Intergenerational support and women's fertility in high-income countries: an evolutionary analysis

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DECLARATION

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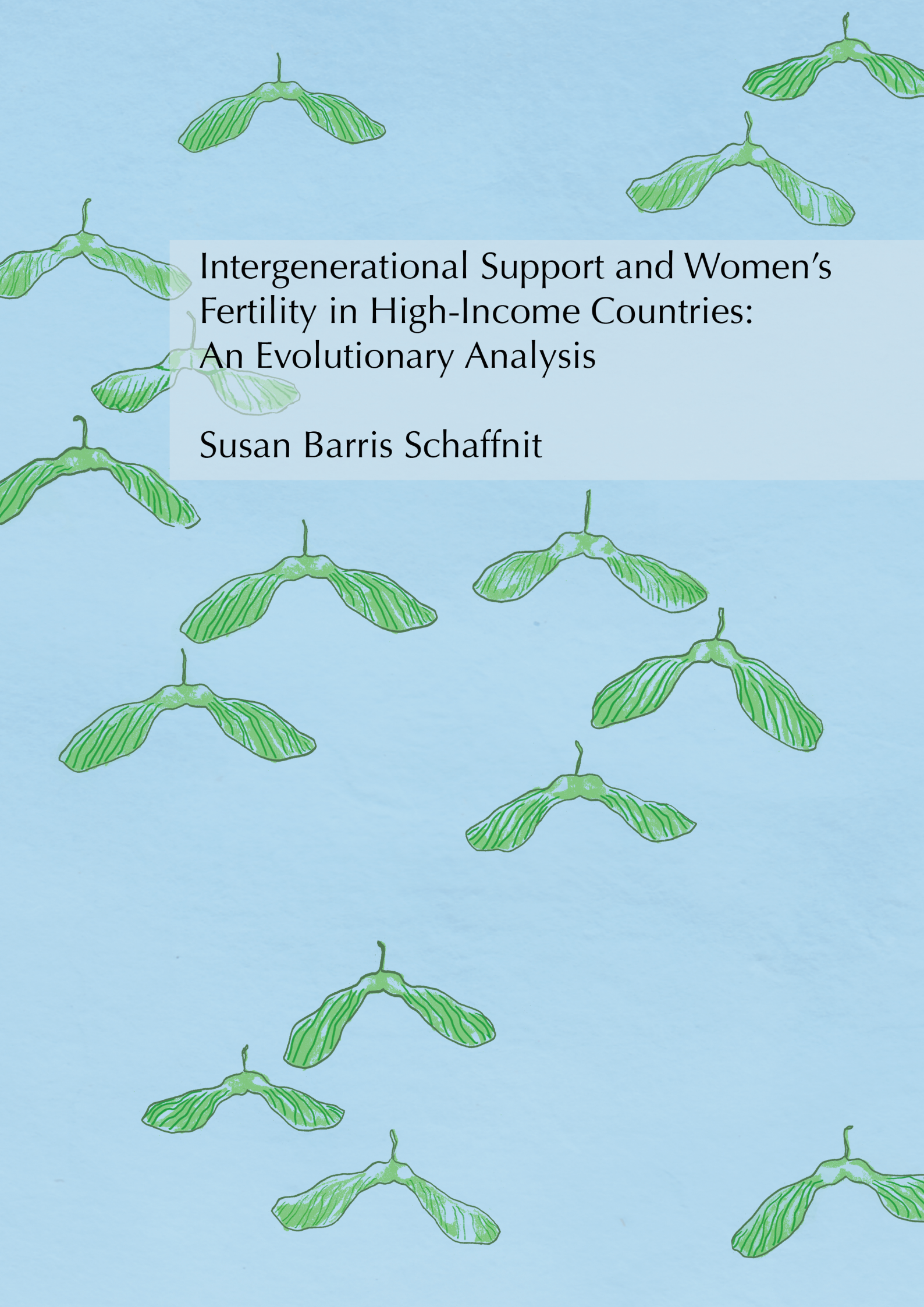

Intergenerational Support and Women's Fertility in High-Income Countries: An Evolutionary Analysis

Susan Barris Schaffnit

ABSTRACT

There is now considerable evidence that humans are cooperative breeders – that is, women need allomaternal support to successfully reproduce. Families play a key role in providing this support to women. Evidence from low-income contexts linking allomaternal support to beneficial child outcomes is particularly strong, but associations between support and successful reproduction are more varied in high-income settings and when fertility is the outcome. Two possible reasons for this are (1) allocare is measured in many forms and at many time points with potentially different meanings for reproductive women, and (2) high-income populations are very heterogeneous, including large socioeconomic inequalities, which may modify associations between support and fertility.

This publication-based dissertation has three main objectives: (1) to contribute to cooperative breeding literature in high-income, low-fertility settings; (2) to deepen our understanding of how family support plays into reproductive decision making by testing associations between many types of support and women's fertility; and (3) to explore contextual factors, particularly socioeconomic position, with may moderate associations between family support and women's fertility. These objectives are investigated in four research chapters (two published and two written for submission) using secondary data from low-fertility, high-income countries.

This research firstly confirms that families provide key allomaternal support for women in high-income countries, while also highlighting other sources of support. However, the results demonstrate that all support is not equal. Types, timing, and sources of support vary in terms of their influence on reproductive outcomes (e.g.in the United Kingdom, material or practical support often associates with lower fertility while non-material support associates with higher fertility). Secondly, this research demonstrates that socioeconomic environments modify many components of the reproductive decision making process, not the least of which is how families interact with and support each other and, in turn, how family support associates with fertility outcomes.

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1 INTRODUCTION

With a skim through the demographic, anthropological, psychological, biological, and policy literature from the past half-century it is evident that there is a long history of interest in the relationship between family support (or pressure) and women's reproduction. This literature, though broad, is based on an underlying assumption that families matter and that they have some vested interest in a women's reproduction. This dissertation will delve into this topic using large demographic data sets from high-income, low-fertility (HILF) countries guided by the framework of evolutionary theory, specifically that used in Human Behavioral Ecology (HBE). Within this framework, intuitions regarding the importance of the family in reproductive decision-making are given ultimate rationality in kin selection theory. Below, I provide a brief overview, and the main aims, of my dissertation. I then layout the theoretical framework of this dissertation, highlighting the hypothesis that humans are cooperative breeders. Cooperative breeding refers to a system in which high-levels of support surrounding reproduction are necessary for the maintenance of reproductive patterns, in the human case, defined by relatively short inter-birth intervals and highly altricial young. I will then outline the predictions arising from this framework which I will test. This is followed by a brief summary of the current HILF literature on kin and fertility. Finally, I present my thesis structure.

1.1 THESIS AIMS AND OVERVIEW

Bearing and raising human children is a costly endeavor. Like all animals, human mothers have a limited amount of energy which they must allocate between many competing life history tasks and functions in their quest to optimize their fitness (Stearns 1992). As cooperative breeders, humans are able to distribute energetic expenditures in childrearing amongst several individuals, or allomothers (Hrdy 2009a; Kramer and Ellison 2010). Usually these allomothers

are either fathers, who gain direct fitness through their support, or individuals related to the mother or child, who gain indirect fitness through their care, but others may also provide support. As recipients of support, women may redirect their energy from childrearing into other tasks, like continued childbearing, at low cost to her existing child's quality. In this way, allomothering can partially offset the tension between competing life history trade-offs.

In natural fertility settings the effects of alloparental support on women's reproductive success (measured by child survival & health: Gibson & Mace, 2005; Sear, Mace, & Mcgregor, 2000; Sear, Steele, McGregor, Mace, & McGregor, 2002; Sear & Mace, 2008; Voland & Beise, 2002; and fertility: Sear, Mace, & McGregor, 2003) are well documented. The low-fertility setting is unique, characterized by unprecedentedly low-fertility and high wealth. In these settings, while the prevalence of allomaternal support remains very high, the relationship between support and reproduction is less well studied and the evidence we do have is varied (see Section 1.4). In this dissertation I will both contribute to this growing field and attempt to address two potential factors which may be contributing to our poor understanding of the relationship between support from families, primarily parents and in-laws, and fertility in low-fertility settings. Firstly, inconsistencies in the literature may be due to the wide variety of measures of support used to predict women's fertility. An objective of this work will be to compare a wide range of types of kin support and exposures (and in Chapter 3 non-kin support) on women's reproductive outcomes to deepen our understanding of how kin support may affect women's fertility. Secondly, the inconsistency in the literature may also partially be due to the fact that within high-income countries (the usual scale of analysis in existing studies) women may respond to family presence and support during reproduction differently depending upon their local environments. Another aim of the proceeding research chapters will be to tease apart contextual factors, such as socioeconomic position (SEP), which may relate to the availability of

support surrounding reproduction and potentially moderate the effects of support on women's reproductive behavior within high-income countries.

