How Does Children's Sex Affect Parental Sex Preferences: Preference Adaptation and Information Learning*

Quanbao Jiang† Qianqian Shang‡ Yongkun Yin§

This study examines whether and how the sex of children shapes women's sex preferences. Using nationally representative data from the Peruvian Demographic and Health Survey, we exploit the quasi-random assignment of child sex at birth. We find that having a first-born daughter lowers the ideal proportion of sons by 6.1 percentage points (mean = 37.1%) and raises the ideal proportion of daughters by 5.2 percentage points (mean = 38.5%). When the first two children are both daughters rather than both sons, the ideal proportion of sons decreases by 8.8 percentage points, and the ideal proportion of daughters increases by 6.2 percentage points. Further analysis reveals that the effects of the first child's sex are more pronounced for women with only one child than for women with multiple children and that the effects of having a daughter vary with her birth order. We conclude that preference adaptation and information learning are crucial mechanisms.

Keywords: Sex of children, Son preference, Preference adaptation, Information learning, Peru.

JEL codes: D19, J13, J16.

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†School of Labor Economics, Capital University of Economics and Business, Beijing, China, email: recluse_jqb@126.com.

‡School of Economics, Shandong University, Jinan, China, email: qianqian.shang@sdu.edu.cn.

§School of Economics, Shandong University, Jinan, China, email: yongkunyin@gmail.com.

1 Introduction

In many developing countries, sons are preferred over daughters, with parents often desiring more sons than daughters or desiring at least one son. This has led to skewed sex ratios in parts of Asia (e.g., China and India), shortages of women in marriage markets, excess male violence, and long-term social instability (Sen, 1990; Dyson, 2012; Guilmoto, 2012; Edlund et al., 2013; Jiang et al., 2014).

Most studies attribute parental sex preferences to structural factors that influence the gendered benefits and costs of children, such as the roles of sons versus daughters in supporting parents in old age (e.g., Das Gupta et al., 2003; Ebenstein and Leung, 2010) and different marriage costs (e.g., Bhalotra et al., 2020). Other studies suggest that individual factors, such as education and exposure to mass media, are also important determinants (Pande and Astone, 2007; Lin, 2009; Chen et al., 2020). However, little is known about whether and how people's sex preferences can change throughout parenthood, which can be crucial for designing policies to reduce son preference and its demographic consequences.

This study proposes two mechanisms—preference adaptation and information learning—through which the sex of children may shape parental sex preferences. First, behavioral economics suggests that preferences are not fixed; people tend to value what they have over what they do not (Elster, 1982; Sen, 1999; Sugden, 2004). Applied to fertility, parents may adjust their sex preferences to align with the actual sex composition of their children when the two differ (*preference adaptation*). Second, parents form their sex preferences based on the expected benefits and costs of raising sons versus daughters (Das Gupta et al., 2003; Ebenstein and Leung, 2010; Bhalotra et al., 2020). Yet, before having children, these expectations are based on limited or imperfect information. After transitioning to parenthood, they acquire first-hand information and update their preferences accordingly (*information learning*). Overall, both mechanisms predict that child sex can influence parental sex preferences.

These two mechanisms yield distinct testable hypotheses. *Under preference adaptation, the effects of a child's sex are more pronounced for parents with fewer children (Hypothesis 1, or H1).* This mechanism emphasizes that parents care about the overall sex composition of their children, so the first child affects more significantly this composition for families with fewer children. Conversely, *information learning predicts that, holding the number of sons and daughters constant, the effects of a child's sex on parental*

preferences depend on the child's birth order (Hypothesis 2, or H2). Parents may pay different levels of attention to children in different birth orders, leading to varying levels of information learned from each child, thus affecting their sex preferences differently. Together, these hypotheses allow us to separately identify the roles of preference adaptation and information learning in shaping parental sex preferences.

To empirically examine the effects of child sex on parental sex preferences, we leverage the ideal context of Peru, where sex-selective abortions are rare and child sex is random. Using data from the Peruvian Demographic and Health Survey (DHS), we measure a woman's sex preference by her ideal proportion of sons and daughters. Our analysis shows that having a first-born daughter decreases the ideal proportion of sons by 6.1 percentage points (pp) and increases the ideal proportion of daughters by 5.2 pp. When the first two children are both daughters instead of both sons, the ideal proportion of sons decreases by 8.8 pp, and the ideal proportion of daughters increases by 6.2 pp. These effects are substantial, given that the average desired proportions of sons and daughters are 37.1% and 38.5%, respectively.

We next assess the mechanisms. To test preference adaptation (H1), we compare the effects of having a first-born daughter between women who have only one child and those with multiple children. The results confirm that the effects are larger for women with only one child, supporting the role of preference adaptation. To test information learning (H2), we focus on the first two children and examine whether the effects of having a daughter depend on her birth order. The results show significant differences in the effects of having a first-born daughter and a second-born son compared to having a first-born son and a second-born daughter, indicating that information learning also plays a crucial role.

This study contributes to the literature on the formation of sex preferences. Most studies attribute sex preferences to structural factors that determine the gendered benefits and costs of children, including old-age support and marriage costs (e.g., Das Gupta et al., 2003; Ebenstein and Leung, 2010; Bhalotra et al., 2020), while some others suggest that individual factors also play a role (e.g., Pande and Astone, 2007; Lin, 2009; Robitaille, 2013; Chen et al., 2020). Our study integrates both insights and investigates how child sex affects parental sex preferences through information learning and preference adaptation. Although some studies have mentioned that child sex may influence parental sex preferences (e.g., Aly and Shields, 1991; Bhat and Zavier, 2003; Robitaille, 2013),

none have seriously investigated this relationship.[1] Our study provides causal evidence that parental sex preferences depend on the sex of their children.

This study also has important policy implications. To address son preference and unbalanced sex ratios, countries like China and India have implemented policies such as bans on prenatal sex selection and financial incentives to families with daughters (Anukriti, 2018; Kumar and Sinha, 2020). However, these policies have often been difficult to implement or ineffective in altering underlying sex preferences (Sinha and Yoong, 2009). Our finding on information learning suggests that policies informing parents about the benefits of raising daughters or encouraging interactions with daughters may help to reduce son preference.[2]

Finally, our study contributes to the broader literature on how children reshape parents' preferences and attitudes. For example, Shafer and Malhotra (2011), Sun and Lai (2017), and Borrell-Porta et al. (2019) find that parents with daughters are less likely to hold traditional gender role attitudes. Similarly, our findings indicate that having daughters leads parents to prefer more daughters and fewer sons. This helps explain why the sex composition of children has little effect on parental happiness, despite the widespread preference for a family with both boys and girls (Margolis and Myrskylä, 2016).

The remainder of the paper is organized as follows. Section 2 discusses the root causes of sex preferences and how it is affected by child sex. Section 3 presents the cultural, social, and demographic background of Peru. Section 4 introduces the data and variables used in the empirical analysis. Section 5 discusses the identification strategy. Section 6 presents the results. Section 7 concludes the study.

2 Theoretical Framework

In this section, we outline a theoretical framework to guide our empirical analysis. We begin by discussing the causes of sex preferences, followed by an exploration of preference adaptation and information learning theories to explain how children's sex can affect

[1]For example, Aly and Shields (1991) state that "childbearing is an important event in changing the preference of parents" (Aly and Shields, 1991: 355). However, they do not discuss how the sex preferences of parents can be changed by childbearing. Instead, they treat it as constant over time and examine how it may affect sequential fertility decisions.

[2]The evidence on preference adaptation implies that banning prenatal sex selection may be effective in reducing parents' preference for sons by increasing their likelihood of having a daughter. However, this policy is difficult to implement (Kumar and Sinha, 2020; Das Gupta, 2019) and may reduce parental investment in daughters in terms of health and education (Anukriti et al., 2022; Rastogi and Sharma, 2022).

parental sex preferences. Finally, we compare the predictions of these two theories.

