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## Whether to have a second child or not? An integrative approach to women's reproductive decision-making in current China

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## ABSTRACT

The transition to low fertility worldwide has led to introduction of diverse frameworks across disciplines to understand its causes and consequences. Previous attempts to compare the relative importance of the key factors influencing women's fertility decision-making largely focused on a single rather than multiple steps of decision-making—an important problem if different factors are associated with different steps. Furthermore, insufficient attention has been paid explicitly to husband's and already-born children's influences, two potentially important factors. Here we introduce a framework covering three steps of reproductive decision-making—ideal family size, fertility desire and fertility intention—and test it using multi-level survey data collected from Chinese one-child mothers. Mother's attitudes towards having two children were paramount factors underlying her ideal family size, and husband's and the firstborn child's attitudes were critical to her desire to have a second child, which in turn played a decisive role in her intention to have a second child. Although husband's attitude was related to all steps, most factors were only relevant to one step; e.g., perceived child mortality and value for old-age security predicted ideal family size, admiration—a prerequisite for social learning—for two-child families predicted fertility desire, and physical/economic constraints primarily predicted fertility intention. Our study emphasizes multiple decision-makers in family reproduction; indicates the relative importance of fertility-influencing factors could vary with steps of decision-making; and has important implications for population policy in low-fertility societies.

### 1. Introduction

The global demographic transition to low fertility is a major event in human demographic history (Livi-Bacci, 2012). Currently, although the vast majority of couples want to have at least one child, many of those with one child would not have another one, which is a leading reason for a fertility rate far below population replacement level in many developed countries and rising economies such as China (Bongaarts, 1998; Kohler, Billari, & Ortega, 2002; Peng, 2011; UN DESA Population Division, 2015). Different frameworks have been raised to explain fertility limitation in the disciplines such as biological anthropology and demography. In recent years, increasing interest has been paid to comparing these frameworks (Huinink, Kohli, & Ehrhardt, 2015; Shenk, Towner, Kress, & Alam, 2013): mortality/uncertainty model—how the reproductive decisions respond to child mortality; investment/economic model—how parents trade off number of children against investment in each child under given constraints; cultural model—how norms or behaviors of important members in social network influence

one's fertility decision-making; value of children model—children's benefits and costs to one's economic and psychological wellbeing (a more detailed account of the economic aspect is given by the wealth-flow framework (Caldwell, 2005)); Bongaarts's model—how postponement of childbearing, involuntary infertility and competing preferences (e.g., work-family conflict) bring low fertility through causing a gap between fertility preference and behavior (Bongaarts, 2001).

The previous attempts to compare the above frameworks developed in different fields to understand drivers of the fertility transition have led to mixed conclusions. In recent years, demographers have focused their comparisons on fertility intention, based on the theory of planned behavior in social psychology (Ajzen, 1991; for a parallel framework, see Coale, 1973). The studies using the widely-cited Gender and Generations Survey data indicated the relative importance of attitudes towards value of children and norms from social network in influencing the decision-making about having a second child varied across geographic areas. For instance, attitudes in terms of individually perceived or expected costs and benefits of childbearing constituted the major

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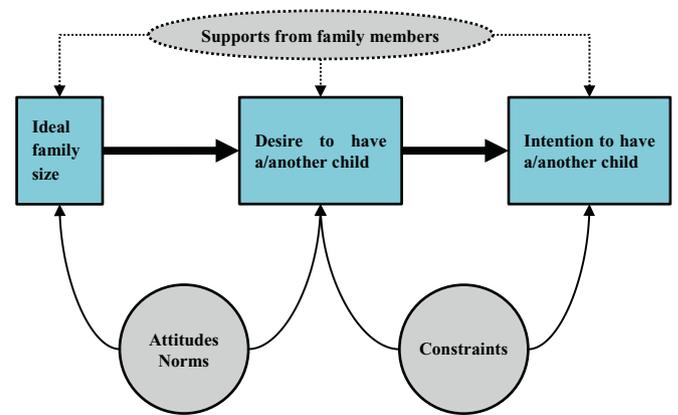
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factor influencing the intention to have a second child in Bulgaria and France; by contrast, norms in terms of the likelihood of important others in social network approving or disapproving one's behavior took the lead in Germany and Norway (Billari, Philipov, & Testa, 2009; Dommermutha, Klobas, & Lappegard, 2011; Klobas, 2010). Economic constraints generally had the least effect. In these demographic studies on fertility intention, child mortality received little attention, which was in clear contrast to the traditional demographic transition model where fertility-mortality relationship was the key focus (Coale, 1986). The comparative analyses of fertility limitation in biological anthropology have focused on fertility behaviors and related ecological constraints; scant attention has been paid to the decision-making process linking constraints and behaviors (McAllister, Pepper, Virgo, & Coall, 2016). Based on survey data from Bangladesh, Shenk et al. (2013) showed economic/investment, child mortality, and cultural transmission factors—e.g., general fertility rate of others in one's social-network—were all significant in predicting fertility, with the economic factors being the most important. The result was corroborated by a study using survey data from Bolivia: investment in one's own and child education were more important than the average fertility level in one's social network in influencing lifetime fertility (Snopkowski & Kaplan, 2014).