The following publication based thesis contains four papers each of which explore the relationships between intergenerational family support and women's fertility outcomes in HILF countries using large data sets. The first three papers use data from Europe to test how kin presence and support affects different measures of women's fertility – timing of first birth, probability of second birth, total fertility, and probability of childlessness. These papers use many measures of family support – parental survival, co-residence, contact frequency, financial support, and childcare – and other support – from partners, friends, and formal supporters – as predictors of the fertility outcomes. These chapters further explore the potentially moderating roles of SEP and fertility intentions in the relationships between support and fertility. The final chapter (co-first authored with Paula Sheppard) takes a slightly different perspective than the preceding chapters and considers the association between early life kin exposures and timing of first sexual and reproductive behaviors.

1.2 THEORETICAL OVERVIEW: COOPERATIVE BREEDING IN HUMANS

This research is conducted within a human behavioral ecology framework and comes with two main assumptions: that human behavior, like other traits, is shaped through natural selection; and that human behavior is plastic depending upon ecological contexts. Traits and behaviors which increase the number of genes passed on to future generations relative to other traits/behaviors should be selected for. The fundamental theory used by human behavioral ecologists is life history theory, which is based on the principle that humans, like all other species, have limited energy to allocate to different life tasks (Stearns 1992). Humans, as cooperative breeders (see Box 1 for disagreements), are unique in that reproducing women

can benefit from pooled energy budgets gained through high levels of cooperative behavior from alloparents, which can offset key life history trade-offs like those between current and future reproduction, and the quantity and quality of children. Cooperative breeding is a system characterized by high-levels of alloparental support in the care and provisioning of infants and children (Hrdy 2009a; Kramer 2010). Though cooperative breeding is generally a species-level descriptor (Mitani and Watts 1997; Ross and MacLarnon 2000; Lukas and Clutton-Brock 2012), previous research has demonstrated the utility of using the framework to test within species variation in non-human animals (Canestrari et al. 2008; Hatchwell et al. 2013) and humans (Sear and Mace 2008; Kaptijn et al. 2010; Sear and Coall 2011; Waynforth 2012; Snopkowski and Sear 2013).

Evidence from natural fertility settings shows that mothers' reduce their provisioning time while caring for new children and this reduction is made up for by allocarers (Hawkes, Oconnell, and Jones 1997; Marlowe 2003); additionally, allocarers can free women's time by providing childcare (Meehan, Quinlan, and Malcom 2013). As members of a cooperative breeding species, women receiving support are able to redirect their energetic expenditures to other tasks including continued reproduction. Within natural fertility populations this link between receiving allomaternal support and increased reproductive success for women is well documented (Sear, Mace, and Mcgregor 2000; Sear et al. 2002; Voland and Beise 2002; Sear, Mace, and McGregor 2003; Gibson and Mace 2005; Sear and Mace 2008), while more recent studies testing for the relationship in low-fertility contexts have produced variable results (See Section 1.4 for an overview of the HILF kin and fertility literature).

Box 1: Terminological debates about human cooperative breeding

Terminological debates surrounding cooperative breeding fall into two main categories: those focusing on the definition of cooperative breeding generally (for a history of the term see Solomon & French, 1997) and those relating to whether humans qualify as cooperative breeders. The negative arguments of the latter debate are briefly discussed here. The arguments against humans as cooperative breeders range the spectrum from human cooperation surrounding reproduction is not ubiquitous enough (Strassmann and Kurapati 2010) to human cooperation is so great that we are super cooperators (Bogin, Bragg, and Kuzawa 2014).

The crux of the first argument is that many studies relating alloparental support to women's reproductive success (previously used as evidence for cooperative breeding; see Sear & Mace, 2008) find no or even negative results (Strassmann and Kurapati 2010; Strassmann and Garrard 2011). Proponents then suggest that cooperative breeding is not species-typical and thus should be reserved for describing the patterns of only certain human populations (Strassmann and Kurapati 2010). The lack of a positive link between allomaternal support and reproductive success, however, is not evidence that humans are not cooperative breeders as the definition refers to the high rates of allomaternal support typical to the species which relates on a *species-level* to short birth intervals and greater reproductive success. Further, proponents of humans as cooperative breeders are comfortable with the presence of competition (Hrdy 2009a). Rather, the high prevalence of alloparental care across human populations suggests that the cooperative breeding is species-typical. Whether cooperative breeding evolved culturally (and universally) or biologically is up for debate, though some paleoanthropological evidence has lent support for the hypothesis that

the human reproductive system and alloparental support have biologically co-evolved suggesting that cooperative breeding may be a species typical trait (DeSilva 2011).

The latter argument highlights that human cooperation surrounding reproduction commonly extends beyond the confines of kin selection (Bogin, Bragg, and Kuzawa 2014). Humans receive alloparental support from sources neither related to the parents of the focal child, nor the child itself. This statement itself is not likely to be disputed by proponents of humans as cooperative breeders. Bogin et al. (2014), however, argue that while human cooperation surrounding reproduction likely evolved and stabilized through kin selection, the current extent of cooperation ("uncoupled from genetic relatedness" p.370) pushes humans beyond cooperative breeding as previously defined. They suggest that humans, instead, practice biocultural reproduction. Their argument is conspicuously missing a discussion of other mechanisms which may stabilize cooperation surrounding reproduction (reciprocity, training for parenthood, mating access, etc.).

This PhD works from the perspective that the ubiquitous high-levels of alloparental care present across societies qualifies our species for the definition.

Kin selection is likely the mechanism through which cooperative breeding evolved (Hrdy 2009a; Hrdy 2009b). Allocare is most commonly provided by individuals related to a mother (her parents and other kin) or to her child (her partner and his kin) due to their overlapping fitness interests. Though not without the potential for conflict (Hadley 2004; Borgerhoff Mulder 2007; Leonetti, Nath, and Hemam 2007; Gibson and Gurmu 2011; Mace and Alvergne 2012), related individuals stand to increase their inclusive fitness through providing support to a mother and her child thus increasing her reproductive success (both in keeping current children alive and aiding in further reproduction). Related alloparents could include children's aunts and uncles

(Gaulin, McBurney, and Brakeman-Wartell 1997; McBurney et al. 2002), cousins (Jeon and Buss 2007), siblings (Kramer 2011), or grandparents (Coall and Hertwig 2010). In all cases, alloparental support is moderated by relatedness, with more related individuals on average being more helpful (Euler and Weitzel 1996; Gaulin, McBurney, and Brakeman-Wartell 1997; Jeon and Buss 2007; David et al. 2009; Danielsbacka et al. 2011). The focus of most cooperative breeding literature on kin effects on women's fertility focus on the role of women's parents and in-laws (grandparents to her children) (Sear and Mace 2008; Sear and Coall 2011), who are also the primary focus in this dissertation. Women's parents and in-laws are in a particularly good position to provide alloparental support being generally post-reproductive (biologically or culturally) thus reducing potential for reproductive conflict, and with relatively high relatedness to their grandchildren (0.25).

Human mothers, particularly in high-income settings, can receive support from a wide variety of sources other than those related to her and her child, though are by no means the only cooperative breeding species to exhibit non-kin allomaternal support (Riehl 2013; Zöttl et al. 2013). Human are unique in the diversity and extent of support they receive surrounding reproduction (a point on which Bogin, Bragg, & Kuzawa (2014) and I agree) much of which comes from allocarers whose support is not explained through kin selection. Rather, other cooperative arrangements stabilize these forms of support. Women's partners, not kin to her, but related to their child gain direct fitness by providing support both through improving the fitness of existing children and maintaining mating access (Price 1990; Smith, Mulder, and Hill 2001). Women's friends, unrelated to women and child, may participate in reciprocal relationships with women in which childcare is exchanged for childcare or other currencies (Ivey 2000). Paid child-minders may be motivated to provide allocare through financial incentives (Paull 2009). In high-fertility countries with strong social services, women also

receive support during pregnancy and childrearing from government funds and free or subsidized childcare (Del Boca 2002; Hank and Kreyenfeld 2003; Fiori 2011). Finally, in non-human cooperative breeders the role of coercion (rather than any sort of reciprocal altruism) can be an important factor motivating allomaternal care (Reeve 1992), but perhaps less so in modern societies (though slavery/servitude may be an example of this in humans).

