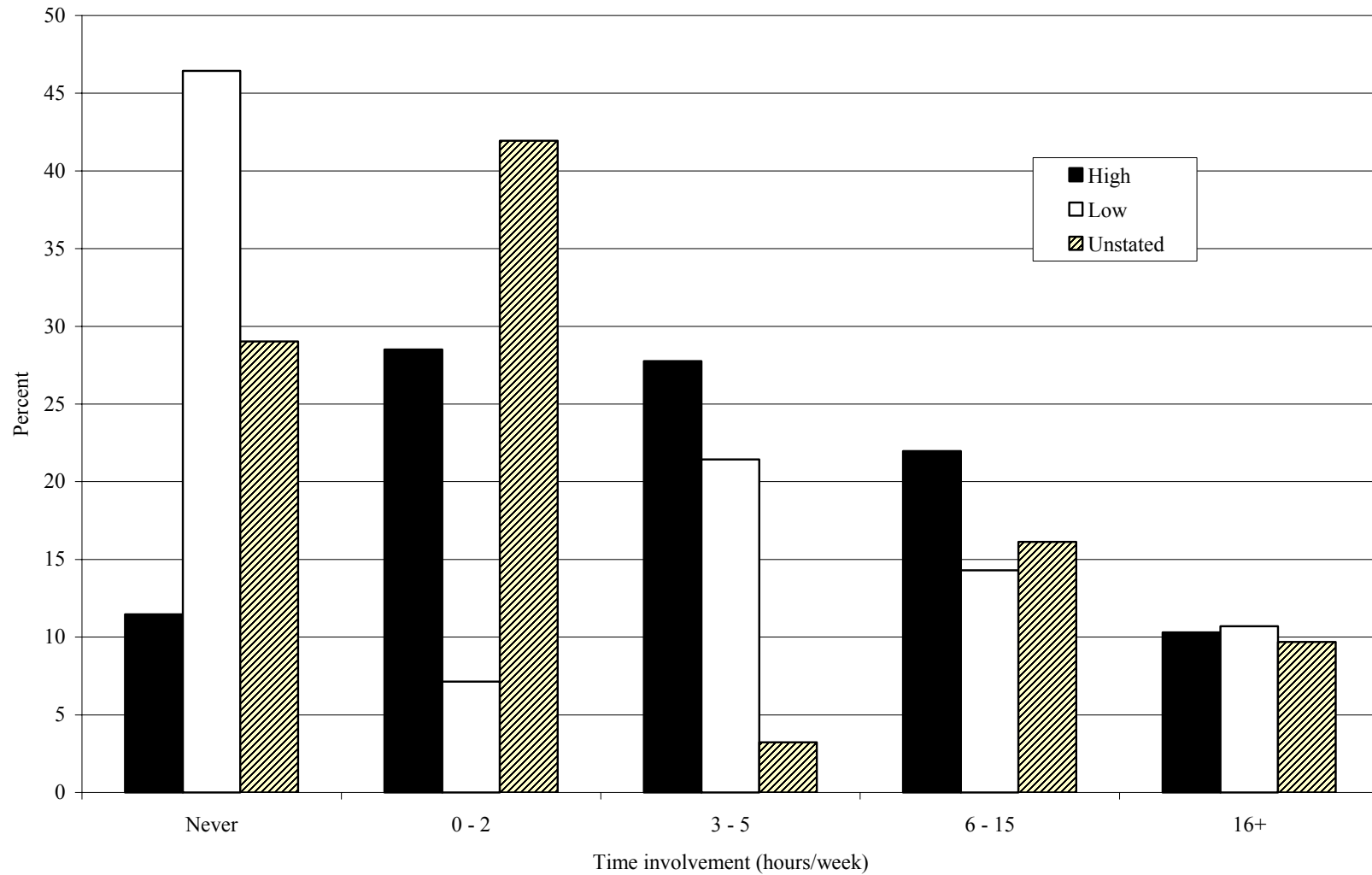


Figure 3. Percentage distribution of time men spend with a child in a group (ages 5-12), by paternity confidence