2.1 Sex Preferences

Since the seminal works of Becker and Lewis (1973) and Becker (1981), economists have approached children as goods, using microeconomic analysis to study fertility decisions. Raising a child requires parents to expend time, effort, and money. In return, parents may expect support from their children in old age (children as investment goods) or derive utility directly from the quantity and quality of their children (children as consumption goods). Based on these costs and benefits, parents decide on the number of children to have. If parents view sons and daughters differently, they may desire different numbers of each (Davies and Zhang, 1997; Kim, 2005; Li and Pantano, 2023). Parents are said to have a "son preference" if they want more sons than daughters, and a "daughter preference" if they want more daughters.[3] We now discuss the factors causing sons and daughters to be viewed differently.

First, the economic returns to raising sons and daughters can differ due to cultural, economic, and institutional factors. For instance, in some Asian countries like India, parents rely primarily on sons for financial support in old age (Das Gupta et al., 2003; Chung and Das Gupta, 2007; Ebenstein and Leung, 2010; Ebenstein, 2021), while in southern European countries such as Greece, daughters typically provide more support (Dagkouli-Kyriakoglou, 2022). Moreover, the earning potential of male and female children may differ, affecting their ability to support parents financially (Qian, 2008; Mahajan and Ramaswami, 2017). In countries like China and India, parents may face significant economic burdens from paying a bride price or dowry (Bhalotra et al., 2020; Dong et al., 2021). As children can serve as a form of investment, parents may prefer the sex associated with higher economic returns.

Second, non-economic returns may also differ between sons and daughters. Indeed, parents highly value children's inherent traits and behavioral characteristics, which, however, may differ by sex. For example, girls are often associated with qualities such as neatness, cuteness, and helpfulness (Arnold and Kuo, 1984), while boys are often perceived as more fun and easier to raise (Goldberg, 2009; Nugent, 2013). These (perceived) differences in non-economic returns can explain why, even in Nordic countries with high

[3]It should be noted that sex preference may arise not only from the personal tastes but also from constraints faced by parents. This differs from the conventional notion of "preference" in economics, which typically reflects only personal tastes.

gender equality, parents still desire at least one child of each sex (Andersson et al., 2006).

Finally, sex preferences can reflect the tastes of parents, forming a feature of their utility function (Davies and Zhang, 1997). Many studies show that migrants from societies with a strong preference for sons retain this preference even after moving to Western countries (e.g., Dubuc and Coleman, 2007; Almond et al., 2013; Carol and Hank, 2020). This persistence, despite dramatic socio-economic changes, highlights the role of parental tastes, which can persist over time despite the absence of initial economic and non-economic drivers.

In summary, sons and daughters are not perfect substitutes from the perspective of parents. Consequently, parents may desire some of their children to be boys and others to be girls.

2.2 Preference Adaptation and Sex Preferences

Behavioral economics has provided compelling evidence that human preferences are not immutable, as assumed by orthodox rational choice theories. A notable way preferences evolve is by aligning desires with realistically available options. People tend to prefer what they have or are likely to get, rather than what they do not have or are unlikely to get (Sugden, 2004; Dorsey, 2010). An archetypal illustration of this phenomenon can be found in the fable *The Fox and the Grapes* from the book *Aesop's Fables*, where the fox, upon realizing that he cannot reach the grapes, convinces himself that he has never really wanted them because they are sour. This preference, known as "adaptive preference," was introduced by Elster (1982) and applied to welfare economics by Sen (1982, 1999) and Nussbaum (2001), who noted that "the poor and deprived may accept and even find justification of their lot in life" (Sen, 1982: 376).

Adaptation plays an important role in parental sex preferences. Consider parents who strongly desire sons but have only daughters and are unable to have more children. They can either maintain their preference for sons and live unhappily with only daughters, or they can adjust their preferences to align with reality and live happily. If preferences are sufficiently malleable, the latter scenario is more likely. Overall, this example suggests that parents may experience disutility when the sex composition of their children does not match their desires, but they can mitigate the disutility by adjusting their preferences.[4]

[4]Similarly, the number of children may affect parents' ideal family size. We explore this possibility in Appendix A.

2.3 Information Learning and Sex Preferences

Classical theories of information economics highlight the importance of information in shaping decision-making (Stigler, 1961, 1962). Consumers often seek information about the price and quality of a good to inform their choices (Stigler, 1961). Some goods, such as office stationery, have attributes that can be easily evaluated before purchase, making it feasible for consumers to acquire relevant information through simple searches. In contrast, some others, such as canned tuna, have attributes that are difficult to evaluate accurately before consumption, requiring consumers to rely on experience for evaluation. This distinction has led Nelson (1970) to classify the former as "search goods" and the latter as "experience goods". In practice, many goods possess a mixture of both attributes (Nelson, 1974).

Children, a special good in economic analyses, possess experience attributes that parents cannot predict with certainty, such as inherent traits and behavioral characteristics (Ben-Porath and Welch, 1972). Before having a child, parents may have some preliminary information about the differences between raising a son or a daughter, but this may be biased or incomplete. For example, in China, there is a widespread belief that sons provide more old-age support to their parents than daughters, although recent empirical research suggests no significant difference (Oliveira, 2016). As individuals enter parenthood, they will gain firsthand insights into their sons/daughters' attributes (Luppi, 2016), and their sex preferences may change based on this new information. Indeed, they tend to want more children of the sex that they find more valuable based on their experience.

In theory, the experience of raising a son/daughter can include both positive and negative aspects (Luppi, 2016), potentially leading parents to adjust their sex preferences in different directions. In practice, however, the positives are likely to outweigh the negatives. While there is no direct evidence on the dynamic changes in people's information before and after having a child, substantial evidence suggests improved subjective well-being upon entering parenthood (Myrskylä and Margolis, 2014; Baetschmann et al., 2016). This implies that the rewards of parenting often exceed initial expectations. Moreover, no concrete evidence suggests that the gains in subjective well-being depend on the sex of the children, implying that parents may have underestimated the joys associated with both boys and girls. Consequently, parents with a son tend to favor sons more, while parents with a daughter favor daughters more.

2.4 Preference Adaptation vs. Information Learning

Both preference adaptation and information learning theories suggest that a child's sex can influence parental sex preferences. However, they propose different mechanisms, leading to different testable hypotheses.

First, *a unique prediction of the preference adaptation theory is that the effects of the first child's sex are more pronounced for parents with fewer children and diminish as parents have more children (H1).* In essence, this theory implies that parents are concerned with the overall sex composition of their children and will adjust their sex preferences toward the actual sex composition if there is a discrepancy. For parents with fewer children, a child has a greater impact on the overall sex composition, necessitating a larger adjustment. To illustrate, consider two hypothetical families, A and B, who both initially preferred boys and wanted all their children to be boys. If each family's first child is a daughter, they will adjust their preferences. However, the extent of this adjustment may differ depending on the total number of children they end up having. For example, if A has four children while B has only two, a simple calculation shows that the first child changes the proportion of sons by 25% for A, but by 50% for B. Consequently, B has to make a larger adjustment to bring her preference closer to the reality.[5]

Second, the preference adaptation theory predicts that parental sex preferences are influenced only by the number of sons and daughters, regardless of their birth order. To illustrate, consider a parent who has a son and a daughter. Whether the daughter is the first or the second child, the sex composition of the children remains the same, implying the same effect on parental sex preferences. In contrast, *the information learning theory predicts that the effect of a child's sex on parental sex preferences depends on the child's birth order, as parents may pay different levels of attention to children in different birth orders (H2).* Indeed, parents are likely to pay more attention to and learn more information from their first child, as this is their first experience of parenthood (Luppi, 2016; Luppi and Mencarini, 2018).[6] Therefore, the information learned from a first-born daughter and a second-born son differs from that from a first-born son and a second-born daughter, implying different effects on sex preferences depending on birth order. In summary, the preference adaptation theory suggests that only the sex composition of

[5]Parents also care about the sex of other children. Here, we focus on the adjustment caused by the first child.

[6]Studies in various research areas suggest that parental attitudes are more affected by having a first-born daughter than by subsequent daughters (e.g., Cronqvist and Yu, 2017; Sharrow et al., 2018; Greenlee et al., 2020).

children influences parental preferences, while the information learning theory emphasizes the importance of birth order in shaping their preferences.