1.3 BASIC PREDICTIONS: ASSOCIATIONS BETWEEN ALLOMATERNAL SUPPORT AND WOMEN'S FERTILITY

As members of a cooperative breeding species, family presence and allomaternal support is expected to provide valuable cues of emotional and material support which could affect women's reproductive behavior (Sear and Dickins 2010). With overlapping fitness interests, families are expected to encourage (even very subtly) behavior which enhances a lineage's fitness – through further reproduction or investments in existing children (quantity or quality of the newest generation). Family support could potentially influence women's fertility in several ways: through direct support like childcare or financial help, by providing information about norms surrounding reproduction and other life events, by applying pressure on women to have or not have a child, by making women feel generally secure, or through shared genes.

Direct family support may be the most intuitive of these modes of influence; by providing direct help to reproductive women families can reduce the costs of childrearing for women (Davis 1955; Manlove, Mariner, and Papillo 2000; Hrdy 2009a; Kaptijn et al. 2010; Balbo and Mills 2011a; Aassve, Meroni, and Pronzato 2012). This energy gained can then be redirected to further childbearing at shorter intervals than possible without support. Alternatively, women may redirect their energy to increased parental investments in existing children or even into her own embodied capital (which theoretically should pay off for her long term fitness).

Families may also influence women's fertility by *providing information on reproductive norms* (Newson et al. 2005) or they may take on a more persuasive role by *applying pro-natal pressure* on women (Udry 1982; Balbo and Mills 2011b). As social learners, humans acquire information from people around them. Kin presence or support may provide subtle cues like perceiving that having a child may strengthen one's relationship with their parents (grandparent of their child) or highlighting the benefits of having children around in old age (Bühler 2008). *Feeling secure* due to kin presence or support could most feasibly be an indication that material support would be available if needed. Some have argued that women who feel secure and thus satisfied may be unlikely to have a(nother) child if she feels doing so would disrupt her positive situation (Simon 1956; Rijken and Liefbroer 2009; Balbo and Mills 2011a). Humans, however, are not expected to maximize satisfaction, but rather fitness. Alternatively, a woman may feel that having a child will enhance her feelings of security and contentment and thus choose to continue or begin reproduction (Balbo and Mills 2011a). Family presence and support may also be a cue about the quality of one's environment (Belsky, Steinberg, and Draper 1991; Chisholm 1993a) which relates strongly to reproductive scheduling. Finally, kin presence and support (as a proxy for presence) on its own may relate to women's reproduction simply through *shared genes* or a healthy family effect in which families share healthy environments. We will try to avoid this possibility by considering the effects of many measures of support and kin presence on women's fertility outcomes.

Several ways in which family support could affect women's fertility outlined above could theoretically be the result of any cooperative arrangement (between non-kin or kin) even though we expect kin to be particularly helpful. Newson et al. (2005), however, suggest that the presence of kin will positively affect women's fertility above and beyond the effects of their material support (financial, childcare, or emotional) through pro-natal influence. They

hypothesize that having a social network more densely packed with kin, who share fitness interests, will increase women's fertility as kin will provide subtle pro-natal messages while non-kin will not. In an experiment testing this hypothesis, Newson et al. (2007) found that study participants gave fitness enhancing advice (have children in good situations, and delay reproduction in situations which may decrease fitness) when playing the role of a mother giving advice to a daughter, but not while playing the role of a friend giving advice to a friend. Potentially lending non-experimental support for this hypothesis Mathews and Sear (2013a) demonstrated that having kin in one's social network relates to earlier first births in the United Kingdom. Newson et al.'s kin influence hypothesis is not one on which we specifically focus in the following research chapters, since data on the proportion of kin in social networks is relatively rare, and not available for the datasets we analyze, but may be helpful in the discussion of our findings.

The most basic prediction throughout the dissertation will be that receiving support from families will have a positive effect on a woman's fertility. I will, however, consider factors which may modify the effect of support on fertility. A common consideration in the cooperative breeding literature is the role of relatedness (Tanskanen et al. 2014), and will be explored in Chapter 5. In prior chapters I focus on the roles of socioeconomic status, fertility intentions and the availability of non-kin support in moderating the relationship between kin support and fertility. The role of each of these factors will be expanded upon in the relevant chapters. Additionally, I test the possibility that all support is not equal; different types of support may differently predict fertility outcomes.

1.3.1 Evolutionary predictions in high-income, low-fertility contexts

Human behavioral ecology is relatively new to addressing questions in HILF settings. The novel setting raises new questions including what currencies we are maximizing as it does not appear to be fitness (Goodman, Koupil, and Lawson 2012). In this dissertation, I will not attempt to explain low or below-replacement fertility from an evolutionary perspective although this is a thriving area of research (Barkow and Burley 1980; Boyd and Richerson 1985; Turke 1989; Kaplan et al. 2002; Newson et al. 2005; Newson et al. 2007). One proposed hypothesis for low fertility, in fact, is that the lack of kin networks in modern high-income countries - resulting in fewer helpers and fewer pro-natal messages - may cause low fertility (Turke 1989; Newson et al. 2005).

Although overall fertility behavior does not appear to be fitness maximizing in the long-term in HILF contexts (Goodman, Koupil, and Lawson 2012), it is possible that women still respond adaptively to previously fitness enhancing cues, due to evolved psychological mechanisms. As members of a cooperatively breeding species, we expect that any support surrounding reproduction from families and others can still provide women with a valuable cue of emotional or material support which may affect her fertility behavior, despite overall low fertility levels. The small amount of empirical work on kin and fertility in HILF contexts gives some grounds to believe women may still respond adaptively to the availability of kin.

1.4 OVERVIEW OF THE LITERATURE AND LINGERING QUESTIONS

Associations between kin and women's fitness (including child survival and women's fertility) are well studied in natural fertility contexts reflected in two review papers on the topic (Sear and Mace 2008; Sear and Coall 2011). These topics are less well explored in the low-fertility context. In this section I present a very brief overview of the results from the available

literature on kin and women's fertility. More targeted literature reviews can be found in the proceeding research chapters; here I will highlight the inconsistencies in the literature as it stands. I have included in this literature review research which looked at the association between parents, parents-in-law, and unspecified kin (their support, presence, survival or co-residence in adulthood) and women's fertility outcomes. All studies come from HILF settings (thus excluding several studies from China despite their very low fertility; see Zhenzhen 2000; Anson and Anson 2003; Jin, Li, and Feldman 2006). The primary part of this section focuses on kin and women's achieved fertility with a brief overview of some of the literature on kin and women's fertility intentions. I excluded studies in which the kin predictor references early-life conditions (for example, who children lived with in childhood) because the predicted effects of kin on women's fertility are different depending on the timing of the kin availability measure (childhood versus adulthood). Also excluded are several studies which used a woman's number of siblings and sibling fertility as a predictor of her own fertility (Pullum and Wolf 1991; Gee 1992; Murphy 1999; Murphy and Wang 2001; Murphy and Knudsen 2002; Wu and Schimmele 2003; Bernardi and White 2009; Kotte 2012; Milne and Judge 2012; Kolk 2014). These studies were excluded because it is particularly difficult to interpret what sibship size or fertility is measuring – shared genes (fecundity) (Pullum and Wolf 1991), shared environment (norms) (Hendershot 1969; Bernardi and White 2009), availability of support, or competitors for parental investment (Lawson and Mace 2011).

Table 1.1 summarizes the literature on the associations between kin on women's fertility in low-fertility, high-income countries. Direction of relationships are noted with +, for a pro-natal effect, and -, for an anti-natal effect. "None" is used to indicate non-statistically significant results. While there are known limitations to using p-values to interpret statistical results (Anderson, Burnham, and Thompson 2000), the studies I report on all have sufficiently large

sample sizes to assume that real associations will be indicated by statistical significance (and may, in fact, overly emphasize very small associations). Table 1.2 summarizes the number and proportion of positive, negative, and non-statistically significant associations by outcome, predictor, and identity of kin. In one case, an association was found to have a different association with the outcome depending upon family structure (Aassve, Meroni, and Pronzato 2012) and the two different associations were each given a value of 0.5. Looking first at the different fertility outcomes, kin most often have pro-natal associations with women's first births (61.5% of effects; n=9) and total fertility (80% of effects; n=4). There are fewer statistically significant associations between kin on women's birth intervals (67.6% of all IBI associations are not statistically significant; n=36.5). In fact after second births, kin more often have a negative relationship to fertility (30% of effects are anti-natal, n=3) than have a positive association (10% are pro-natal, n=1), though still 60% (n=6) of all findings are non-statistically significant.