Despite such findings, some important issues have not been addressed in the previous empirical comparative analyses of factors influencing fertility. First, they largely focused on a single step or outcome (i.e. behavior) of decision-making and thus, failed to check whether the influence of a given factor may vary with different steps of decision-making. Fertility behavior is the outcome of several different decision-making steps. What is the best or ideal number of children to have? Does one want to have a/another child? Is one going to have a/another child? To understand the final fertility outcome, we need to understand the different steps and the relative importance of key factors at each step. An empirical study based on American survey data found that infertility condition had contrasting effects on desire and plan to have a child (Shreffler et al., 2016). Second, although possible sexual conflict over reproductive decisions has been noticed (Borgerhoff Mulder, 2009; Mace & Collieran, 2009; Morita, Ohtsuki, & Hiraiwa-Hasegawa, 2016; Moya, Snopkowski, & Sear, 2016; Park, Cho, & Choi, 2010; Testa, 2012; Thomson, McDonald, & Bumpass, 1990), not many comparative analyses considered explicitly this factor. This conflict refers to husband-wife conflict over attitudes towards having another child, as well as division of housework including childcare, a question of paternal investment in evolutionary terms or gender equity within family in demographic terms (McDonald, 2013; Trivers, 1985). Third, almost none of the previous comparative studies considered possible influence from already-born children on maternal decision to have another child. The parent-offspring conflict theory in evolutionary biology suggests that a child might oppose his/her parents to have another offspring: having a sibling would lead to share of parental investment (Trivers, 1974), but the already-born children growing up in a context of very few siblings may have not become accustomed to such a sharing (Lutz, Skirbekk, & Testa, 2006). If there is any opposition, it could influence parental reproductive strategy (Liu, Duan, & Lummaa, 2017).

To address these issues, we introduce a framework to analyze the three-step decision-making about having a second child among one-child mothers, the key point in understanding low fertility in modern societies (Harknett, Billari, & Medalia, 2014; Kohler et al., 2002). We then test our framework using data collected from a survey in China, where after 30 years of one-child policy (Gu, Wang, Guo, & Zhang, 2007; Mattison, Moya, Reynolds, & Towner, 2018; Peng, 2011), the two-child policy has been implemented—initially selectively and then universally—since 2014 and now, people's fertility decision-making displays a similar pattern as that in other low-fertility societies, especially East Asian ones (Bao, Chen, & Zheng, 2017; Peng, Li, Song, & Tian, 2015). Our survey covers multiple levels of factors—individual vs.



**Fig. 1.** The conceptual framework of reproductive decision-making and its influencing factors. Rectangles of the three steps of decision-making are in greenish-blue color and those of influencing factors are in light gray color. The dashed oval depicts the generally neglected supports from family members including husband, the already-born children and possibly grandparents (note: in the case of decision-making about having the first child, the support from “already-born children” will be null). Here, attitudes—perception of values of children, child mortality, etc. Constraints—work-family conflict, economic pressure in raising children, physical suitability for having a/another child, etc. Norms may be either in injunctive form—approval or disapproval of one's fertility choice by non-family social network—or in descriptive form such as family size of friends/colleagues/neighbors. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

family vs. social network vs. institutional/social factors—that are relevant to major frameworks about fertility limitation and thus, allows us to compare more systematically the relative importance of factors influencing women's reproductive decision-making at each step. Finally, some population policy implications are discussed based on the results.

## 2. Conceptual framework

Our conceptual framework depicts how various factors influence the three steps of fertility decision-making ranked by their distances from actual fertility behavior: ideal family size, fertility desire and fertility intention (Fig. 1). It was constructed starting from the previous frameworks, especially Ajzen's theory of planned behavior and Miller's trait-desire-intention-behavior model (Ajzen, 1991; Miller, 1994). In theory construction, we took the issues mentioned above into account and also conducted a qualitative field study consisting of 13 semi-structured interviews to learn about women's logic behind reproductive decision-making.

Ideal family size is a psychological disposition, i.e. relatively stable emotion, representing one's attitude towards the best number of children to have when he/she focuses on the benefits—in other words, without considering the practical costs or constraints—of having such children. It has been an important social and demographic indicator for decades (Blake, 1966; Hagen & Morgan, 2005; Lutz et al., 2006). Fertility desire is a psychological state—i.e. emotional change triggered by relevant fertility dispositions and given situations—that represents what one explicitly wishes or wants to do regarding childbearing, i.e. childbearing goals or objectives. Fertility intention is a psychological state that represents what one actually plans to do regarding childbearing, i.e. a fertility decision. To some extent, the decision can be seen as a result from evaluating practicability of the fertility desire. Thus, fertility intention differs from fertility desire in that it takes more constraints into account and is relevant to commitment (Miller, 1994); if the possibility of fulfilling some reproductive goal is not high, one might still have a desire to do so, but it is unlikely for him/her to have

an intention to do so.

As a global measurement of attitude towards childbearing, ideal family size is affected by specific attitudes towards having a/another child (including perceived child mortality risk), fertility norms in one's non-family social network, and support from family members including husband, already-born children and possibly grandparents. It is worth noting evolutionary demographers generally focus on descriptive norms like actual reproductive behavior of relatives (e.g., Collieran & Mace, 2015), while social psychologists and demographers following their frameworks generally focus on injunctive norms like others' approval or disapproval of one's fertility choice (e.g., Billari et al., 2009; Klobas, 2010). Among the three indicators of reproductive decision-making, ideal family size is least associated with practical and estimable constraints like economic pressure in raising children, as it reflects the number of children people would like to have if they lived under a condition without practical constraints or norm pressures (Blake, 1966; Moya et al., 2016; Sobotka & Beaujouan, 2014). In our qualitative interviews, eleven mothers thought it was better to have two children in a family, one mother thought of having one child as ideal and the last one thought of having 1–2 children as ideal.

Fertility desire is influenced by ideal family size and factors mentioned above, and also more or less by constraints, especially the most urgent ones (Gray, Evans, & Reimondos, 2013), and fertility intention is affected by fertility desire, constraints far and near, and within-family support. Thus, support from family members (e.g., emotional and instrumental support) is assumed to influence each step of reproductive decision-making: on the one hand, such support is a norm around the focal women; on the other hand, it means a kind of constraint on women's decisions. This treatment is somewhat different from those studies treating emotional support from family members just as a kind of norm. Our qualitative interviews indicated that attitude and norm factors may not have direct influence on fertility intention. Among the 13 interviewed mothers, three had both a desire and an intention to reproduce again, six had neither a desire nor an intention, two had a desire but an uncertain intention, and finally, two had a desire but no intention. The last three types of mothers emphasized the restriction of their physical status or other constraints on their plan to have a second child, e.g., “surely, having two children is good/ideal, but in reality, it's hard to have two children”.