3 Background of Peru

While a preference for sons prevails in many societies, a very slight preference for daughters is present in Peru, as well as in other Latin American countries. In Peru, most women either express no sex preference or want an equal number of sons and daughters. Some women may want more daughters than sons, but relatively few women want the opposite (Fuse, 2010).[7]

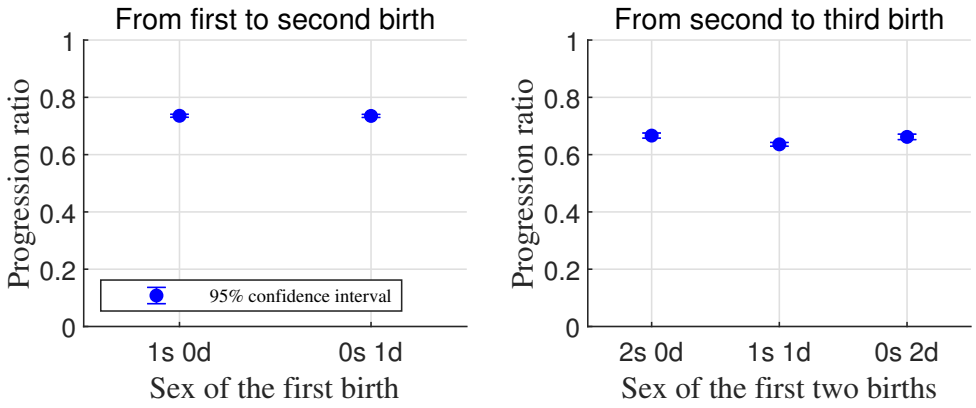
The absence of son preference in Peru is deeply rooted in its family system and social norms. In regions where son preference is particularly strong, such as India, the family system is typically patrilineal and patrilocal (Das Gupta et al., 2003; Chung and Das Gupta, 2007). Married daughters typically move away from their natal parents, limiting their ability to support them, while married sons often reside with or near their parents, facilitating resource flow between them (Kochar, 2000; Ebenstein, 2021). As a result, parents rely primarily on their sons for old-age support. Conversely, in Peru and other Latin American countries, the family system and social norms place few constraints on women's economic and social autonomy, allowing married daughters to maintain close relationships with their parents (Basu and Das Gupta, 2001). Indeed, married daughters are as likely as sons to live with their parents, enabling them to significantly contribute to their parents' well-being (Bongaarts and Zimmer, 2002).

To assess parental sex preferences, researchers often estimate the parity progression ratio (PPR), or the proportion of women who progress from one parity to the next, conditional on the sex composition of existing children (e.g., Clark, 2000; Altindag, 2016; Cukrowska-Torzewska and Grabowska, 2023). The underlying logic is that if parents prefer sons over daughters, they will be more likely to have another child if they do not have a son than if they do not have a daughter, and vice versa. Figure 1 shows the conditional PPR for Peruvian parents with one or two children. The plot on the left shows that about 74% of women would have a second child regardless of the sex of the first child. Similarly, the plot on the right shows that if they have only two sons or only

[7] According to Fuse (2010), a woman shows no sex preference if she states that her ideal sex composition is up to God, or that her ideal number of both sons and daughters is zero while the number of children whose sex does not matter is positive.

two daughters, they are equally likely to have another child, with a probability of 66%.[8] Overall, the two plots suggest that Peruvian parents do not have a *strong* preference for either sons or daughters.

Figure 1: Parity Progression Ratio Conditional on the Sex of Existing Children



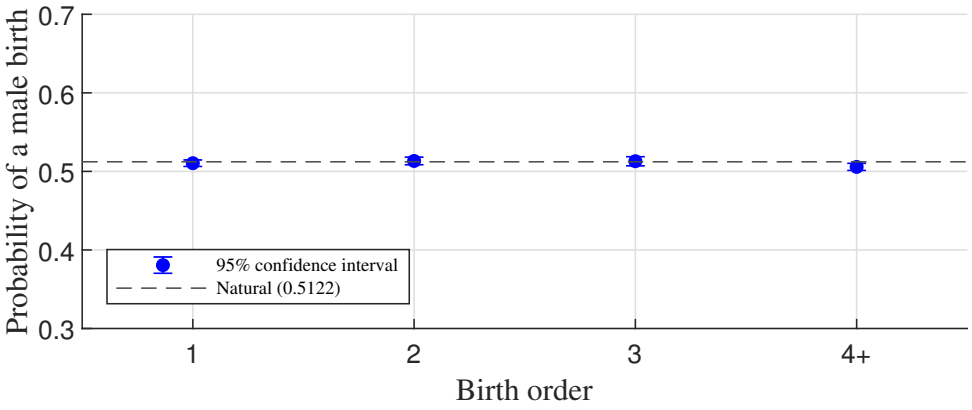
Notes: Data are from the Peruvian Demographic and Health Survey in 1996, 2000, and 2004-2011. "1s 0d" means that parents previously had one son and zero daughters. Other abbreviations can be interpreted similarly.

Since Peruvians do not have a strong preference for sons or daughters, they have no incentive to use abortion to select the sex of their children. Moreover, abortion has been illegal in Peru since 1924, making prenatal sex selection difficult. As a result, the sex of children is a random variable. Figure 2 shows the probability of a male birth at each parity. It is about 0.51 regardless of the birth order, which is within the biologically normal range.

Since Figure 2 may mask the possibility that some parents abort male fetuses while others abort female fetuses, Figure 3 further plots the probability that the next birth is a male, conditional on the sex composition of previous children. If parents were using abortion to control the sex of their children, the next birth would be more likely to be a boy if the parents prefer sons but do not have one, and more likely to be a girl if they prefer daughters but do not have one. Figure 3 shows that the probability that the second (or third) birth is a male does not depend on the sex of the first child (or the first two children). This is strong evidence that Peruvian parents do not use abortion to control the sex of their children. As will become clear below, the randomness of child sex in

[8]In addition, the plot on the right shows that parents are less likely to have a third child if they have a son and a daughter, suggesting satisfaction with a mixed-sex composition of children. This PPR pattern, where the progression to a second birth does not depend on the first child's sex, while the progression to a third child does, is not unique to Peru. Andersson et al. (2006) document the same pattern for Denmark, Finland, Norway, and Sweden.

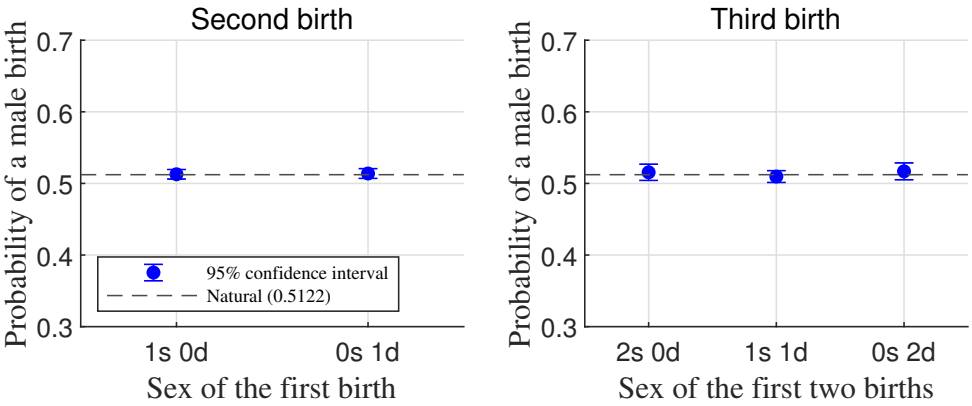
Figure 2: Probability of a Male Birth at Each Parity



Notes: Data are from the Peruvian Demographic and Health Survey in 1996, 2000, and 2004-2011.

Peru offers great advantages for identifying the causal effects of child sex on parental sex preferences and the underlying mechanisms.

Figure 3: Probability of a Male Birth Conditional on the Sex of Previous Children



Notes: Data are from the Peruvian Demographic and Health Survey in 1996, 2000, and 2004-2011. "1s 0d" means that parents previously had one son and zero daughters. Other abbreviations can be interpreted similarly.