Of the reported kin predictors, co-residence with kin most frequently positively relates to fertility. Upon closer inspection, however, nine out of ten of the positive associations between co-residence with kin and fertility come from the Asian literature (Figure 1.1). Co-residence between women and her in-laws is both common and culturally encouraged in several Asian countries (Chi and Hsin 1996), while the same is not true in Europe and America despite recent rises in extended co-residence (Office for National Statistics 2014b). This likely partially accounts for the fact that 64.35 (n=9) of the Asian effects of co-residence are positive on fertility, while only 25% (n=1) of the European/American studies show pro-natal relationships. This could also be due to the fact that co-residence is less often used as a predictor of fertility in Europe and America because the cultural norm for post-marital co-residence does not exist. The majority of associations, no matter the type of support measured, are not statistically

significant; of those that are, most demonstrate positive associations between kin and women's fertility. When findings are split by the providers of care (parents, in-laws, or unspecified kin), unspecified kin show primarily pro-natal relationships to women's fertility (70% of effects), followed by in-laws (41.7% of effects) and then parents (22.4 % of effects).

Like the literature relating kin to women's achieved fertility, that linking kin to fertility intentions provides us with mixed evidence (Table 1.3). In this case, the trends from Asian and non-Asian studies are similarly inconsistent. Of 29 associations presented in Table 1.3, 14 are not statistically significant, 13 are positive and 2 are negative. The measure of kin support/presence does not seem to relate to effects direction. For example, while Tanskanen & Rotkirch (2014) find consistently positive associations between emotional support from kin on fertility intentions, Balbo & Mills (2011b) find similar support negatively predicts fertility intentions and Miller (1992) finds no such associations.

Evident from this summary of the literature is that kin do not consistently predict women's fertility outcomes, at all or in direction, particularly in the European and American studies. (We actually see a great deal of consistency in the Asian studies where co-residence with paternal kin positively affects birth progressions). One possible reason for this is that different segments of society may respond differently to kin support. By analyzing large demographic data sets without testing whether different groups utilize kin support differently may dilute possible associations. Indeed, Aassve, Meroni, and Pronzato (2012) did just this and find that family context matters in the relationship between kin support and women's decision to have an additional child. Families with children over three years old felt positive effects of kin support in childcare, while those with younger children did not (Aassve, Meroni, and Pronzato 2012). In this dissertation, I will consider a few of many factors in which we could expect that kin will

differently associate with women's fertility outcomes. In Chapters 2 and 3 I consider the role of socioeconomic status. Within high-income countries, large wealth inequalities mean that reproductive decision-making environments are drastically different for many individuals. Environmental harshness, measured by socioeconomic status, relates both to the nature of associations between family members (cooperative or competitive), the types of help that are available to women, but also women's reproductive schedules. Another moderating factor addressed in this dissertation is women's fertility intentions which may represent different reproductive strategies. Women in high-income countries often pursue non-reproductive goals which are incompatible with having children. As such in Chapter 4, I consider how kin support relates to women's fertility for those with positive and negative fertility intentions.

Another possible reason for the inconsistency in the literature is the wide range of kin support measures used to predict many fertility outcomes. Predictors I have classified as 'support' in Table 1.1 include childcare received from kin and financial support (Manlove, Mariner, and Papillo 2000; Del Boca 2002; Kaptijn et al. 2010; Aassve, Meroni, and Pronzato 2012; Waynforth 2012; Thomese and Liefbroer 2013; Mathews and Sear 2013b). 'Proximity' predictors include various measures of distance to family members' homes (Hank and Kreyenfeld 2003; Nosaka 2009; Kaptijn et al. 2010; Aassve, Meroni, and Pronzato 2012; Thomese and Liefbroer 2013), contact frequency with kin (Waynforth 2012; Mathews and Sear 2013a; Mathews and Sear 2013b; Tanskanen et al. 2014), and presence of kin in social groups (Mathews and Sear 2013a). Some studies used survival as a proxy for support (Del Boca 2002; Kertzer et al. 2009; Tanskanen et al. 2014) and others focused on emotional support from kin (Balbo and Mills 2011a; Waynforth 2012; Mathews and Sear 2013b). Finally, primarily the Asian studies (Thornton et al. 1986; Chi and Hsin 1996; Tsay and Chu 2005; Fukukawa 2013) but some others (Manlove, Mariner, and Papillo 2000; Mathews and Sear 2013a) used co-

residence with kin as a predictor of fertility outcomes. While the exact mechanisms through which kin affect women's fertility are unknown, it is not necessarily reasonable to assume that all forms of support will have the same effects on women's fertility throughout life (Gurven and Schniter 2010; Michalski 2010). To try to tease this issue apart, I will compare the effects of few kin measures, but on several fertility outcomes (Chapter 2), and in Chapters 3 and 4 compare the effects of many types of kin (and non-kin) support measures on one fertility outcome. Doing so allows us to understand more deeply how it is that kin support affects women's fertility.

Table 1.1: Summary of associations between kin and fertility from literature from high-income, low-fertility countries

			Effect of:								
			Own Kin			In-laws					
Region	Sample	Out.	Mo	Fa	Either	Mo	Fa	Either	Any	Predictor	Authors
Europe	EU	IBI			none/+[1]					Support	(Aassve et al., 2012)
		IBI			none					Proximity	
	NL	FB			none					Emotional/other	(Balbo and Mills 2011a)
		IBI			-					Emotional/other	
	NL	FB			none					Proximity	(Kaptijn et al. 2010)
		IBI			none					Proximity	
		IBI			+					Support	
	NL	IBI			none			none		Proximity	(Thomese and Liefbroer 2013)
		IBI			none			none		Support	
		IBI			none			none	+	Support	
	NOR	FB	-							Proximity	(Rindfuss et al. 2007)
	DE	FB			+					Proximity	(Hank and Kreyenfeld 2003)
		IBI 2nd			none					Proximity	
	IT	TCH			+					Survival	(Del Boca 2002)
		TCH			+					Support	
	IT	FB			none					Survival	(Kertzer et al. 2009)
		IBI 2nd			none					Survival	
	UK[2]	FB							+	Proximity	(Mathews and Sear 2013a)
		FB	none	none					+	Co-residence	
		FB							+	Proximity	
		FB							+	Proximity	
	UK	IBI							none	Emotional/other	(Mathews and Sear 2013b)
		IBI							+	Proximity	
		IBI							+	Support	
	UK[3]	FB/IBI			+					Emotional/other	(Waynforth 2012)
		FB/IBI			+			none	none	Proximity	

		FB/IBI			none					Support	
		FB/IBI			none					Support	
		IBI			none			none		Support	
		IBI							none	Support	
	UK	IBI 2nd	none	none		+	+			Proximity	(Tanskanen et al. 2014)
		IBI 3rd+	-	-		none	None			Proximity	
		IBI 2nd	none	none		none	None			Survival	
		IBI 3rd+	-	none		none	None			Survival	
America	US	IBI			none					Co-residence	(Manlove et al., 2000)
		IBI			none					Support	
Asia	TW	TCH						+		Co-residence	(Thornton et al. 1986)
	TW	FB						+		Co-residence	(Tsay and Chu 2005)
		IBI 2nd						+		Co-residence	
		IBI 3rd +						+		Co-residence	
	TW	IBI 2nd						+		Co-residence	(Chi and Hsin 1996)
		IBI 3rd +						none		Co-residence	
	JP	FB			+			+		Co-residence	(Fukukawa 2013)
		IBI	none	none	none	+	None	+		Co-residence	
	JP	TCH	+			none				Proximity	(Nosaka 2009)
Number of effects		+	1	0	7	2	1	7	7	+	
		-	3	1	1	0	0	0	0	-	
		none	4	5	16	4	4	6	3	none	
		total	8	6	24	6	5	13	10	total	

[1] positive effect only for parents with child under three years old

[2] results from models with most controls used

[3] study also presents data for males; only female results presented here

IBI=interbirth interval; could refer to any birth after 1st unless otherwise specified; includes EHA models and logit models for higher order births

FB=first birth; either EHA or logistic regression on first birth

TCH=total number of children

Table 1.2: Number and proportion of associations by outcome, predictor, and kin identity