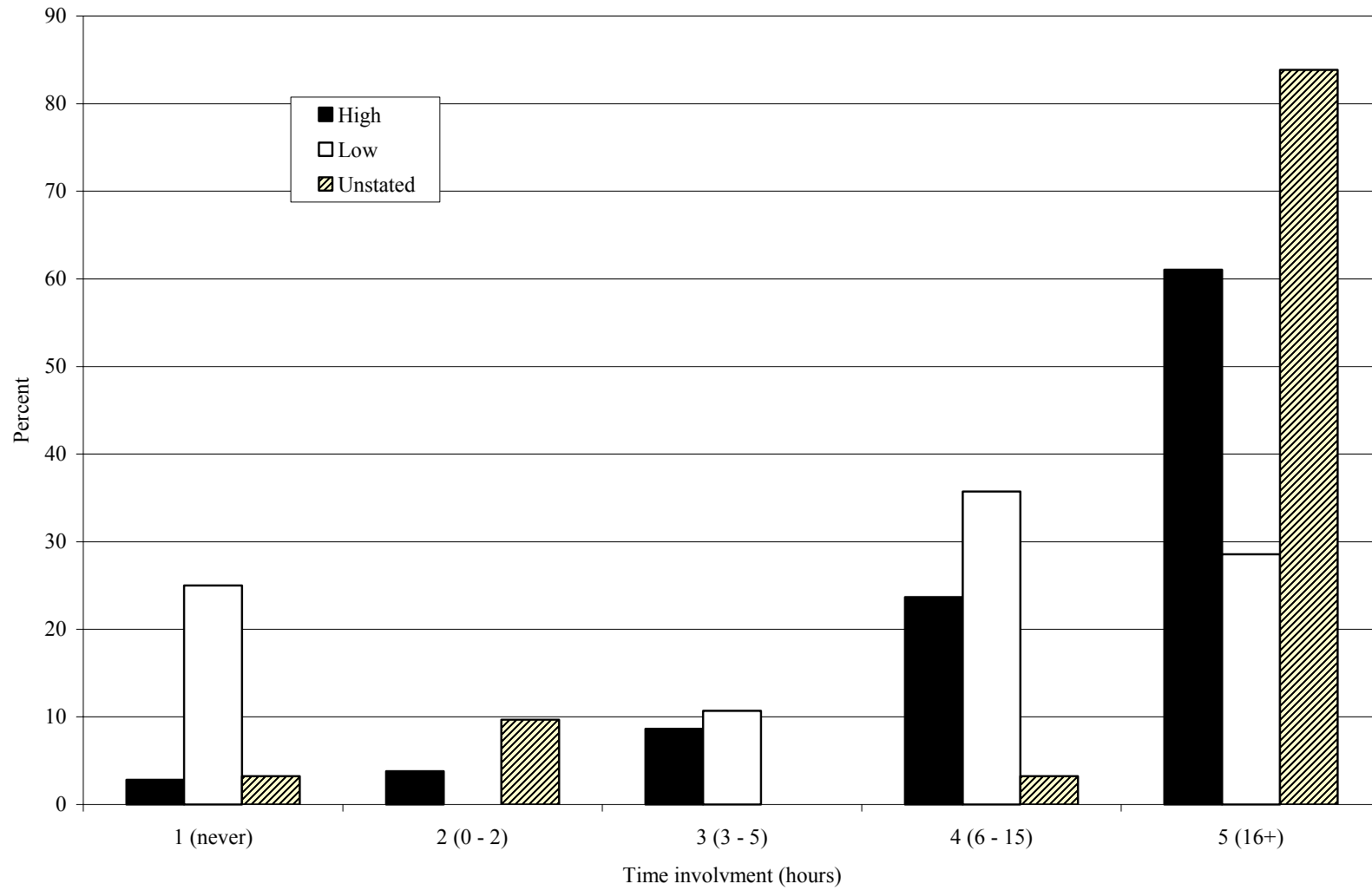


Figure 3. Percentage distribution of time men spend with a child in a group (ages 5-12), by paternity confidence