4 Data and Variables

This study uses data from three rounds of the Peruvian Demographic and Health Survey (DHS) in the years 1996, 2000, and 2004-2011. The data are repeated cross-sectional and are part of the DHS program, which has been collecting high-quality, nationally representative data on population and health in developing countries since 1984. Since 1990, the DHS has systematically included questions to elicit information on fertility ideals and sex preferences. In Peru, the collection of data on fertility ideals and sex preferences began with the 1996 survey, which provides the key data for our study.

We have access to each woman's complete birth record, from which we extract valuable information about the sex of her children. We exclude women with twin births from the study. In our empirical analysis, we focus on either the sex of the first child or the sex of the first two children. When the first birth involves twins of different sexes, it is both difficult and meaningless to determine the sex of the first child. In addition, when examining the role of information learning, we need to consider the birth order of the daughter. However, in the case of twins, it is not practically meaningful to distinguish their birth orders. After excluding women with twin births, our dataset consists of 107,560 women aged 15-49.[9]

Table 1 presents a summary of the key variables. Peruvian women in our sample have an average of 3.0 children, with a probability of 0.49 that a child is female. The average time since the first birth is about 13 years. These women have an average age of 34 and have received an average of 8.3 years of schooling, with a standard deviation of 4.5 years. Approximately 64.2% of them are employed at the time of the survey, and 68.9% live in urban areas.

Following the literature (e.g., Clark, 2000; Bhat and Zavier, 2003; Fuse, 2010), our measures of sex preferences are constructed from the answers to the following two questions:

Q1. If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?

Q2. How many of these children would you like to be boys, how many would you like to be girls, and for how many would it not matter if it's a boy or a girl?

When answering questions about sex preferences, respondents may be reluctant to

[9]In the 1996 survey, the questions about sex preference were also administered to a sample of men. In Appendix B, we show that having daughters leads men to prefer a smaller proportion of sons and a larger proportion of daughters, which is in line with the findings for women.

Table 1: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Panel A. Individual characteristics					
Children ever born	107,560	2.997	2.085	1	16
First-born daughter	107,560	0.490	0.500	0	1
Second-born daughter	80,720	0.487	0.500	0	1
Years since first birth	107,560	13.039	8.350	0	38
Age	107,560	34.069	8.404	15	49
Years of schooling	107,560	8.328	4.492	0	17
Employed	107,560	0.642	0.479	0	1
Urban residence	107,560	0.689	0.463	0	1
Panel B. Sex preferences					
Ideal proportion of sons	107,560	0.371	0.278	0	1
Ideal proportion of daughters	107,560	0.385	0.284	0	1
Want at least one son	107,560	0.691	0.462	0	1
Want at least one daughter	107,560	0.708	0.455	0	1
Want at least one child of each sex	107,560	0.642	0.479	0	1
Want more sons than daughters	107,560	0.131	0.337	0	1
Want more daughters than sons	107,560	0.141	0.348	0	1

admit dissatisfaction with the sex of their children, and therefore they may not reveal their true preferences. To address this issue, the DHS program asks respondents to consider a hypothetical scenario in which they had no children and could freely determine both the number and sex of their children, effectively mitigating the risk of justification bias. Based on the responses, we construct three variables to measure sex preferences: the ideal proportion of sons, the ideal proportion of daughters, and the proportion of children whose sex does not matter. Since the three variables add up to one, we focus on the first two variables as the outcome variables, which effectively capture parental preferences for sons and daughters, respectively.

Table 1 shows that, on average, Peruvian women want 37.1% of their children to be boys and 38.5% to be girls, indicating a slight preference for daughters (difference = 1.4 pp, p-value = 0.000), which is consistent with the findings of Fuse (2010).[10,11] In addition, the data show that 69.1% of Peruvian women want to have at least one son, 70.8% want to have at least one daughter, and 64.2% want to have at least one child of each sex.

[10]To put the degree of daughter preference in Peru into perspective, we compare it with the son preference in India. The 2015-2016 DHS data in India suggest that Indian women want about 47.5% of their children to be boys but only 40.5% to be girls. This implies a difference of 7.0 pp (p-value = 0.000), much larger than the 1.4 pp observed in Peru.

[11]Since the preference for daughters is very slight, the fertility and sex selection behaviors of Peruvian parents are not affected, as discussed in the previous section.

Finally, 13.1% of them want more sons than daughters, while 14.1% want more daughters than sons.

5 Identification Strategies

5.1 Identifying the Effects of Children's Sex

To estimate the effects of children's sex on parental sex preferences, we use the following regression model,

$$Preference_i = \beta_0 + \beta_1 Sex_i + \beta_2 X_i + \epsilon_i. \quad (1)$$

In this equation, $Preference_i$ is the outcome variable, which can be the ideal proportion of sons or daughters reported by Woman i. The variable Sex is a measure of the sex of the children, to be detailed shortly. X is a vector of control variables, including the number of children ever born, the number of years since the first birth, age, years of schooling, employment status (whether employed or not), and residential type (urban or rural) of the respondent.[12] In addition, X includes dummy variables for the state and year of the interview. Lastly, ϵ is the disturbance term. If the variable Sex is exogenous, β_1 captures the causal effect of children's sex on parental sex preferences.

We now discuss the measurement of children's sex. While the sex of each child is essentially a random variable, the measure of children's sex (Sex) can become endogenous in the regression analysis if children born later in the birth order are improperly considered. This is because parental decisions about further childbearing may depend on their sex preferences and the sex of their existing children. For example, parents with a preference for sons/daughters are more likely to have another child if their current children are all girls/boys, and are less likely to do so in the opposite scenario. If we consider children born later in the birth order, we will unintentionally exclude parents who were satisfied with the sex of their earlier children and stopped childbearing. Consequently, the sample mainly includes parents who were not satisfied with the sex of their earlier children and continued to have more children. This will lead to a sample selection bias, whereby a correlation between the sex of earlier children and parental sex preferences can be observed, even if the former does not causally affect the latter.[13]

The potential bias can be avoided by focusing on the sex of the first child. This

[12] Age squared is not included, as its effect is minimal, but results are robust to its inclusion.
[13] See Choi and Hwang (2015) for more discussions.

approach is supported by Dahl and Moretti (2008) and Choi and Hwang (2015), who identify the causal effects of the sex of the first child on family structure and parental investment in children, respectively. In the Peruvian context, the analysis can be extended to include the sex of the second child. As shown in the left-hand plot of Figure 1, the likelihood of a second birth is not affected by the sex of the first child, suggesting that including the sex of the second child does not introduce a sample selection bias. However, extending the analysis to higher birth orders is problematic, as parental decisions about having a third child are influenced by the sex composition of the first two children. Therefore, we mainly use two measures of child sex: (a) whether the first child is a daughter, and (b) the proportion of daughters among the first two children.

5.2 Identifying the Roles of Preference Adaptation and Information Learning

The preference adaptation theory suggests that the effects of the first child's sex are more pronounced for parents with relatively few children. To test this hypothesis, we compare the effects of the first child's sex between parents with only one child and those with at least two children.[14] The comparison is made using the following regression model,

$$Preference_i = \alpha_0 + \alpha_1 Daughter_{1,i} + \alpha_2 Daughter_{1,i} \times Children_{2,i} + \alpha_3 X_i + u_i, \quad (2)$$

where $Children_2$ is a dummy variable taking the value 1 if parents have at least two children and 0 otherwise. The effect of a first-born daughter on parental sex preference is α_1 for parents with only one child and $\alpha_1 + \alpha_2$ for parents with more than one child. If preference adaptation plays a role, we expect $\alpha_1 + \alpha_2$ to have the same sign as α_1, but a smaller magnitude.

The information learning theory suggests that the effect of a child's sex on parental sex preferences depends on the child's birth order, as parents may pay different levels of attention to children in different birth orders. In particular, the effect of a first-born daughter may differ from that of a second-born daughter. To test this hypothesis, we use the following regression model,

$$Preference_i = \gamma_0 + \gamma_1 DS_i + \gamma_2 SS_i + \gamma_3 DD_i + \gamma_4 X_i + v_i. \quad (3)$$

[14] We consider whether women have at least two children, as using the number of children directly is invalid due to its endogeneity. Indeed, the decision to have a third child depends on the sex composition of the first two children and the parents' sex preferences, making the number of children an endogenous variable. In contrast, the decision to have a second child does not depend on the sex of the first child and is thus an exogenous variable.