		# studies	# effects	Number +	Number -	Number none	Proportion +	Proportion -	Proportion none
Outcome	FB	8	14	8	1	5	57.1	7.1	35.7
	IBI	13	54	13.5	4	36.5	25	7.4	67.6
	IBI 2nd	5	12	4	0	8	33.3	0	66.7
	IBI 3rd +	3	10	1	3	6	10	30	60
	TCH	3	5	4	0	1	80	0	20
Predictor	Support	7	15	4.5	0	10.5	30	0	70
	Proximity	10	25	9	3	13	36	12	52
	Co-residence	6	18	10	0	8	55.6	0	44.4
	from Asia	4	14	9	0	5	64.3	0	35.7
	from Europe/US	2	4	1	0	3	25	0	75
	Survival	3	11	1	1	9	9.1	9.1	81.8
	Emotional/other	3	4	1	1	2	25	25	50
Who	Parents	14	39	8.5	5	25.5	21.8	12.8	65.4
	In-laws	8	24	10	0	14	41.7	0	58.3
	from Asia	5	11	8	0	3	72.7	0	27.3
	from Europe/US	3	13	2	0	11	15.4	0	84.6
	Unspecified	4	10	7	0	3	70	0	30

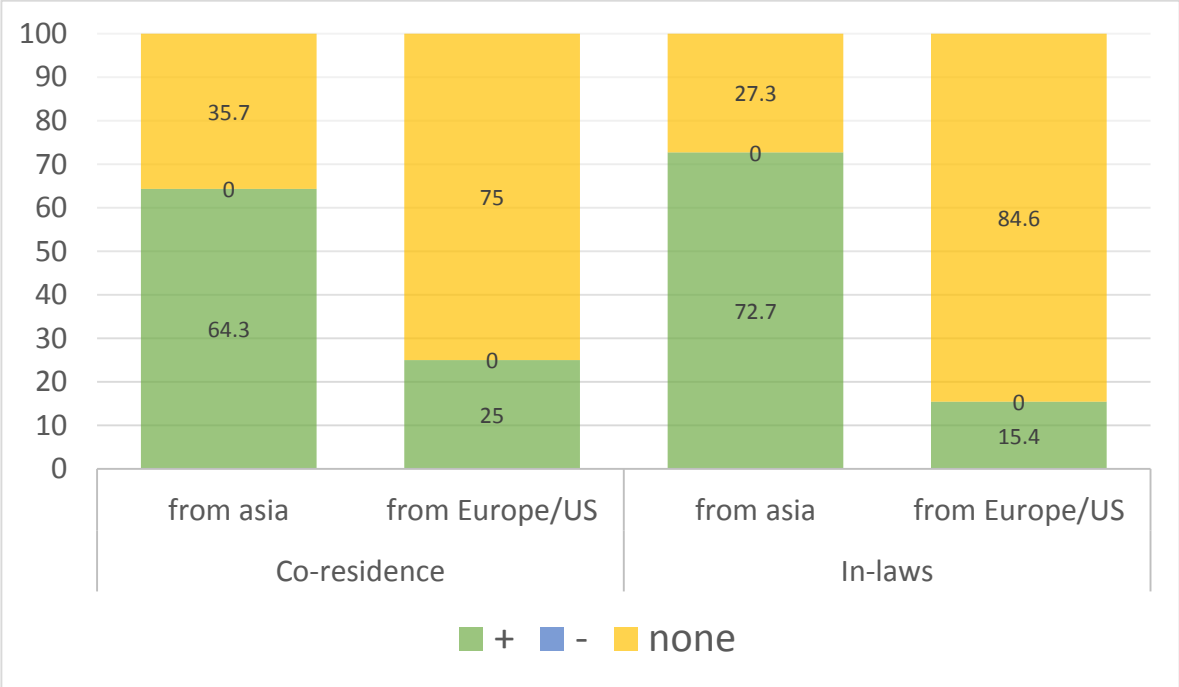

Figure 1.1: Proportion of associations for co-residence and kin identity by study setting (Asia versus Europe and America)

Table 1.3: Summary of associations between kin and women's fertility intentions

Region	Population	Outcome	Effect of:			Predictor	Authors
			Parents	*In-laws*	*Unspec. Kin*		
Europe		Intention (2^{nd}/3^{rd})	+[1]	none	none	Childcare	(Tanskanen and Rotkirch 2014)
	EU	Intention (2^{nd}/3^{rd})	+	+[2]	+	Emotional	
	IT	Intention (2^{nd})			+	Support	(Fiori 2011)
	IT	Intention (2^{nd}+)			-	Co-residence	(Modena and Sabatini 2011)
	IT	Intention (1^{st})			+	Proximity	(Raymo et al. 2010)
		Intention (2^{nd})			none	Proximity	
		Intention (3^{rd})			none	Proximity	
	BG	Intention (1^{st})	+		+	In network	(Bühler 2005)
		Intention (2^{nd})	+		none	In network	
		Intention	none		none	In network	
	NL	Intention (1^{st})	-			Emotional	(Balbo and Mills 2011a)
		Intention (2^{nd}+)	none			Emotional	
America	US	Intention	none			Emotional	(Miller 1992)
	US	Intended fertility			+	Childcare	(Lehrer and Kawasaki 1985)
Asia	JP	Intention (1^{st})			none	Proximity	(Raymo et al. 2010)
		Intention (2^{nd})			none	Proximity	
		Intention (3^{rd})			none	Proximity	
	TW	Intended fertility		+		Proximity	Yen et al 1989
	TW	Intended fertility		+		Co-residence	Thornton et al 1986
	KR	Intention (2^{nd})			+	Childcare	Park et al 2010
	KR	Intention (2^{nd})	none	none		Co-residence	Park 2012
1 maternal grandfathers only							
2 paternal grandmothers only							

1.5 THESIS STRUCTURE

The broad aims of my dissertation are as follows:

1) contribute to the understanding of the relationship between support (particularly from parents and in-laws, but also others) and women's fertility in low-fertility, high-income countries
2) test the effects of many types of support on women's fertility to deepen our understanding of how kin support plays into women's reproductive decision-making
3) explore contextual factors which may moderate the effects of support on women's fertility

Each of the following research chapters will address one or several of these aims. As a publication based thesis, each of the chapters is written to comply with the themes and formats of various peer-reviewed journals. Two of the chapters represent work already published, while the other two are written to be submitted in the coming months.

The work presented in this thesis uses three secondary data sets collected from low-fertility, high-income countries: the Generations and Gender Survey (Programme 2012); the Millennium Cohort Study (Hansen 2012); and the original Kinsey survey (Kinsey, Pomeroy, and Martin 1948; Kinsey et al. 1953). The benefits of using secondary data include the saved time and costs of data collection, and access to far larger amounts of data than would be possible to collect during a three-year PhD studentship, including longitudinal information. A limitation of using secondary data is that researchers must be flexible in how to address their research questions as their own research aims may not perfectly align with the original goals of the data collectors. The individual data sources will be discussed in the methods of each chapter.

CHAPTER 2: *Wealth modifies relationships between kin and women's fertility in high-income countries*

In this chapter, published in *Behavioral Ecology* (Schaffnit and Sear 2014), I used data from Wave 1 of the Generations and Gender Survey to test if wealth modifies associations between kin presence and women's lifetime fitness approximated in three ways: timing of first birth, total fertility, and probability of childlessness. Environmental context, particularly resource scarcity or abundance, is expected to modify the interactions between kin (cooperative, neutral or competitive) and thus potentially their relationship to women's fertility behavior. While observed in other species and (infrequently) in natural fertility human populations, there are few studies which explore this potential interaction between wealth and kin availability and its effects on female reproductive success in a low-fertility setting. I focus specifically on the effects of parental survival and length of co-residence with parents as measures of availability for practical reasons - this was the time-varying information available in the data set - and because these are the most commonly used proxies for kin support in the literature. I find evidence that extended co-residence with families delays first births, reduces total fertility and increases the probability of childlessness. The negative effect of co-residence with parents on lifetime fitness is felt more strongly for poorer women than wealthier women. While the result may be partially explained by competition between kin in resource stressed environments, self-selection of co-residers may better explain the result.