Fertility behavior is not included in the framework, as it is the outcome but not a process of fertility decision-making. However, a series of propositions about fertility behavior can be proposed as a natural extension of the above framework; some of them have been tested by previous studies. First, although parity-specific fertility intention has relatively high validity in predicting fertility behavior (Harknett et al., 2014; Schoen, Astone, Kim, Nathanson, & Fields, 1999), there is still some distance between them, and fertility behavior is more closely linked with practical constraints than intention, which is mainly associated with perceived constraints (for perceived vs. actual behavioral control or constrains, see Ajzen, 1991). Second, both to have and not to have a/another child can be one's ideal/desire/intention; in the latter sense, constraints such as unavailability or ineffective contraception are responsible for unwanted or unintended pregnancy (Bongaarts, 2001). The discussion also applies to husband-wife and parent-offspring conflicts over the fertility desire. Third, given the time interval between decision-making and actual behavior, change of determinants of reproductive decision-making along one's life course would change decision-making result and the consequent behavior (Liefbroer, 2009). Thus, a generalized framework about reproductive decision-making and behavior is warranted to take time factors—parity, life course/history, etc.—into account, a consideration relevant to both quantum and tempo, i.e. level and timing, of fertility.

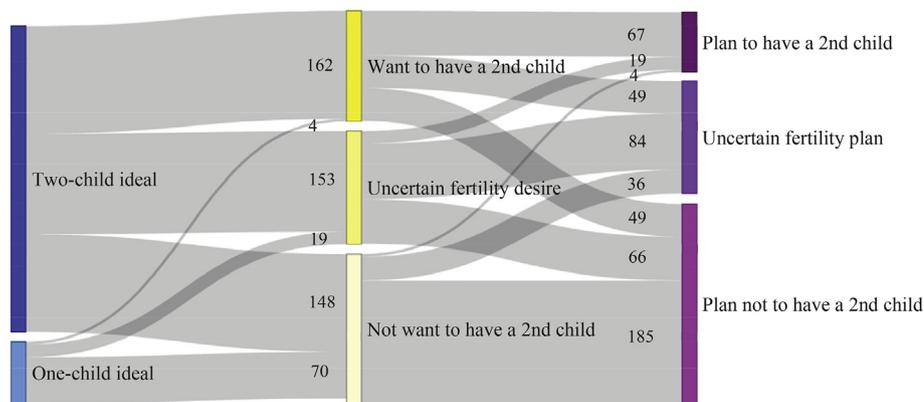
### 3. Material and methods

#### 3.1. Survey data

From October of 2015 to January of 2016, we tried a probability sampling survey in seven rural and urban districts of Xi'an metropolitan area, Shaanxi Province of China, an area with a fertility rate slightly lower than the average rate across China (Bureau of Statistics and Office for the Sixth Population Census of Shaanxi Province, 2012). By the time of survey, respondents already knew that the country decided to implement two-child policy and they were allowed to have two children; thus, their answers reflected their true reproductive decision-making without restriction of the one-child policy. In the practical multi-stage sampling, the original random selection procedure was adjusted somewhat: streets and communities within a district were selected randomly, but mothers with one child in communities were selected by quota sampling. The Supplementary Note S1 gives more details on sampling. In total, 1183 reproductive-aged mothers—aged 20–44 years—were sampled and 570 of them contributed to an effective questionnaire; at the time of survey, none of these effective respondents were pregnant with or had produced the second child. The survey-based forecast of total second births for 2016 that was made at the beginning of the year had an error roughly at 5%, compared to the actual birth registers counted by the end of 2016 (unpublished consulting report to Xi'an Municipal Government, titled “Xi'an fertility survey & two-child policy implementation report 2015”). Thus, the survey gave a relatively accurate estimation of reproductive decisions among one-child mothers in the metropolitan area.

In the questionnaire, the reproductive decision-making questions asked were: 1) ideal family size, ‘in your eyes, what is an ideal number of children for a family in current China?’ 2) fertility desire, ‘do you want to have a second child?’ and 3) fertility intention, ‘do you have a plan to have a second child?’ The answer to question 1 was a number: 1, 2, etc. The available answers to questions 2 and 3 were ‘yes’, ‘neutral/uncertain’ and ‘no’ (note: the 3-point desire item was collapsed from the original 5-point item, as quite a few interviewees felt confused to differentiate “do not want particularly” from “do not want at all”). Fig. 2 depicts the flow of surveyed women along each step of decision-making; the figure was produced by the statistical package “networkD3” run on R (Allaire, Gandrud, Russell, & Yetman, 2017; RCore Team, 2016).

The questions on predictors used in regression models covered the levels of individual, family, social network and bigger social environments: 1) Mother's individual background factors (family annual income, own and husband's occupation and education, mother's age, and gender of the firstborn child); 2) mother's individual attitudes towards having a second child (value-of-children factors, i.e. perception of loneliness of an only child—e.g., being short of playmates now and in the near future and being left alone and helpless in caring for aged parents in the far future—and the benefit of having another child to old-age security; perception of child mortality or the risk of death of only child); 3) support from family members (emotional support—husband's and firstborn's attitudes to having a second child, i.e. whether husband and the firstborn child supported to have a second child in mother's eye; instrumental support—husband's share of housework; grandparental influence—a composite item about grandparental attitude to having a second child and whether they can provide childcare help, a possible factor promoting higher fertility (Lahdenperä, Lummaa, Helle, Tremblay, & Russell, 2004)); 4) cultural transmission factors (rural-versus-urban settlement; mother's own and husband's number of siblings; mother's estimate of the average number of children of relatives/friends/neighbors; sharing of information about the second child via social media app like *weixin* by members in non-family social network; admiration for two-child families in one's social network, presumably a prerequisite for social learning (Onu, Kessler, & Smith, 2016)); 5) individual and institutional/social constraints (mother's perception of



**Fig. 2.** The flow of one-child mothers along reproductive decision-making steps. There were two nodes on fertility ideal, e.g. “two-child ideal” meant that a mother thought it better to have two children. There were three nodes on fertility desire: “want to have a 2nd child”; “uncertain fertility desire”; “do not want to have a 2nd child”. There were three nodes on fertility intention: “plan to have a 2nd child”; “uncertain fertility plan”; “plan not to have a 2nd child”. The number on a link between two nodes represented flow quantity of mothers. Due to missing data, sample size varied across fertility ideal, desire and intention.

work-family conflict; pressure in raising two children, somewhat an investment factor—many interviewed mothers mentioned the pressure in assuring living and education quality of children; physical suitability for having another child; and kindergarten crunch, i.e. difficulty with small children to enter a quality kindergarten).