In this equation, we use three dummy variables: DS, which takes the value 1 if the first child is a daughter and the second is a son; SS, which takes the value 1 if the first two children are both sons; and DD, which takes the value 1 if the first two children are both daughters. The reference group consists of women who have a first-born son and a second-born daughter. Thus, γ_1 captures the effect of having a first-born daughter and a second-born son relative to having a first-born son and a second-born daughter. If γ_1 is significantly different from zero, we can infer that information learning plays a role.

6 Results

This section presents the findings of our study. First, we show how children's sex affects women's sex preferences. Next, we explore the role of preference adaptation and learning in shaping these effects. Finally, we demonstrate the robustness of our results using alternative measures of sex preferences.

6.1 Effects of Children's Sex on Parental Sex Preferences

Table 2 shows how a woman's sex preference is affected by the sex of her first child. In Columns (1) and (2), the outcome variable is the ideal proportion of sons, while in Columns (3) and (4), it is the ideal proportion of daughters. We first conduct the analysis without control variables, followed by a complete analysis with controls.

The results indicate a significant effect of the first child's sex on the mother's sex preference. Columns (1) and (2) show that having a first-born daughter reduces the ideal proportion of sons by 6.1 pp. Meanwhile, Columns (3) and (4) show that having a first-born daughter increases the ideal proportion of daughters by 5.2 pp. These effects are substantial, given that the average ideal proportions of sons and daughters are 37.1% and 38.5%, respectively. Notably, the inclusion of control variables does not alter the estimated effects, reaffirming that child sex is a completely random variable.

In Table 3, we extend the analysis to include the sex of the second child and examine how a woman's sex preference is affected by the proportion of daughters among her first two children. Again, the presence of daughters causes a woman to want a higher proportion of sons and a lower proportion of daughters. Specifically, when the first two children are both daughters rather than sons, the ideal proportion of sons decreases by 8.8 pp, while the ideal proportion of daughters increases by 6.2 pp.

Table 2: Effect of the first child's sex on a woman's sex preference

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
First-born daughter	-0.061***	-0.061***	0.052***	0.052***
	(0.002)	(0.002)	(0.002)	(0.002)
Children ever born		-0.000		-0.004***
		(0.001)		(0.001)
Years since first birth		0.001***		0.002***
		(0.000)		(0.000)
Age		-0.001***		-0.002***
		(0.000)		(0.000)
Years of schooling		0.001***		0.002***
		(0.000)		(0.000)
Employed		-0.002		0.001
		(0.003)		(0.003)
Urban		-0.008***		0.004
		(0.003)		(0.003)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	107,560	107,560	107,560	107,560
R^2	0.012	0.036	0.008	0.020

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3: Effect of the first two children's sex on a woman's sex preference

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
Proportion of daughters	-0.088***	-0.088***	0.062***	0.062***
	(0.004)	(0.004)	(0.004)	(0.004)
Children ever born		-0.001		-0.005***
		(0.001)		(0.001)
Years since first birth		0.001		0.002***
		(0.000)		(0.000)
Age		-0.001		-0.001***
		(0.000)		(0.000)
Years of schooling		0.001		0.002***
		(0.000)		(0.000)
Employed		-0.001		0.001
		(0.003)		(0.003)
Urban		-0.013***		0.001
		(0.003)		(0.003)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	80,664	80,664	80,664	80,664
R^2	0.013	0.038	0.006	0.018

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Regarding control variables, Tables 2 and 3 show that the ideal proportion of sons is positively associated with the number of years since the first birth and the mother's level of education, but negatively associated with the mother's age and urban residence. The ideal proportion of daughters, on the other hand, is positively associated with the number of years since the first birth and the mother's level of education, but negatively associated with the total number of children ever born and the mother's age. It is important to note that the effects of these control variables are much smaller than the effects of child sex.

In summary, the results in Tables 2 and 3 suggest that having daughters significantly reshapes a woman's preferences, leading to a decreased desire for sons and an increased desire for daughters. These effects are both statistically significant and substantial.

6.2 Preference Adaptation

This subsection investigates the role of preference adaptation in reshaping parental sex preferences. According to the preference adaptation theory, the effects of the first child's sex are more pronounced for parents with fewer children. We test this hypothesis by comparing the effects of having a first-born daughter between women with only one child and those with at least two children, as specified in Equation (2).

The results, presented in Table 4, show that having a first-born daughter has a significant effect on the mother's sex preference, but the effect is much smaller for women with multiple children. Specifically, Columns (1) and (2) show that for women with only one child, having a first-born daughter reduces their ideal proportion of sons by 9.1-9.2 pp. However, this effect is reduced by 4.1-4.2 pp for women with more than one child. Columns (3) and (4) show that for women with only one child, having a first-born daughter increases their ideal proportion of daughters by 8.5 pp. However, this effect is reduced by 4.4-4.5 pp for women with at least two children. These results highlight the importance of preference adaptation for child sex in influencing parental sex preferences.

One potential concern is that some women in the sample may not have completed their fertility, potentially taking future children into account when adapting their preferences based on the sex of the first child. To address this issue, we conduct two robustness checks in Appendix C. First, we restrict the sample to women who have completed their fertility, i.e., those who have decided not to have more children, have been sterilized, or have become infertile, and find that the findings remain robust. Second, we examine how the effect of having a first-born daughter varies with women's ideal number of children. The

results show that the effect of the first child's sex on a woman's sex preference diminishes as her ideal famize size increases.

Table 4: Effects of the first child's sex on sex preference for women with different numbers of children

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
First-born daughter	-0.092***	-0.091***	0.085***	0.085***
	(0.005)	(0.005)	(0.005)	(0.005)
First-born daughter	0.042***	0.041***	-0.044***	-0.045***
× At least two children	(0.005)	(0.005)	(0.006)	(0.006)
At least two children	-0.015***	-0.017***	0.024***	0.031***
	(0.004)	(0.005)	(0.004)	(0.004)
Children ever born		-0.001		-0.004***
		(0.001)		(0.001)
Years since first birth		0.001**		0.002***
		(0.000)		(0.000)
Age		-0.001***		-0.002***
		(0.000)		(0.000)
Education		0.001**		0.002***
		(0.000)		(0.000)
Employed		-0.002		0.002
		(0.003)		(0.003)
Urban		-0.008**		0.004
		(0.003)		(0.003)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	107,560	107,560	107,560	107,560
R^2	0.013	0.037	0.010	0.021

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

6.3 Information Learning

While preference adaption is important, it is unclear whether it is the sole mechanism through which a child's sex affects a mother's sex preference. This subsection examines the role of information learning in transforming parental sex preferences. To reiterate, the information learning theory predicts that the effect of a child's sex on parental sex preferences may depend on the child's birth order. In particular, the effect of a first-born daughter may differ from that of a second-born daughter. To test this hypothesis, we compare the sex preferences between women who have a first-born daughter and a second-born son and women who have a first-born son and a second-born daughter, as specified in Equation (3).

The results, presented in Table 5, indicate that the effect of having a daughter on a woman's sex preference is much larger if the daughter is the first child. Columns (1) and (2) show that, relative to having a first-born son and a second-born daughter, having a first-born daughter and a second-born son reduces the ideal proportion of sons by 1.3 pp, while Columns (3) and (4) show that it increases the ideal proportion of daughters by 2.0 pp. These findings underscore the importance of information learning for child sex in influencing parental sex preferences.[15]

6.4 More Robustness Checks

In the previous analysis, a woman's sex preference is measured by the ideal proportions of sons or daughters, reflecting the assumption that parents who favor a particular sex want a larger proportion of children of that sex. Sex preferences, however, may manifest in different ways. Appendix D reports robustness checks employing alternative measures.

First, sex preference may take the form of a minimum desire to have at least one child of a given sex. To capture this, we construct three indicator variables: (1) the woman desires at least one son, (2) she desires at least one daughter, and (3) she desires at least one child of each sex. Indicators (1) and (2) identify preferences for sons and daughters, respectively, while indicator (3) captures whether the respondent differentiates between the two sexes.