CHAPTER 3: *All allocare is not equal: Socioeconomic position, allomaternal support, and the decision to have a second child in the United Kingdom*

Mixed associations between support between support and fertility in HILF countries may be due to (1) the diversity of support types investigated between studies, or (2) the highly variable local reproductive decision-making contexts within countries including large amounts of socioeconomic inequality. This chapter uses data from the UK's MCS on second births to

address these issues. Firstly, patterns of support across socioeconomic groups are described for first time mothers, considering support from many sources (families, partners, and non-kin) and in many forms (emotional, childcare, or practical). Secondly, it was tested whether the absence of women's partners – key allomaternal carers in HILF countries, but often absent for some women – is substituted by support from other allocarers. Finally, associations were tested between different types of support and the probability of having second child, taking into account potential variation by SEP. The results demonstrate that (1) poorer women receive less support following the birth of a first child than wealthier women; (2) the absence of partners is somewhat substituted by support from others, particularly families; and (3) in general, practical support negatively associates with having a second birth, while emotional support has the opposite relationship with fertility. In one case, the association between support and fertility was modified by SEP: poor women receiving childcare from families had a higher probability of birth, while the opposite was true for wealthier women. This chapter highlights SEP as proxy for environmental harshness that may modify (allo)parental investment strategies, patterns of support, and women's reproductive schedules (in contrast to Chapter 2 where I consider how SEP can modify the nature of family relations from cooperative to competitive). The results of this study are discussed in terms of what support means and how SEP may modify these meanings. I plan to submit this piece of research for peer review in the next few months.

CHAPTER 4: *The role of family support in the fulfillment of fertility intentions in the United Kingdom*

In low-fertility settings, women often have fewer children than they intend leading some to suggest that there is an unmet need for children. One of the reasons for this may be a lack of

support for mothers. The role of family support in the fulfillment of fertility intentions is understudied despite good evidence that family support relates to intentions and, separately, to achieved fertility. Associations with fertility from the literature are mixed, however, with some particularly surprising negative associations between support and fertility. One reason for this may be that women's intentions are not being taken into account. Women have many competing goals and intentions. It is not clear how family support should associate with a woman's fertility given her fertility intentions. In this chapter, I test (and reject) the hypotheses that (1) for women who intend to have a second child, those with family support will be more likely to do so and (2) associations between support and fertility will be muted for women who do not intend to have children. Instead, the results show that family support, while sometimes positively relating to fertility intentions, does not help women achieve their fertility intentions (i.e. having a baby when one was intended). Further, associations between support and fertility are very similar regardless of fertility intentions. This study suggests that lack of family support is not a barrier to achieving fertility intentions in the UK.

CHATPER 5: *Fostering relations: first sex and marital timings for children raised by kin and non-kin carers*

In the final chapter, published in *Evolution and Human and Behavior* (Sheppard et al. 2014) and co-first authored with Paula Sheppard, a slightly different perspective is taken than in the preceding three papers. Rather than consider how support and family availability around the time of reproduction affects entry to motherhood, total fertility, probability of childlessness, or progression to second births, we consider how *early* life family contexts affects timings of first sex and reproduction (approximated using marriage). In the previous studies, kin support is conceptualized as a means of lowering the costs of reproduction; in this chapter, we predict

that the availability of kin in childhood will *delay* sexual and reproductive behavior. In low-fertility settings early sex, particularly, but also early reproduction are sometimes seen as risky behaviors. Because of this we expect kin, those with shared fitness interests, to buffer children from risky behaviors which may decrease their embodied capital and/or fitness. Using original Kinsey survey data, we tested the hypothesis that kin fosterers will serve as more similar proxies for genetically related parents than non-kin fosters, by testing the effect of early life family context (fostered by kin, fostered by non-kin, raised by genetically related parents) on the timing of first sex and marriage. Our hypothesis was supported, but we address several complications with interpreting this result in the chapter discussion.

CHAPTER 6: *Discussion*

Finally, in the discussion I will summarize the empirical findings of this dissertation and point out some of the methodological contributions of this work for studies on kin and fertility, particularly in low-fertility, high-income countries. I will then situate my own research within our knowledge of humans as cooperative breeders both in terms of the support we receive and how this support influences women's fertility outcomes in HILF countries.

2 WEALTH MODIFIES RELATIONSHIPS BETWEEN KIN AND WOMEN'S FERTILITY IN HIGH-INCOME COUNTRIES

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Principal Supervisor	Rebecca Sear
Thesis Title	Intergenerational Support and Women's Fertility in High-Income Countries: An Evolutionary Analysis

If the Research Paper has previously been published please complete Section B, if not please move to Section C

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Student Signature: Susan B Schaffer **Date:**

Supervisor Signature: Rebecca Sear **Date:**

2.1 ABSTRACT

Kin are generally expected to behave more cooperatively with their relatives than with unrelated individuals, and this cooperative behavior may result in positive effects on fitness. Such kin effects are likely to be modified by resource availability: in contexts of resource stress, cooperation among kin may disappear or weaken as more energy is required for investment in self. We use the Generations and Gender Survey, a large, multinational demographic survey, to test the following: firstly, how kin availability measures (parental survival status and co-residence with parents) affect measures of women's fitness (timing of first birth, total fertility, and probability of childlessness); and, secondly, whether wealth (an indicator of resource stress or abundance) modifies kin effects in a high- income, low-fertility setting. We find differing effects of survival status of, and co-residence with, parents on fertility outcomes. Having a living mother tends to be correlated with higher fitness: women with living mothers have earlier first births, and mothers' death in early life is correlated with a higher probability of childlessness. Fathers' survival has no effect on any outcome. Co-residence with parents, on the other hand, delays first births and results in lower total fertility and higher probability of childlessness. We additionally find that the negative effects of co-residence on reproductive outcomes are exaggerated for poor women. Our results speak of the role of environment in modifying the relationship between kin and fertility.

2.2 INTRODUCTION

Helping behavior between kin is both expected, since the development of Hamilton's Rule in the 1960s (Hamilton 1964), and commonly observed. In some species, this cooperation takes the form of help during reproduction, that is, cooperative breeding (see Cockburn 1998 on birds; Solomon & French 1997 on mammals), which can be partly explained by the indirect

fitness benefits helpers gain by raising related young (Clutton-Brock et al. 2001; Griffin and West 2003; Russell et al. 2007; Salomon and Lubin 2007). Though obligate cooperative breeding is rare among mammals, the order our own species belongs to is a relatively social order, and kin cooperation has been observed in a number of primate species (Paul 2005; Silk 2006). Further, help from kin has been shown to enhance the fitness of the helped individual across primate species, for example, by allowing higher reproductive rates (Hasegawa and Hiraiwa 1980; Ross and MacLarnon 2000; Pavelka, Fedigan, and Zohar 2002). In humans, the availability of kin is positively correlated with fitness outcomes, including child survival and female fertility (see reviews in Sear & Coall 2011; Sear & Mace 2008), leading some to classify our species as cooperative breeders (Hrdy 2009a)[1]. Variation in ecological context, however, may modify the effects of kin availability on reproductive outcomes (e.g., Borgerhoff Mulder, 2007 in humans). Indeed, kin are not always expected to be cooperative. They may engage in competition, particularly where kin share the same resource base (Clark 1978; Silk 2006), thus diminishing fitness-enhancing effects. Empirically, the effects of kin on women's fitness are not universally positive (Voland and Beise 2005; Sear 2008; Sear and Coall 2011; Strassmann 2011; Strassmann and Garrard 2011).

In this study, we use a large demographic database to test the hypothesis that kin availability will increase women's fertility in a high-income, low-fertility (HILF) context (see also Aassve, Meroni, & Pronzato, 2012; Hank & Kreyenfeld, 2003; Kaptijn, Thomese, van Tilburg, & Liefbroer, 2010; Mathews & Sear, 2013a, 2013b; Waynforth, 2012). We also test if and how

[1] This sentence appears as it does in the *Behavioral Ecology* publication; I have since reconceptualized cooperative breeding discussed in Chapter **1**, Section 1.2 and Box 1. To reiterate, some people have argued that the observed relationships between kin support and individuals' fertility/child survival either qualifies or disqualifies humans as cooperative breeders. However, I believe that the definition of humans as cooperative breeders hinges upon our high levels of cooperation surrounding reproduction related to species or group level reproductive patterns, rather than the effects of support on a given individual's reproductive outcomes.

individual variation in resource availability modifies the effect of kin on fitness outcomes, something not often done in HILF settings. We address 2 main questions:

1) (How) does maternal kin availability—measured by parental survival and co-residence—affect women's fitness in terms of timing of first birth, total fertility, and probability of childlessness?
2) (How) does individual-level resource availability modify the effects of kin on women's fitness?