In this survey, although we did not ask husband and offspring directly about their attitude towards having a second child, wife's perception of husband's attitude has been shown to be generally consistent with husband's actual attitude in previous studies (Miller, 1994). Additionally, according to the theory of planned behavior, wife's perception of their attitude could be more directly relevant to her reproductive decision-making (Ajzen, 1991; Shreffler et al., 2016). It is worth noting that the firstborn children of the surveyed mothers were on average 6.58 years old; some of them were too little to communicate their attitude towards having a second child (most of the “not-asked” answers corresponded to an age below two years in the firstborn child; Table 1).

Table 1 shows the descriptive statistics of all variables.

### 3.2. Statistical methods

To compare the relative importance of each group of predictors, all of the above mentioned five groups of predictors were included in each base/global model predicting one of three steps of reproductive decision-making. Multi-collinearity was checked using variance inflation factor, which was ensured to be below 5 for each predictor. Goodness of fit of each global model was measured by both McFadden's  $\rho^2$ —i.e. explained proportion of deviance in the null model; for binomial/multinomial data, a 0.2–0.4  $\rho^2$  suggested tentatively a sound fitting model with no major predictors omitted (Domencich & McFadden, 1975)—and the proportion of correct prediction of (categorical) response variable by the model.

In the analysis of women's ideal family size, the response variable was ideal number of children, coded as a binary variable (0 for “one” and 1 for “two or three”). Only three mothers thought having three children was ideal, so we combined “two children” with “three children” to form a category “two or three” and conducted a logistic regression analysis of ideal family size. The effective sample size for the global model was smaller than 570 due to missing values either on predictors or on the response variable for some subjects; the same case applied for the following two analyses.

In the analysis of women's fertility desire, the response variable was the desire to have a second child, an ordinal variable with 3 levels (‘do not want to have a second child’, ‘neutral/uncertain’ and ‘want to have a second child’). We conducted an ordered logistic regression model using the statistical package “ordinal” run on R (Christensen, 2015). The model had the form:  $\text{logit}[P(Y \leq j)] = \theta_j - \sum \beta_i x_i + \epsilon$ . Here,  $j$  took values of 1, 2, ...,  $J-1$ ;  $J$  is the number of categories of ordinal response variable (in this study,  $J = 3$ ).  $P(Y \leq j)$  was the cumulative probability of occurrence of  $Y$  up to  $j$ .  $\theta_j$  was  $j$ -specific intercept.  $\beta_i$  was the

regression coefficient of the  $i$ th regressor. Ideal family size and all the five groups of predictors were included in the global model.

In the ordered logistic regression analysis of women's fertility intention, the response variable was the intention to have a second child, an ordinal variable with three levels (‘do not plan to have a second child’, ‘neutral/uncertain’ and ‘plan to have a second child’). The five groups of predictors, ideal family size and fertility desire were included in the model. Given the strong possibility that the same fertility desire had different effect on fertility intention under different degrees of constraints (e.g., Shreffler et al., 2016), interactions between fertility desire and constraints (e.g., physical suitability for reproducing again) as well as family support (also a kind of constraint) were included in the initial global model. AIC-based model comparison indicated that only the interaction between fertility desire and physical suitability for having a second child should be retained; removal of other interaction terms would lead to either the same or a lower AIC<sub>c</sub> and thus, was justified from the perspective of information theory (see below for more details).

Relative importance of given predictor(s) in the multi-level predictor set was evaluated using an information- or likelihood-based method (Burnham & Anderson, 2002; Colleran & Mace, 2015; Mazerolle, 2017); we did not conduct an evaluation based on standardizing variables, as a few key categorical variables were not ordinal. The procedure was as follows: 1) a global model was established; 2) a given predictor or group of predictors were removed from the global model to get a simplified model; 3) the difference in corrected AIC value (i.e.  $\Delta\text{AIC}_c = \text{AIC}_{c,\text{simplified}} - \text{AIC}_{c,\text{global}}$ ) was taken as the criterion for evaluating relative importance. If the  $\Delta\text{AIC}_c$  was negative, the removed predictor(s) was not important, as including it in the global model led to even a larger distance between model and reality; if the  $\Delta\text{AIC}_c$  was positive, the removed predictor(s) was important, especially when  $\Delta\text{AIC}_c \geq 2$ . The larger the  $\Delta\text{AIC}_c$ , the larger the distance between model and reality caused by removing predictor(s), and therefore the more important was the predictor(s) in predicting the response variable. The above process helped to evaluate which predictor(s) in the global model was not important in predicting the response variable and thus, helped to test the conceptual framework directly. We did not calculate further the so-called relative-importance index based on  $\Delta\text{AIC}_c$ , as this index has the property of low resolution: when two significant variables A and B have similar relative-importance indices, the model without A might be much more likely than that without B and vice versa (Shenk et al., 2013).