Second, sex preference may manifest as a desire for a higher number of children of one sex relative to the other. We therefore construct two additional indicators: (1) the

[15]Excluding from the sample women whose first two children are both sons or both daughters does not alter the results.

Table 5: Effects of the first two children's sex and birth order on a woman's sex preference

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
Daughter-Son	-0.012***	-0.013***	0.019***	0.019***
	(0.004)	(0.004)	(0.004)	(0.004)
Son-Son	0.041***	0.041***	-0.012***	-0.012**
	(0.004)	(0.004)	(0.004)	(0.004)
Daughter-Daughter	-0.046***	-0.046***	0.051***	0.051***
	(0.004)	(0.004)	(0.004)	(0.004)
Children ever born		-0.001		-0.005***
		(0.001)		(0.001)
Years since first birth		0.001		0.002***
		(0.000)		(0.000)
Age		-0.001		-0.001**
		(0.000)		(0.000)
Education		0.001		0.002***
		(0.000)		(0.000)
Employed		-0.001		0.001
		(0.003)		(0.003)
Urban		-0.013***		0.001
		(0.003)		(0.003)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	80,664	80,664	80,664	80,664
R^2	0.013	0.038	0.007	0.019

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

woman desires more sons than daughters and (2) she desires more daughters than sons. These indicators capture the relative valuation of sons and daughters, respectively.

Across all alternative measures, the findings consistently indicate that a child's sex exerts a robust influence on women's reported sex preferences. Moreover, both preference adaptation and information learning play roles in generating this effect.

7 Conclusions

This study proposes two mechanisms, preference adaptation and information learning, through which the sex of children influences parental sex preferences. First, parents may adjust their preferences based on the actual sex composition of their children, when it differs from their desired composition. Second, parents may acquire new information about the values of sons and daughters through their parenting experiences and revise their sex preferences accordingly. While both theories suggest an effect of child sex on parental sex preferences, they lead to different testable hypotheses: the preference adaptation theory posits that the effect of the first child's sex is more pronounced for parents with fewer children, whereas the information learning theory suggests that the effect of a child's sex varies with the child's birth order.

Using data from the Peruvian DHS, we examine the effect of child sex on parental sex preferences and test these hypotheses. The results show significant effects of child sex on parental sex preferences. Specifically, having daughters leads women to prefer a smaller proportion of sons and a larger proportion of daughters. Further analysis reveals that the effect of the first child's sex is significantly larger for women with only one child compared to those with multiple children, confirming the role of preference adaptation. Finally, we find that the effect of having a daughter depends on her birth order, supporting the significance of information learning in shaping parental sex preferences.

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How Does Children's Sex Affect Parental Sex Preference: Online Appendix

A Number of Children Ever Born and Ideal Family Size

In the main analysis, we demonstrate that parental sex preferences are influenced by the sex of their children due to preference adaptation and information learning. Similarly, it can be hypothesized that the ideal family size of parents can be affected by the number of children they have. This appendix investigates this possibility empirically, finding that the number of children ever born affects the ideal family size.

We begin with an ordinary-least-squares (OLS) regression to examine the correlation between the actual number of children and the ideal number of children,

$$Ideal_i = \theta_0 + \theta_1 Children_i + \theta_2 X_i + \upsilon_i, \tag{A.1}$$

where $Ideal_i$ is the ideal number of children of Women i and $Children_i$ is her number of children ever born. X is the same set of control variables as in the main text, excluding the number of children.

The results, reported in Column (1) of Table A.1, indicate a strong positive correlation between the actual number of children and the ideal number of children. On average, women with one additional child want about 0.14 more children.

This positive correlation, however, may arise because parents make fertility decisions based on their ideal family size. To examine the causal effect of the actual number of children on the ideal number of children, we employ two-stage-least-square (2SLS) regressions. The first-stage regression is,

$$Children_i = \eta_0 + \eta_1 Instrument_i + \eta_2 X_i + \xi_i, \tag{A.2}$$

where $Instrument$ is an instrumental variable for the number of children ever born. This regression predicts the actual number of children using the information from the instrumental variable. In the second stage, we regress the ideal number of children on the predicted number of children as in Equation (A.1).

The instrumental variable should satisfy two conditions. That is, it should affect the number of children ever born but should not directly affect the ideal number of children. Following the literature, we use two instrument variables. First, we consider whether the

first birth is a twin birth since twin births are an exogenous shock increasing family size (e.g., Kolk, 2015). Second, we consider whether the first two children are of the same sex, as parents are more likely to have another birth if the first two children have the same sex (e.g., Cools and Hart, 2017).

The first-stage results are presented in Table A.2. Column (1) suggests that the number of children increases by about 0.17 if the first birth is a twin birth, and Column (2) indicates that if the first two children are of the same sex, the number of children increases by about 0.05.

The second-stage results are presented in Columns (2) and (3) of Table A.1. Column (2) shows a positive effect of the number of children on the ideal number of children when we use twin birth as the instrument. However, Column (3) shows that the effect cannot be estimated precisely when we use the sex composition of the first two children as the instrument. Since 2SLS regression models provide an estimate of the local effect, the results imply that the number of children has a positive effect on the ideal number of children when the number of children increases from one to two.

Table A.1: Effect of the number of children on a woman's ideal family size

	(1)	(2)	(3)
	OLS	2SLS (twin birth)	2SLS (same-sex births)
Children ever born	0.122***	0.211*	-0.330
	(0.004)	(0.089)	(0.305)
Controls	Yes	Yes	Yes
N	112,600	112,600	82,775
R^2	0.108	-	-

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.2: Effects of twin birth and the first two children's sex on the number of children

	(1)	(2)
Twin birth	0.170***	
	(0.002)	
Same-sex births		0.045***
		(0.013)
Controls	Yes	Yes
N	112,600	82,775
R^2	0.572	0.491

Notes. Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

B Children's Sex and Men's Sex Preference

Our main analysis focuses on women since the questions about sex preference were primarily administrated to women. However, these questions were also administered to a sample of men in the 1996 survey, although the sample size was much smaller. Using this data, we examine the effects of children's sex on men's sex preferences and find that having daughters leads men to prefer a smaller proportion of sons and a larger proportion of daughters, consistent with the findings for women.

The data are prepared as follows. The sex of children is obtained from the complete history of women's birth records, which is not readily available for men. Therefore, we link each man to his partner who shares the same birth history. We focus on couples where the man and woman are currently spouses, excluding couples where either partner has previously married or cohabited with another person to avoid cases where a man might have fathered a child with another woman or a woman might have borne children with another man. Next, we exclude couples where the husband and wife report different numbers of children ever born or different numbers of living children. Finally, we exclude men with twin births, as in the analysis for women. This leaves us with a restricted sample of 705 men.

We replicate the baseline analysis for men and present the results in Tables A.3 and A.4. The findings show that having daughters leads men to prefer a smaller proportion of sons and a larger proportion of daughters. Specifically, Table A.3 indicates that if the first child is a daughter, the ideal proportion of sons will decrease by 5.9-6.6 pp, while the ideal proportion of daughters increases by 7.4-7.8 pp. Table A.4 demonstrates that if the first two children are daughters instead of sons, the ideal proportion of sons decreases by 12.5-14.7 pp, while the ideal proportion of daughters increases by 10.2-10.7 pp. These findings are in line with those for women.