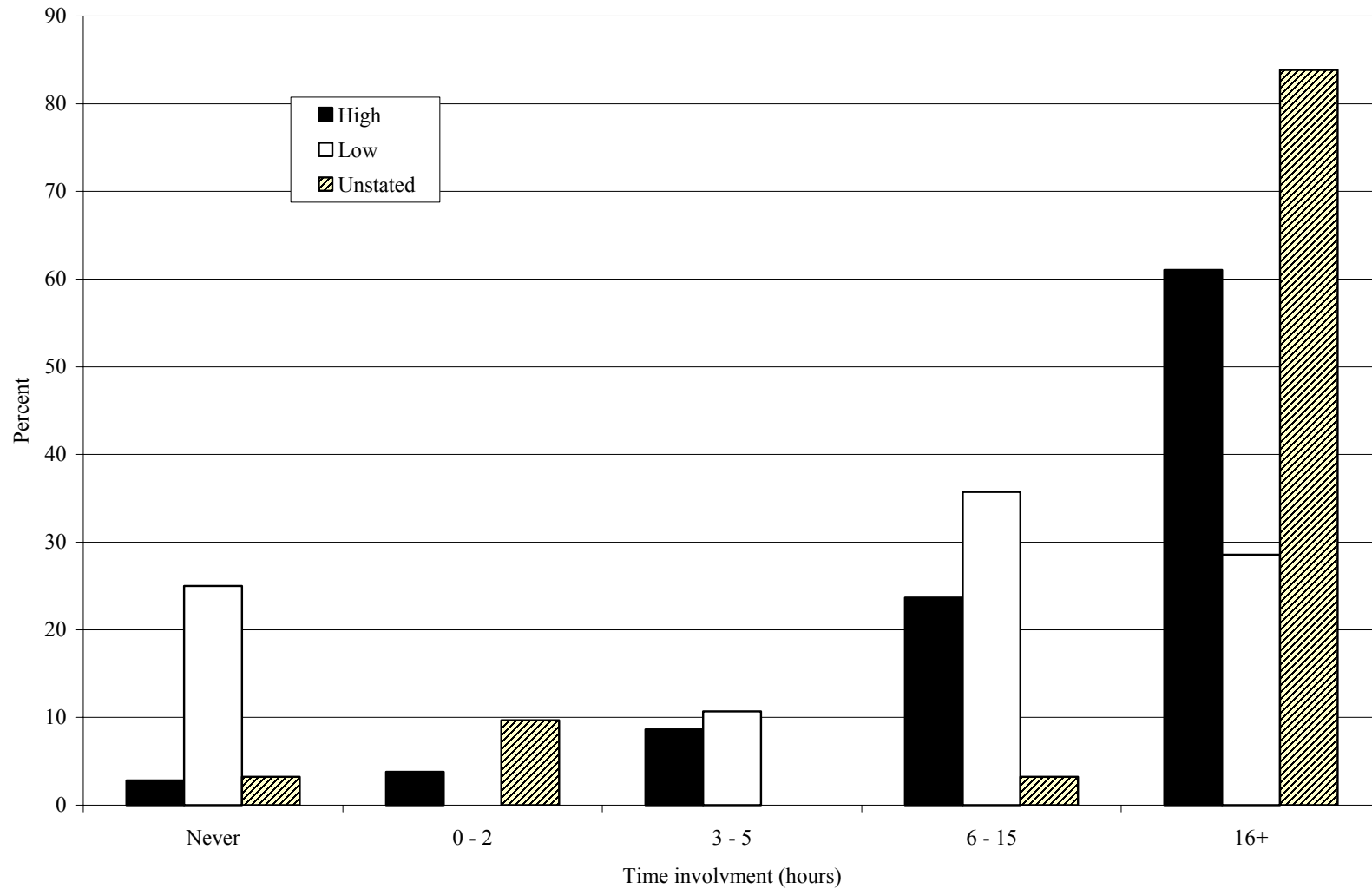


Figure 4. Proportion of men reporting being extensively involved with the educational progress of children ages 5-12, by paternity confidence (bars denote standard errors)