## 4. Results

Fig. 2 shows the fertility ideal, desire and intention among mothers already with one child. About five in six of the interviewed mothers with one child thought having two or three—the latter case had only three mothers—children was ideal; others thought having one child was

**Table 1**  
Descriptive statistics of response and predictor variables used in global models.

Group of variables	Variables	Sample size	Mean	Standard error	
Response variables	Ideal number of children <sup>a</sup>	558			
	One		0.167	0.016	
	Two or three		0.833	0.016	
	Do you desire to have a second child?	568			
			Yes	0.292	0.019
			Neutral/uncertain	0.31	0.019
	Do you have a plan to reproduce a second child?	560			
			No	0.398	0.021
			Yes	0.161	0.016
	Predictors: background factors	Neutral/uncertain		0.304	0.019
		No		0.536	0.021
		Mother's age <sup>b</sup>	562	32.759	0.267
Gender of the firstborn		568			
			Son	0.53	0.021
Daughter			0.47	0.021	
Mother's occupation <sup>c</sup>		570			
			Time-wise inflexible job	0.298	0.019
			Time-wise flexible job	0.386	0.02
Housewife			0.249	0.018	
Other jobs			0.067	0.01	
Mother's education <sup>d</sup>		566			
			Pre-college level	0.516	0.021
			College/graduate level	0.484	0.021
Husband's occupation		568			
			Time-wise inflexible job	0.477	0.021
			Time-wise flexible job	0.38	0.02
Workless			0.055	0.01	
Other jobs			0.088	0.012	
Husband's education		555			
			Pre-college level	0.519	0.021
	College level		0.398	0.021	
Graduate level		0.083	0.012		
Family annual income in the last year <sup>e</sup>	562				
		Low income	0.496	0.021	
		Middle income	0.288	0.019	
High income		0.215	0.017		
Predictors: Individual reproductive attitudes	Do you think the only child is lonely?	569			
	Yes		0.859	0.015	
	No		0.141	0.015	
	Do you think having two children is beneficial to your old age security?	568			
	Yes		0.597	0.021	
	No		0.403	0.021	
	Do you think there is any risk with losing the only child?	565			
	No		0.377	0.02	
	Yes		0.623	0.02	
Predictors: Family support factors	Husband's attitude to having a second child <sup>f</sup>	566			
	Supportive		0.318	0.02	
	Neutral		0.35	0.02	
	Not supportive		0.332	0.02	
	Firstborn's attitude to having a second child <sup>g</sup>	567			
	Supportive		0.268	0.019	
	Conservative		0.295	0.019	
Not asked	0.437		0.021		

Group of predictors	Predictors	Sample size	Mean	Standard error	
Predictors: Family support factors	Is your fertility decision-making influenced by your parents or parents-in-law?	568			
	Yes		0.153	0.015	
	No		0.847	0.015	
	Husband's share of housework	565			
			More than half	0.088	0.012
Half			0.227	0.018	
Less than half		0.685	0.02		
Predictors: Social-network factors	Family settlement	570			
	Rural		0.311	0.019	
	Urban		0.689	0.019	
	Mother's number of siblings <sup>h</sup>	568	1.526	0.054	
	Husband's number of siblings	560	1.614	0.056	
	Number of children of relatives <sup>i</sup>	570			
			One child	0.647	0.02
Two children			0.204	0.017	
Uncertain		0.149	0.015		
Number of children of friends	568				

(continued on next page)

Table 1 (continued)

Group of predictors	Predictors	Sample size	Mean	Standard error
Predictors: constraint factors	One child	568	0.796	0.017
	Two children		0.144	0.015
	Uncertain		0.06	0.01
	Number of children of community neighbors	566	0.71	0.019
	One child		0.178	0.016
	Two children		0.113	0.013
	Have you seen relatives/friends/neighbors share information about their second child, e.g., via <i>weixin</i> ? <sup>j</sup>	567	0.246	0.018
	Yes, frequently		0.491	0.021
	Yes, but only occasionally		0.263	0.019
	Do you admire two-child families?	561	0.577	0.021
	Yes		0.423	0.021
	No		0.677	0.02
	Do you or your doctor think you are suitable for having another child?	569	0.323	0.02
	Yes		0.077	0.011
	No		0.392	0.02
	In your eyes, how will having a second child affect your career development?	570	0.276	0.019
	Positively		0.255	0.018
	Neutrally		0.132	0.014
	Negatively	560	0.314	0.019
	N/A (housewife)		0.554	0.021
	Do you think there will be any pressure in parenting two children?		0.332	0.02
	No	560	0.288	0.019
	Possible		0.38	0.021
	Definite			
	Do you think it is easy for small children to enter a kindergarten nowadays?	560	0.332	0.02
	Yes		0.288	0.019
	Neutral/uncertain		0.38	0.021
No				

Notes. a) For each categorical variable, statistics referred to proportions of categories of the variable—the sum of proportions was 1—and standard errors of the proportions. b) For each continuous variable, statistics referred to mean and standard error. c) Mother's occupation, timewise inflexible job—job with fixed office hours (according to national occupation classification). d) Mother's education, pre-college level—education terminated before entering a college or university; college and graduate levels were combined, as only 20 mothers entered a graduate school. e) Family annual income, low income—an income below 40 thousand Chinese Yuan a year; middle income—an income between 40 and 80 thousand Yuan a year; high income—an income above 80 thousand Yuan a year. f) Husband's attitude to having another child, supportive—a husband supported his wife to have another child. g) Firstborn's attitude to having another child, conservative—a firstborn did not express explicit support towards having a second child; not asked—couples did not inquire their firstborn child about his/her attitude to having another child. h) Mother's number of siblings—number of children of mother's parents minus one; for an only child, its value was zero. i) Number of children of relatives, one child—relatives universally or generally had one child. j) Extremely popular in China, *weixin* is a social media app run on smartphone.

ideal. Evidently, the average ideal family size was below replacement level. About 29% of the interviewed mothers with one child desired to have a second child, 40% did not desire to reproduce again and others had no clear fertility desire. Furthermore, about 16% of the investigated mothers with one child actually planned to have a second child, 54% did not plan to reproduce again and others had no clear fertility intention. Only about 35% of mothers thinking it better to have two children really wanted to do so; similarly, only about 41% of mothers wanting to have a second child really planned to do so.

4.1. Ideal family size

The global model of the logistic regression analysis of ideal family size achieved a sound goodness of fit: McFadden's  $\rho^2 = 0.374$ ; correctness of prediction = 88.33% (Table 2).