Table A.3: Effect of the first child's sex on a man's sex preference

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
First-born daughter	-0.066**	-0.059*	0.078***	0.074***
	(0.025)	(0.025)	(0.021)	(0.021)
Children ever born		-0.002		0.006
		(0.009)		(0.007)
Years since first birth		-0.001		0.001
		(0.004)		(0.003)
Age		0.000		-0.004
		(0.003)		(0.003)
Education		0.000		-0.000
		(0.004)		(0.004)
Employed		0.017		-0.008
		(0.056)		(0.050)
Urban		-0.034		-0.026
		(0.039)		(0.032)
State fixed effect	No	Yes	No	Yes
N	705	705	705	705
R^2	0.017	0.087	0.030	0.114

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.4: Effect of the first two children's sex on a man's sex preference

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
Proportion of daughters	-0.147***	-0.125***	0.102***	0.107***
	(0.042)	(0.043)	(0.038)	(0.038)
Children ever born		0.004		0.004
		(0.010)		(0.008)
Years since first birth		-0.001		0.001
		(0.005)		(0.004)
Age		-0.001		-0.005
		(0.004)		(0.003)
Education		-0.000		-0.001
		(0.004)		(0.004)
Employed		0.025		0.037
		(0.079)		(0.065)
Urban		-0.003		-0.014
		(0.043)		(0.035)
State fixed effect	No	Yes	No	Yes
N	542	542	542	542
R^2	0.040	0.138	0.025	0.133

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

C Robustness Checks: Preference Adaptation

In the main text, we identify the role of preference adaption by comparing the effect of having a first-born daughter between women with only one child and those with at least two children, as shown in Equation (2). It is important to note that women in the sample may not have completed their fertility, potentially considering future children into account when adapting their preferences based on the sex of the first child.

To address this concern, we conduct two robustness checks. First, we refine our sample by including only women who have completed their fertility, i.e., those who have decided not to have additional children, those who have undergone sterilization, and those who have become infertile. We exclude women who plan to have more children or have not made a decision yet. In this restricted sample, the current number of children can be considered as final. We then repeat the analysis and present the results in Table A.5. Again, the findings show that the effect of the sex of the first child on a woman's sex preference is much smaller for those with multiple children.

Second, we examine how the effect of having a first-born daughter varies between women with different ideal numbers of children. If preference adaptation plays a role, the effect should be smaller for women with a larger ideal family size. The results, presented in Table A.6, indicate that the effect of the sex of the first child on a woman's sex preference diminishes as the ideal number of children increases. These results are consistent with those in Table 4.

Table A.5: Effect of the first child's sex on sex preference for women with different completed fertility

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
First-born daughter	-0.169***	-0.168***	0.174***	0.175***
	(0.009)	(0.009)	(0.010)	(0.010)
First-born daughter	0.122***	0.121***	-0.133***	-0.133***
× At least two children	(0.010)	(0.010)	(0.010)	(0.010)
At least two children	-0.047***	-0.045***	0.070***	0.081***
	(0.008)	(0.008)	(0.007)	(0.007)
Children ever born		-0.002*		-0.005***
		(0.001)		(0.001)
Years since first birth		0.000		0.002***
		(0.000)		(0.000)
Age		-0.000		-0.002***
		(0.000)		(0.000)
Education		0.000		0.001**
		(0.000)		(0.000)
Employed		-0.004		0.001
		(0.003)		(0.003)
Urban		-0.009**		0.002
		(0.003)		(0.003)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	76,638	76,638	76,638	76,638
R^2	0.017	0.041	0.016	0.027

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.6: Effect of the first child's sex on sex preference for women with different ideal family sizes

	Ideal proportion of sons		Ideal proportion of daughters	
	(1)	(2)	(3)	(4)
First-born daughter	-0.100***	-0.100***	0.097***	0.097***
	(0.006)	(0.006)	(0.006)	(0.006)
First-born daughter	0.015***	0.015***	-0.017***	-0.017***
× Ideal number of children	(0.002)	(0.002)	(0.002)	(0.002)
Ideal number of children	-0.004**	-0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Children ever born		-0.001		-0.003***
		(0.001)		(0.001)
Years since first birth		0.001**		0.002***
		(0.000)		(0.000)
Age		-0.001***		-0.002***
		(0.000)		(0.000)
Education		0.001**		0.002***
		(0.000)		(0.000)
Employed		-0.002		0.001
		(0.003)		(0.003)
Urban		-0.007*		0.003
		(0.003)		(0.003)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	107,560	107,560	107,560	107,560
R^2	0.014	0.038	0.011	0.022

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

D More Robustness Checks: Alternative Measures of Sex Preferences

In the previous analysis, a woman's sex preference is measured by her ideal proportions of sons and daughters. The rationale for these measures is that parents who prefer a particular sex want a larger proportion of children of that sex. However, sex preferences may manifest in different ways. In this appendix, we conduct robustness checks by using alternative measures of sex preferences. First, we measure a woman's sex preference by her minimum desire for a son and a daughter. Next, we measure it by the relative importance of sons and daughters. From these analyses, we conclude that child sex has a robust effect on a woman's sex preference.

D.1 Minimum Desire for A Son and A Daughter

Parents who prefer sons/daughters may primarily want to have at least one son/daughter, but may not care much about the proportion of sons/daughters as long as they have one son/daughter. In this subsection, we measure a woman's sex preference with three dummy variables indicating (1) that the woman wants at least one son, (2) that she wants at least one daughter, and (3) that she wants at least one child of each sex. The first two variables capture the woman's preference for a son and a daughter, respectively, and the third variable reflects whether she differentiates between sons and daughters. We then repeat the analyses in Tables 2-5. The results are presented in Tables A.7- A.10.

Table A.7 shows that compared to women with a first-born son, women with a first-born daughter are 5.1 pp less likely to want at least one son, 3.0 pp more likely to want at least one daughter, and 1.2 pp less likely to want at least one child of each sex. Table A.8 shows a similar pattern: the proportion of daughters among the first two children decreases the desire for at least one son, increases the desire for at least one daughter, and decreases the desire for at least one child of each sex. Overall, the results provide further evidence that having a daughter affects a woman's sex preference.

Table A.9 shows that having a first-born daughter decreases the likelihood that a woman wants at least one son and increases the likelihood that she wants at least one daughter. However, these effects are much smaller for women with at least two children compared to those with only one child. These results provide additional evidence that preference adaptation plays a role when child sex affects a woman's sex preference. Table

A.10 suggests that, compared to having a first-born son and a second-born daughter, having a first-born daughter and a second-born son has a larger effect on the likelihood that the mother wants at least one daughter. The results provide further evidence that information learning is important for child sex to affect the mother's sex preference.

Table A.7: Effect of the first child's sex on a woman's sex preference (minimum desire for sons and daughters)

	Want at least one son		Want at least one daughter		Want at least one child of each sex	
	(1)	(2)	(3)	(4)	(5)	(6)
First-born daughter	-0.051***	-0.051***	0.029***	0.030***	-0.012**	-0.012**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Children ever born		0.003*		0.001		0.008***
		(0.001)		(0.001)		(0.001)
Years since first birth		0.003***		0.004***		0.003***
		(0.001)		(0.001)		(0.001)
Age		-0.002***		-0.003***		-0.002**
		(0.001)		(0.000)		(0.001)
Education		0.003***		0.004***		0.005***
		(0.001)		(0.001)		(0.001)
Employed		-0.007		-0.002		-0.008
		(0.004)		(0.004)		(0.004)
Urban		-0.012*		-0.003		-0.012*
		(0.005)		(0.005)		(0.005)
State fixed effect	No	Yes	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes	No	Yes
N	107,560	107,560	107,560	107,560	107,560	107,560
R^2	0.003	0.026	0.001	0.019	0.000	0.018

Notes: Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.8: Effect of the first two children's sex on a woman's sex preference (minimum desire for sons and daughters)

	Want at least one son		Want at least one daughter		Want at least one child of each sex	
	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of daughters	-0.066***	-0.066***	0.010	0.010	-0.030***	-0.030***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Children ever born		-0.000		-0.003		0.003*
		(0.001)		(0.001)		(0.002)
Years since first birth		0.001		0.002***		0.001
		(0.001)		(0.001)		(0.001)
Age		-0.000		-0.001*		0.000
		(0.001)		(0.001)		(0.001)
Education		0.002***		0.003***		0.003***
		(0.001)		(0.001)		(0.001)
Employed		-0.004		-0.002		-0.006
		(0.005)		(0.005)		(0.005)
Urban		-0.023***		-0.013*		-0.024***
		(0.005)		(0.005)		(0.005)
State fixed effect	No	Yes	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes	No	Yes
N	80,664	80,664	80,664	80,664	80,664	80,664
R^2	0.003	0.027	0.000	0.019	0.001	0.021