We first discuss the previous literature on ecological variation in kin effects, considering contexts in which kin cooperation or competition may occur. Second, we discuss briefly how kin availability is measured and the confounding factors that may muddle the interpretation of results gained from such measures.

2.2.1 Ecological variation in kin effects

Between species, the frequency of cooperation, including cooperative breeding, varies ecologically: one of the factors that influences whether species adopt this relatively rare breeding system is whether ecological conditions are such that the costs of helping are outweighed by the benefits (Stacey and Ligon 1991; Arnold and Owens 1999; Hatchwell and Komdeur 2000). Within species, ecological conditions also relate to patterns of cooperative behavior (Brown and Brown 1993a; Roberts et al. 1998; Canestrari et al. 2008; Eikenaar et al. 2010; Hatchwell et al. 2013): for example, carrion crows respond to enhanced territory resources by increasing their helping behavior at the nest (Canestrari et al. 2008). Behavioral ecologists working on our own species are very fortunate in both the amount of data available on human reproductive behavior and in the broad range of ecologies that humans inhabit; ecological variation in kin cooperation in humans is, therefore, becoming well documented.

Although kin availability in both high- and low-fertility settings is often correlated with women's reproductive success (birth timings, child survival and health, total completed fertility, etc.: see summaries in Sear & Coall, 2011; Sear & Mace, 2008), the exact relationships show some variation among populations. The effects of kin are often positive on women's fitness, as expected due to shared fitness goals between women and their kin, but variation in environment may modify either the costs or the benefits of helping for kin such that kin presence may not result in increased fitness for an individual woman. Resource availability is one factor that may modify the effects of kin due to changing costs and benefits of helping (Clark 1978; Brown and Brown 1993a).

Theoretically, resource availability should enhance potential cooperation between kin, whereas scarcity should magnify competitive outcomes and diminish cooperative behavior (Brown and Brown 1993a; Brown and Brown 1993b) as individuals find it harder to address their own needs and fitness interests (Wilson 2000). Empirically, this has been demonstrated in several species (e.g., rainbow trout: Brown & Brown, 1993a; pathogenic bacteria: Griffin, West, & Buckling, 2004; and fig wasps: West, Murray, Machado, Griffin, & Herre, 2001). In humans, evidence of resource availability modifying the effects of kin on women's fitness measures comes from natural fertility settings: in a Kenyan patrilocal group (i.e., married women live with husbands' kin), paternal kin increase the survival of children more effectively in wealthy families than in poor families (Borgerhoff Mulder 2007). However, in a Tanzanian population, an interaction was found between the effects of socioeconomic status and kin availability on children's weight-for-age status, such that kin availability benefited children from poorer households more than those from wealthy households (Hadley 2004), suggesting that kin are not always detrimental in resource- stressed environments and may be able to buffer the effects of low socioeconomic status in certain contexts. This points to a need for additional studies of the

interaction between wealth and kin availability, to clarify under what conditions kin may help and when they may hinder the reproductive output of their relatives. Further, although there is a large body of literature demonstrating that even in HILF environments, there is competition within families for resources (Lawson and Mace 2011), modification of kin effects on women's reproductive outcomes by wealth in these settings is not well documented.

A potential complication with studying fertility in a HILF setting is that individuals do not seem to be optimizing their fitness; despite high country-level wealth, total fertility rates are extraordinarily low (Lesthaeghe and Willems 1999). However, reproductive decision-making is still likely to be influenced by evolved mechanisms, even if total fertility levels are lower than what would be expected under the assumption of fitness maximization. Low fertility is frequently assumed by evolutionary anthropologists to partly result from the misfiring of evolved mechanisms in a novel environment, rather than to be entirely decoupled from fitness considerations (Borgerhoff Mulder 1998; Smith, Mulder, and Hill 2001). Testing evolutionary hypotheses in low-fertility contexts is still a worthwhile endeavor, and evidence supports the suggestion that human behavior is still informed by evolved mechanisms even in such contexts (Lawson and Mace 2010), including empirical support for the hypothesis that kin availability increases fertility (Kaptijn et al. 2010; Mathews and Sear 2013a; Mathews and Sear 2013b). We, therefore, still expect to see women responding to previously fitness-enhancing cues such as kin availability when making reproductive decisions, even if they ultimately do not end up maximizing their fitness. A lack of kin support may even be part of the explanation for very low fertility (Barkow and Burley 1980; Turke 1989; Newson et al. 2005). Individuals may perceive that there is a lack of suitable support for raising children given the loosening of kin ties in industrialized societies and may therefore restrict their fertility even if they are relatively economically secure.

2.2.2 Measures of kin availability

Both parental survival and co-residence with kin are commonly used measures of kin availability in studies of human reproductive behavior (parental survival: Sear, Mace, and Mcgregor 2000; Voland and Beise 2002; Sear, Mace, and McGregor 2003; Gibson and Mace 2005; Sear 2008; Mace and Colleran 2009; Sear and Mace 2009; co-residence: Morgan and Rindfuss 1984; Jamison et al. 2002; Tsay and Chu 2005; Snopkowski and Sear 2013), and we use these measures here. Both measures are generally assumed to indicate the presence of cooperative kin, but there are confounding factors that may mean that the interpretation of such measures is not straightforward, particularly for co-residence.

The availability of kin measured by parental survival may be indicative of kin cooperation but may also capture a healthy family effect because individuals within the same family share similar healthy genes and/or a healthy environment. Comparing correlations across different parents (mothers vs. fathers, as done here, or across maternal vs. paternal kin, as done by Sear, Mace, and Mcgregor 2000; Jamison et al. 2002; Voland and Beise 2002; Sear, Mace, and McGregor 2003) and different outcomes, in addition to examining the timing of parental effects, is often done to try and exclude the possibility that such correlations are spurious. But even where alternative explanations can be excluded, parental survival does not indicate how kin may be supporting women—with allomaternal care, resource transfers, or emotional support.

Co-residence between kin may be a more reliable measure of kin availability than parental survival status as interactions between kin are essentially guaranteed. This measure has been frequently used as a proxy for kin cooperation (Morgan and Rindfuss 1984; Jamison et al. 2002; Tsay and Chu 2005; Snopkowski and Sear 2013). Co-residence has been shown to positively

relate to cooperative behavior between parents and their adult children as measured by providing childcare to grandchildren (Hank and Buber 2009; Smits, Van Gaalen, and Mulder 2010; Heylen et al. 2012), and such childcare independently has been shown to positively affect women's fertility (Kaptijn et al. 2010; Aassve, Meroni, and Pronzato 2012; Mathews and Sear 2013a). Extended co-residence with kin may, however, indicate poverty (particularly in contexts where adults are expected to maintain households separate from their parents, as has been typical in Western Europe for several centuries: Hanjnal 1982) and/or the need to support either a parent or child incapable of independent living (Choi 2003; Robila 2004), although, empirically, most supportive investments are from older to younger generations as predicted evolutionarily (White 1994; Choi 2003; Pollet and Dunbar 2008; Fingerman et al. 2011; Dykstra and Komter 2012).

2.3 METHODS

2.3.1 Data

To address our objectives, we use data collected between 2004 and 2010 by the Generations and Gender Program (GGP; http://www. ggp-i.org/), a collaboration between 11 European institutes with the purpose of improving policy in Europe (United Nations 2005). The data come from 19 high-income countries and include around 10,000 randomly selected participants per country. Sampling methods varied between countries, but effort was made to produce nationally representative samples. Though the purpose of the GGP is policy oriented, the data, collected through face-to-face surveys, include women's birth schedules and provide an excellent opportunity to test evolutionary hypotheses with larger sample sizes than usually available to behavioral ecological researchers. For this study, we use data for 26,787 women between the ages of 17 and 83 from 8 countries—Austria, Belgium, Bulgaria, France, Georgia,

Lithuania, Norway, and Russia. Countries and individuals were included in our analyses based on the availability of our variables of interest (outlined below). Austrian data were only included in the timing of first birth model because women aged older than 46 were not surveyed in the country (only 6 women aged 46 years were surveyed, and all other participants were aged 45 years or younger). The total fertility and probability of childlessness models include all 7 other countries. Participants experienced 20,675 births, with parities ranging from 0 to 13. For those older than the age of 45 (assumed to be post-reproductive), the average fertility was 1.83, which is in line with recent measures of completed family size in Europe (Myrskylä, Goldstein, and Cheng 2013), and 14.09% of these women remained childless. Fertility varied between the countries we included; it is generally lower in eastern, and higher in northern Europe. To account for the non-independence of individuals' fertility outcomes within each country, all analyses outlined in the following section control for country with a random-effects term. All analyses were completed using STATA 12.