The important factors associated with mother's ideal family size

Table 2

Goodness of fit of the global models of decision-making about having a second child.

Goodness of fit	Ideal family size	Desire to have a second child	Intention to have a second child
McFadden's $\rho^2$	0.374	0.320	0.319
Correctness of model prediction of response variable	88.33%	64.79%	69.86%

were as follows. (1) Background factors. Husband's higher education was associated with an increased likelihood of holding a two-child ideal in wives (college/university level of education, OR = 1.67, 95% confidence interval or CI = 0.65, 4.34; postgraduate, OR = 14.10, 95% CI = 1.83, 184.20; Supplementary Table S1). (2) Attitude factors. Thinking that an only child was not lonely meant reduced odds of considering having two or more children to be ideal (OR = 0.20; 95% CI = 0.08, 0.45). The lower odds were also observed in those mothers who did not think having two children were beneficial for their old-age security (OR = 0.28; 95% CI = 0.13, 0.57). Perception of a risk of death of the only child was associated with a higher fertility ideal (OR = 3.09; 95% CI = 1.58, 6.21). (3) Family support factors. Compared to the case when husband did most of housework, the odds of having a two-child ideal declined to 0.09 when husband did half of housework or so (95% CI = 0.02, 0.35). In contrast to the case when husband supported a mother to have a second child, the odds of her two-child ideal would decline to 0.35 (95% CI = 0.12, 0.96) and 0.15 (95% CI = 0.05, 0.39) when husband held a neutral attitude and un-supportive attitude, respectively.

Removing attitudes towards having a second child (loneliness of an only child; benefit to old age security; child mortality risk) caused the largest increase in AIC<sub>c</sub>, indicating women's fertility ideal was best explained by attitude factors (Table 3). Support within family was the next important influencing factor. Social network, individual background and constraint factors did not show important association with mother's ideal family size. Overall, husband's share of housework ( $\Delta AIC_c = 17.69$ ; Supplementary Table S1), perception of loneliness of

**Table 3**  
Model comparison in the analysis of reproductive decision-making on the second childbearing.

Models	$\Delta AIC_c$ in comparison with the global model of <sup>a,c</sup>		
	Ideal family size	Desire to have a second child	Intention to have a second child
Global - background factors <sup>b</sup>	–7.28	–7.3	–13.16
Global - individual reproductive attitudes	41.64	34.39	–3.71
Global - family support factors	23.56	59.02	4.67
Global - social-network factors	–16.06	12.79	–12.52
Global - constraint factors	–5.83	3.75	22.56
Global - fertility desire	–	–	30.15

<sup>a</sup> The AIC for the global models predicting fertility ideal, desire and intention valued specifically 366.61, 828.41 and 751.87.

<sup>b</sup> The simplified model was obtained by removing background factors from the global model.

<sup>c</sup> The  $\Delta AIC_c$  referred to the difference between  $AIC_c$  of the global and simplified models (i.e.  $\Delta AIC_c = AIC_{c,simplified} - AIC_{c,global}$ ).

an only child ( $\Delta AIC_c = 12.49$ ), husband's emotional support ( $\Delta AIC_c = 11.93$ ), perception of children's value for old-age security ( $\Delta AIC_c = 10.11$ ) and perceived child mortality ( $\Delta AIC_c = 8.56$ ) were the top five single most important factors associated with fertility ideal.

#### 4.2. Fertility desire

The global model of the ordered logistic regression analysis of women's desire to have a second child achieved a McFadden's  $\rho^2$  at 0.32 and the correctness of model prediction of fertility desire was roughly 65% (Table 2).

The following factors were found to be significantly relevant to the desire to have a second child. (1) Background factors. Compared to those working in a sector without flexible office hours (i.e. time-wise inflexible), women with other occupations had a higher desire to have a second child (e.g., working in a sector with flexible time, OR = 1.67, 95% CI = 0.90, 3.09; housewives, OR = 3.11, 95% CI = 1.55, 6.24; Supplementary Table S1). The desire abated with women's age (one year increase, OR = 0.95, 95% CI = 0.90, 0.99), when other factors were controlled for. (2) Attitude factors. Compared to an ideal family size at one child, fertility ideal at two or three children was associated with improved likelihood of desiring to have another child (OR = 4.37, 95% CI = 2.11, 9.06). A negative opinion towards the benefit of having another child to old age security meant a lower desire to have a second child (OR = 0.51, 95% CI = 0.32, 0.80). (3) Support from family members. Compared to that in women with husbands supporting them to reproduce again, odds of desiring to have a second child declined by 78.12% (OR = 0.22, 95% CI = 0.13, 0.37) and 86.32% (OR = 0.14, 95% CI = 0.08, 0.25) when husbands held a neutral or unsupportive attitude, respectively. In the case of a conservative firstborn's attitude, odds in favor of desiring to have a second child were lower by 64.58% (OR = 0.35, 95% CI = 0.20, 0.63) than the case of a supportive attitude; in the case that firstborn's attitude was not considered, the odds were lower by 56.56% (OR = 0.43, 95% CI = 0.25, 0.75). (4) Social network factors. Higher husband's number of siblings was associated with a higher desire to have a second child (one more sibling, OR = 1.23, 95% CI = 1.02, 1.48). Compared to that among those admiring two-child families, odds in favor of desiring to have a second child decreased by 69.34% among women not admiring these families (OR = 0.31, 95% CI = 0.19, 0.49). (4) Constraint factors. Perception of a potential pressure in raising two children was associated with a lower fertility desire, especially when realizing a definite pressure (OR = 0.43, 95% CI = 0.22, 0.83).

Except for individual background factors, all other groups of predictors showed an important influence on fertility desire (Table 3). Removing family support factors caused the largest increase in  $AIC_c$ , followed by mother's attitudes, social-network factors, and constraints. This sequence of change in  $AIC_c$  corresponded to the relative importance of these groups of factors in predicting mother's fertility desire. The top five single most important factors included husband's

emotional support ( $\Delta AIC_c = 47.97$ ), admiration for two-child families ( $\Delta AIC_c = 23.41$ ), ideal family size ( $\Delta AIC_c = 15.10$ ), emotional support from the firstborn child ( $\Delta AIC_c = 9.96$ ), and attitude towards children's value for old-age security ( $\Delta AIC_c = 6.32$ ).