Notes: Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.9: Effect of the first child's sex on sex preference with different numbers of children (minimum desire for a son and a daughter)

	Want at least one son		Want at least one daughter		Want at least one child of each sex	
	(1)	(2)	(3)	(4)	(5)	(6)
First-born daughter	-0.092***	-0.091***	0.068***	0.069***	-0.015	-0.014
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
First-born daughter	0.056***	0.054***	-0.052***	-0.054***	0.004	0.003
× At least two children	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
At least two children	-0.001	-0.013	0.051***	0.045***	0.043***	0.020**
	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.008)
Children ever born		0.002		-0.000		0.006***
		(0.001)		(0.001)		(0.001)
Years since first birth		0.002***		0.003***		0.002***
		(0.001)		(0.001)		(0.001)
Age		-0.002***		-0.003***		-0.002**
		(0.001)		(0.000)		(0.001)
Education		0.003***		0.004***		0.005***
		(0.001)		(0.001)		(0.001)
Employed		-0.007		-0.002		-0.008
		(0.004)		(0.004)		(0.004)
Urban		-0.011*		-0.003		-0.012*
		(0.005)		(0.005)		(0.005)
State fixed effect	No	Yes	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes	No	Yes
N	107,560	107,560	107,560	107,560	107,560	107,560
R^2	0.004	0.027	0.002	0.020	0.002	0.019

Notes: Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.10: Effects of the first two children's sex and birth order on a woman's sex preference (minimum desire for a son and a daughter)

	Want at least one son		Want at least one daughter		Want at least one child of each sex	
	(1)	(2)	(3)	(4)	(5)	(6)
Daughter-Son	-0.007	-0.007	0.021***	0.021***	0.007	0.007
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Son-Son	0.017**	0.017**	0.002	0.002	-0.010	-0.010
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Daughter-Daughter	-0.049***	-0.049***	0.012*	0.013*	-0.041***	-0.041***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Children ever born		-0.000		-0.002		0.003*
		(0.001)		(0.001)		(0.002)
Years since first birth		0.001		0.002***		0.001
		(0.001)		(0.001)		(0.001)
Age		-0.000		-0.001*		0.000
		(0.001)		(0.001)		(0.001)
Education		0.002***		0.003***		0.003***
		(0.001)		(0.001)		(0.001)
Employed		-0.004		-0.002		-0.006
		(0.005)		(0.005)		(0.005)
Urban		-0.023***		-0.013*		-0.024***
		(0.005)		(0.005)		(0.005)
State fixed effect	No	Yes	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes	No	Yes
N	80,664	80,664	80,664	80,664	80,664	80,664
R^2	0.003	0.028	0.000	0.020	0.001	0.022

Notes: Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

D.2 Relative Importance of Sons and Daughters

In this subsection, we measure a woman's sex preference with two dummy variables indicating (1) that the woman wants more sons than daughters and (2) that she wants more daughters than sons, respectively. The former captures the relative importance of sons among the children, while the latter captures the relative importance of daughters. We then repeat the analyses in Tables 2-5. The results are presented in Tables A.11-A.14.

Table A.11 shows that having a first-born daughter decreases the probability that a woman wants more sons than daughters by 8.8 pp and increases the probability that she wants more daughters than sons by 8.6 pp. Table A.12 shows that if the first two children are both daughters rather than both sons, the probability that the woman wants more sons than daughters decreases by 15.0 pp, and the probability that she wants more daughters than sons increases by 13.6 pp. Again, the results suggest that having daughters leads women to prefer daughters.

Table A.13 shows that having a first-born daughter decreases the likelihood that a woman wants more sons than daughters and increases the likelihood that she wants more daughters than sons. However, these effects are smaller for women with at least two children compared to those with only one child. These results provide additional evidence that preference adaptation plays a role when child sex affects a woman's sex preference. Table A.14 indicates that, compared to having a first-born son and a second-born daughter, having a first-born daughter and a second-born son has a larger negative effect on the likelihood that the mother wants more sons than daughters and a larger positive effect on the likelihood that she wants more daughters than sons. These results provide further evidence that information learning is crucial for child sex to affect the mother's sex preference.

Table A.11: Effect of the first child's sex on a woman's sex preference (relative importance of sons and daughters)

	Want more sons than daughters		Want more daughters than sons	
	(1)	(2)	(3)	(4)
First-born daughter	-0.088***	-0.088***	0.086***	0.086***
	(0.003)	(0.003)	(0.003)	(0.003)
Children ever born		0.001		-0.005***
		(0.001)		(0.001)
Years since first birth		0.000		0.002***
		(0.000)		(0.000)
Age		-0.000		-0.001
		(0.000)		(0.000)
Education		-0.001*		0.000
		(0.000)		(0.000)
Employed		0.004		0.006
		(0.003)		(0.003)
Urban		-0.014***		0.004
		(0.003)		(0.004)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	107,560	107,560	107,560	107,560
R^2	0.017	0.029	0.015	0.018

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.12: Effect of the first two children's sex on a woman's sex preference (relative importance of sons and daughters)

	Want more sons than daughters		Want more daughters than sons	
	(1)	(2)	(3)	(4)
Proportion of daughters	-0.150***	-0.150***	0.136***	0.136***
	(0.005)	(0.005)	(0.005)	(0.005)
Children ever born		0.001		-0.006***
		(0.001)		(0.001)
Years since first birth		-0.000		0.001*
		(0.001)		(0.001)
Age		-0.000		-0.000
		(0.000)		(0.000)
Education		-0.001		0.001
		(0.000)		(0.000)
Employed		0.003		0.004
		(0.004)		(0.004)
Urban		-0.016***		0.008
		(0.004)		(0.004)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	80,664	80,664	80,664	80,664
R^2	0.024	0.035	0.018	0.022

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.13: Effect of the first child's sex on sex preference with different numbers of children (relative importance of sons and daughters)

	Want more sons than daughters		Want more daughters than sons	
	(1)	(2)	(3)	(4)
First-born daughter	-0.101***	-0.100***	0.110***	0.110***
	(0.005)	(0.005)	(0.006)	(0.006)
First-born daughter	0.017**	0.017**	-0.032***	-0.033***
× At least two children	(0.006)	(0.006)	(0.007)	(0.007)
At least two children	0.017***	0.012*	0.034***	0.043***
	(0.005)	(0.006)	(0.004)	(0.004)
Children ever born		-0.000		-0.007***
		(0.001)		(0.001)
Years since first birth		0.000		0.001**
		(0.000)		(0.000)
Age		-0.000		-0.001
		(0.000)		(0.000)
Education		-0.001*		0.000
		(0.000)		(0.000)
Employed		0.004		0.007*
		(0.003)		(0.003)
Urban		-0.014***		0.004
		(0.003)		(0.004)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	107,560	107,560	107,560	107,560
R^2	0.018	0.029	0.016	0.019

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.14: Effects of the first two children's sex and birth order on a woman's sex preference (relative importance of sons and daughters)

	Want more sons than daughters		Want more daughters than sons	
	(1)	(2)	(3)	(4)
Daughter-Son	-0.017***	-0.017***	0.019***	0.019***
	(0.004)	(0.004)	(0.005)	(0.005)
Son-Son	0.105***	0.105***	-0.022***	-0.022***
	(0.005)	(0.005)	(0.004)	(0.004)
Daughter-Daughter	-0.044***	-0.044***	0.116***	0.116***
	(0.004)	(0.004)	(0.005)	(0.005)
Children ever born		0.001		-0.006***
		(0.001)		(0.001)
Years since first birth		-0.000		0.001*
		(0.001)		(0.001)
Age		-0.000		-0.000
		(0.000)		(0.000)
Education		-0.001		0.001
		(0.000)		(0.000)
Employed		0.003		0.004
		(0.004)		(0.004)
Urban		-0.016***		0.007
		(0.004)		(0.004)
State fixed effect	No	Yes	No	Yes
Year of interview fixed effect	No	Yes	No	Yes
N	80,664	80,664	80,664	80,664
R^2	0.027	0.039	0.022	0.025

Notes. Numbers in parentheses are standard errors. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

References

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