#### 4.3. Fertility intention

The global model of the ordered logistic regression analysis of women's intention to have a second child achieved a McFadden's  $\rho^2$  at 0.32 and the correctness of model prediction of fertility intention was roughly 70% (Table 2).

The desire to have another child was important in predicting fertility intention, both via its main effect—compared to not desiring to have another child, a neutral desire had a positive influence: OR = 3.35, 95% CI = 1.61, 6.96; a desire to have another child also had a positive influence: OR = 8.87, 95% CI = 3.87, 20.33—and via its interaction with physical suitability for reproducing again (see below). Other important predicting factors were as fellows. (1) Background factors. The intention to have another child declined significantly with maternal age: a year increase in age corresponded to 6.62%—OR = 0.93, 95% CI = 0.89, 0.98—decrease in odds of a plan to reproduce again. (2) Family support factors. Compared to that in women with husbands holding a supportive attitude, odds in favor of planning to reproduce again decreased by 51.77% (OR = 0.48, 95% CI = 0.27, 0.86) and 69.03% (OR = 0.31, 95% CI = 0.16, 0.58) in women with husbands holding neutral and unsupportive attitudes, respectively. (3) Constraint factors. The interaction of a positive desire under an unsuitable physical condition had a large negative effect on plan to have a second child (OR = 0.07, 95% CI = 0.02, 0.28; note: the reference in the global model was desiring not to have a second child under a suitable physical condition for reproducing again), but the main effect of physical suitability was not significant (OR = 0.71; 95% CI = 0.30, 1.70). A logistic regression analysis indicated that the perceived physical condition was mainly explained by maternal age, which predicted correctly the indicator in 77% of mothers. Compared to the perception of a potentially positive effect of having two children on career development, perception of either a neutral effect (OR = 0.38, 95% CI = 0.17, 0.86) or a negative effect (OR = 0.26, 95% CI = 0.11, 0.62) would reduce the odds of planning to have a second child.

Removing desire to have a second child (and relevant interaction) caused the largest increase in  $AIC_c$ , followed by constraint factors, and within-family support (Table 3). Individual background, social network and attitude factors did not show important influence on fertility intention, after controlling for the above groups of factors. The top five single most important factors were fertility desire (including interaction term;  $\Delta AIC_c = 30.15$ ), physical suitability for reproducing again (including interaction term;  $\Delta AIC_c = 24.10$ ), husband's emotional support ( $\Delta AIC_c = 8.72$ ), maternal age ( $\Delta AIC_c = 5.63$ ) and work-family conflict ( $\Delta AIC_c = 3.28$ ). Evidently, family members only had a minor direct association with mother's fertility intention, when other influencing

factors—especially fertility desire—were controlled for.

## 5. Discussion

Whether to have a second child or not could be the major factor accounting for below-replacement fertility in modern societies; consequently, decision-making about it is one of major topics in modern demography (Billari et al., 2009; Bongaarts, 1998; Harknett et al., 2014; Kohler et al., 2002). By integrating concepts and frameworks from evolutionary theory and social psychology and using multi-level data collected from a survey of Chinese women, our study contributes to the understanding of the topic through a series of important findings.

First, our conceptual framework about distinct steps of women's reproductive decision-making—i.e., ideal family size, fertility desire and fertility intention—was supported and different fertility-influencing factors were associated with different steps of fertility decision-making. In this population, > 80% of reproductive-aged mothers with one child thought it was ideal to have two children, only 30% of them had a desire to reproduce again and even less had an intention to do so. Generally speaking, fertility desire was associated with a wide range of predictive factors, including individual attitudes, family support, social network and constraint factors. By contrast, constraint factors had no important association with ideal family size; after controlling for fertility desire, individual reproductive attitudes and social norm factors were not important factors directly relevant to fertility intention. Thus, a given fertility-related factor may have specific action site(s) along the chain of reproductive decision-making and to better understand the decision-making and underlying mechanisms, it is helpful to integrate all three steps in analysis.

Some specific details were also worth noting. Perceived child mortality affected fertility ideal, but not fertility desire. The result indicates child mortality may be still relevant to women's reproductive decision-making in modern societies. Presumably, although the under-five mortality rate was below 4‰ in the study region, people's perceived child mortality was not that low (Table 1), e.g., due to the interaction between an inclination to avoid parenting or breeding failure—no offspring raised to adulthood—and their localized shocking experience of death of only children in social network members or hearing similar reports from the media (Liu, Rotkirch, & Lummaa, 2012; Owoo, Agyei-Mensah, & Onuoha, 2015; Sobotka & Beaujouan, 2014; Wei, Jiang, & Gietel-Basten, 2016). On the other hand, partly consistent with the prevalent opinion (e.g., Mace, 2008), the total effect of child mortality on fertility behavior was only moderate: child mortality risk was the fifth important factor associated with fertility ideal, which was the third important factor associated with fertility desire. Perception of benefit of having a second child to old age security had a positive effect on fertility ideal; given that perception of loneliness of the only child in the far future was also related to caring for aged parents (see data section), consideration for old age security was evidently a major factor relevant to ideal family size, a result consistent with the framework of inter-generational wealth flow (Caldwell, 2005). However, this consideration had only a moderate direct influence on fertility desire; additionally, it did not associate directly with fertility intention. Physical suitability for having a second child and work-family conflict only affected the intention but not desire to have a second child. Evidently, fertility intention was more susceptible to constraints than fertility desire: constraints were one of two major determinants of fertility intention and physical suitability was the most important constraining factor (Table 3). Therefore, our study was consistent with previous ones regarding the moderation effect of maternal age—presumably via its more direct effect, i.e. the perceived physical suitability—on the gap between fertility desire and intention (Chen & Yip, 2017; Jin, Song, & Chen, 2016).

Second, we obtain two important results regarding the role of support from family members in women's reproductive decision-making. As predicted by the conceptual framework, husband had an important

influence on all three steps of fertility decision-making. In particular, husband's share of housework and emotional support for having two children were the single most important factor predicting women's ideal family size and desire to have a second child respectively, a result somewhat contradicting previous view that desire is influenced primarily by factors internal to the individual (Miller, 1994). Presumably, women would revise their reproductive desire when confronted with intractable and urgent difficulties (e.g., Gray et al., 2013): husband's attitude might be a difficulty of this kind and put in prior consideration in formulating one's desire. It is worth noting that housework division could also reflect women's attitude towards gender role within family or family orientation, e.g., whether a woman should focus on family and children (Torr & Short, 2004). Actually, the relationship between fertility ideal/desire and housework division was U-shaped so that when husband shared half of housework or so, wife nonetheless had the lowest ideal/desire to have a second child (Supplementary Table S1). It was possible that those women with modern view of gender role within family had more trouble in balancing work and family than women with traditional gender role attitude, which accounted for their lower fertility ideal/desire. Another important result is that the firstborn child played an important role in influencing mother's fertility desire, a result consistent with parent-offspring conflict theory (Liu et al., 2017; Trivers, 1974); actually, the effect size of firstborn's emotional support was larger than that of socio-economic factors like parenting pressure and maternal occupation. Some may question whether the young children did have such a large effect, but two considerations may help to answer the question. First of all, a child has complicated psychological adaptations to manipulate parents (Trivers, 1974). Additionally, after a long time of implementation of the one-child policy, families in China have become child-centered: the interests of the already-born children are above those of other family members in many aspects and they play an important role in family plans, from how to spend the weekends to where to buy a flat (e.g., Goh & Kuczynski, 2009; McNeal & Mindy, 1996). The above discussion suggests that in the analysis of women's fertility decision-making, it is helpful to take other (nuclear) family members into account (see also Sear, 2017).

Third, our result emphasizes the importance of individual factors like attitudes to reproduction, age, and physical suitability for child-bearing, instead of external constraints and norms, in determining female reproductive strategy. On the whole, mother's own attitudes were the most important factor underlying her ideal family size, and her fertility desire contributed most to her fertility intention. By contrast, economic constraints—e.g., work-family conflict, pressure in raising children and difficulty to find a quality kindergarten for children—played a minor role in influencing both desire and intention to have a second child. Consequently, our result is somewhat in contrast to those studies emphasizing the importance of economic factors in determining female fertility behavior (Shenk et al., 2013; Yang & Du, 2017). The contrast may arise owing to the neglect of psychological mechanisms in the previous analyses of fertility behavior, the outcome of fertility decision-making. Certainly, although fertility intention or plan is close to actual fertility behavior, they are different and in implementing a plan, more constraints will be taken into account, but we believe that the relative importance of economic constraints in influencing behavior will be clarified when decision-making processes and their determinants are considered. Norm factors—family size and sharing of information like pictures of the second child in non-family social network members—may also have only a limited influence on women's fertility ideal and desire in current China. One of the possible reasons might be that the diffusion of a norm like having two children is slow at the stage of origin of the norm (e.g., Colleran, 2016): at the time of survey, the vast majority of social network members had only one child (Table 1). Presumably, after more couples produce the second child, two-child norm may diffuse more quickly and influence from relatives and friends may become larger. It is warranted to test this prediction with empirical data. Additionally, to further clarify the influence of non-family social

network members it is helpful to take injunctive norms into account as done in some demographic studies (e.g., Billari et al., 2009), besides descriptive norms here.

Our findings have important applied implications for population policies in China and possibly in other low-fertility societies too. First, a local family intervention system aiming at family harmony and happiness—which to our knowledge, almost does not exist in China—should be set up, in the light of the husband-wife conflict and parent-offspring conflict over family size. For example, < 30% of the inquired firstborns explicitly supported their parents to have another child, but > 80% of women thought it was better to have two or three children (Table 1). Family intervention cannot eliminate such conflicts, as they have biological foundations; however, it may have an alleviating effect. Second, as admiration for two-child families was a major factor influencing women's desire to have a second child, one approach to lessen the tendency of very low fertility in current China may be to emphasize the benefits of having two children and happiness of two-child families, e.g. through the media (Goldstein, Lutz, & Testa, 2003). By this way, cultural transmission through social learning might be accelerated and more one-child families may decide to have a second child. Third, given that physical suitability and its underlying age factor were the major constraints on converting fertility desire into fertility intention, governments concerned with too low fertility levels should take some measures to slow down the trend of postponed marriage and reproduction so that the gap between desire and intention can be somewhat lessened. In designing practical policies, some policy experiments are needed beforehand; also, the implications are based on practices in China only and cautions are warranted in extending them to other low-fertility societies.

In the future, testing these findings and their policy implications using data from other geographic or cultural contexts could further shed light on fertility issues in low-fertility societies. We expect that biological factors like parent-offspring conflict may still be at work. Norms from social network may have a different importance in influencing fertility ideal and desire, due to the difference in cultural and social contexts. More works are needed to understand how the interplay between biological adaptations and cultural transmission promotes low fertility. Additionally, our work is based on cross-sectional data and we do not expect that the analysis based on longitudinal data will necessarily produce the same results: e.g., the relative importance of ideal family size in predicting fertility desire along time might be different from that discovered in this work. Also, when using longitudinal data to study the relationship between decision-making and actual behavior, it might be helpful to consider the propositions suggested by our conceptual framework. Third, it is helpful to analyze in which contexts, husband and wife or parents and already-born children may have different attitudes towards future childbearing. Clarifying the point will improve our understanding of reproductive decision-making in a context with multiple decision-makers.

#### Data availability

The data and R code used in the work are available upon request.

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#### Interest statement

The authors declare no competing interests.

#### Appendix A. Supplementary data

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