2.3.2 Fitness measures

Our study consists of 3 outcomes related to women's fertility—timing of first birth, total fertility, and probability of lifetime childlessness—which we use as proxies for fitness. Each outcome allows us to understand how kin affect different aspects of a woman's reproductive behavior at different points in her life.

2.3.3 Timing of first birth

The relationship between timing of first birth and kin availability was analyzed using random-effects discrete-time event-history analysis, which models the probability of a birth per unit time. Using discrete-time event-history analysis to analyze the timing of first birth offers 2 main benefits relative to using a linear regression with age at first birth as the outcome: 1) the model

allows the inclusion of women who have not yet had a child (i.e., censored cases), which avoids biasing the analysis toward those women who have early births and 2) effects of predictors are allowed to vary over time (relevant for predictors such as kin availability because parental survival status and co-residence status both often change across the time period over which women are at risk of having a first birth) (Singer and Willett 1993). All women without missing data for our variables of interest were included in the analysis (n = 26,787). The dependent variable was a binary indicator of whether a first birth occurred for a participant in a given time interval (i.e., the analysis is based not on an individual-level data file, but a file in which each row represents a unit of time within a woman's life). Time was measured in years, and women were entered into the analysis at 15 years of age because few births occurred before this age. Time and time-squared were included in the model to control for the nonlinear relationship between age and probability of first birth. Interactions between time/time square and all predictors were included in initial models to test the proportional hazards assumption of these models, and significant interactions were retained in the model.

Dates of both the first transition out of the parental home and parental deaths were available, so the independent variables coding for kin availability were time-dependent binary indicators of whether, at a given time point, 1) a woman's mother and 2) father were still alive and 3) she still lived with her mother and/or father. The time-varying co-residence variable captures only women's first transition from the parental home (i.e., women are considered non-co-resident once they have left the parental home for the first time even if they later move back in) because later transitions tend to be related to hardships such as illness or change in either partnership or employment status (Grundy and Harrop 1992; Smits, Van Gaalen, and Mulder 2010; Berrington and Stone 2013), the effects of which we do not wish to capture. The number of siblings was included to control for heritable fertility and/or fecundity, and this was modeled

using a quadratic function because the correlation between number of siblings and probability of birth was not linear.

Resource availability is approximated by a wealth score created using factor analysis from a set of variables regarding women's possessions (whether she owned a second home, washing machine, digital video disk player, home computer, dish washer, and second car), whether the household can make ends meet, and whether the respondent had accrued savings. Due to the binary and categorical nature of these variables, a Pearson correlation matrix, from which factor analyses are generally run, was not appropriate (Child 2006). Rather, a polychoric correlation matrix was created under the assumption that the variables included herein represent a trait (wealth) that is continuously distributed among the people in the study population (Kolenikov and Angeles 2004; Howe, Hargreaves, and Huttly 2008; Kolenikov and Angeles 2009). A factor score was then created from the polychoric correlation matrix by country. Higher wealth scores represent higher wealth relative to fellow country residents. This single variable coding for wealth was then entered in the model, as were interactions between wealth and the kin availability variables.

In addition, several control variables were included in the model. At the participant level, these included a binary, time-varying indicator of partnership status (partnership was defined as co-residing with an unmarried or married partner), a categorical measure of the highest level of completed education (1 = no school or primary only; 2 = secondary school; and 3 = postsecondary/tertiary), respondent age group, and a binary indicator of whether the respondent was in education at the time of interview. A country-wealth score was included in the models. This represented the mean wealth score for individuals within each country relative to the whole sample measured at time of interview. When countries were ranked by

this wealth variable, their order reflected their relative Human Development Index ranks in 2014 suggesting that this measure was a good approximation of country wealth/standard-of-living status. An interaction term between living with parents and partnership status was included in the model because we expect partnership status to modify the effects of parents: women may need more help from parents if they lack help from a partner, for example.

The wealth (individual and country-level) and control variables were all collected as current status data, that is, women's wealth at the time of interview (not necessarily at the time of first birth) was included in the model (as is commonly done in the literature on socioeconomic status and fertility; see Weeden et al. 2006; Fieder and Huber 2007; Huber, Bookstein, and Fieder 2010; Fieder, Huber, and Bookstein 2011; Barthold, Myrskylä, and Jones 2012). Particularly in Eastern Europe where there have been significant economic changes since the dissolution of the Soviet Union using current individual and country level wealth could muddle results. By using relative measures of wealth, we hope to somewhat alleviate this danger. Further, in an attempt to account for any potential social mobility among women between their first births and their current status, we included a social mobility score. This was created by measuring the difference between women's educational achievement and that of their fathers. We calculated the mean for educational attainment for different age groups and then, for both women and their fathers, we calculated the standard deviation from the mean for educational attainment for their age group. The fathers' values were subtracted from those of their daughters to obtain the social mobility score.

2.3.4 Total fertility

Total fertility at the time of the survey was modeled using a random-effects Poisson regression, as the outcome is a count variable. Women aged older than 45 years, presumed to be post-

reproductive, were included in the model if data for key variables were not missing (n = 12,910). Mother's survival status was measured with a categorical variable, coded for the age of the woman when her mother died. Women who were older than the age of 45 when their mother died or whose mothers were still alive at the survey date were used as a reference category. A variable for father's survival status was created similarly. The age at which women left their natal home was included as a categorical variable. Those who exited the natal home prior to the age of 15 years were the reference category. The oldest category, women who exited the natal home after the age of 30 years, included the very small number of women who still lived with their parents at the time of interview (n = 161). Women's age and age-squared were included in the model, as was a binary variable indicating whether the respondent had ever had a partner. As in the first birth models, number of siblings and number of siblings squared, education, wealth, country wealth, and social mobility were also controlled for. An interaction between wealth and the age at which women left their natal home was included to address our second objective.

2.3.5 Probability of childlessness after age 45

Probability of childlessness was analyzed using a random-effects logistic regression. The binary dependent variable indicated whether respondents were childless at the age of 45 years. The sample included only women older than 45 years at the time of interview for whom we had all variables of interest (n = 12 910). The predictors in this model were identical to those in the total fertility Poisson regression model (above).

Table 2.1: Descriptive data for key variables used in the analysis by wealth quartiles

	Wealth Quartile				
	Lowest	Low	High	Highest	Total
Median ages at					
Leaving natal home	20	20	20	20	20
First partnership	21	21	22	22	22
First birth	23	23	24	25	24
Mother's death	46	44	44	44	45
Father's death	37	36	35	38	36
Education (%)					
No education/primary education	17.7	8.6	8.8	9.8	11.1
Secondary	58.3	55.8	45.8	48.2	51.5
Post-secondary/tertiary	24	35.6	45.3	42	37.4
Number of Siblings (%)					
1	26.9	38.8	42	33.4	35
2	24.5	24	24.8	27.6	25.5
3	17	14.2	12.2	16	15
4	11	8.5	7.4	8.1	8.7
5	7.7	5.2	4.6	4.4	5.4
6+	12.9	9.4	9.1	10.5	10.5
Social Mobility (mean)	0.05	0.08	0.14	0.16	0.12

2.4 RESULTS

Women typically followed a predictable sequence of life events, starting with exiting the parental home (median age: 20 years), gaining a cohabiting partner (median age: 22 years), and then reproducing (median age: 24 years) (*Table 2.1*). There is some variation among countries in the timing of this sequence, but in all countries, the median of these transitions occurs within 2–6 years of one another, and the transitions are always in the order described. Median ages at the time of death of mothers and fathers differed by 9 years between countries; the medians for all countries combined was 45 years at mother's death and 36 years at father's death. The median education of respondents was 2, indicating secondary school, across wealth quartiles and countries. Average number of siblings ranged from 1.6 in Bulgaria to 2.9 in France, with total mean of 2.3.

Table 2.2: Results from random-effects models for timing of first birth (discrete-time event history analysis), total fertility (Poisson regression), and childlessness (logistic regression)

	Timing of First Birth [a]			Total Fertility [b]			Prob. of Childlessness [b]		
	OR	95% C.I.		IRR	95% C.I.		OR	95% C.I.	
Resources									
Wealth	0.46**	0.41	0.51	1.06	0.97	1.15	0.74	0.49	1.10
Kin									
Has partner	18.87**	16.50	21.58						
Has had partner				1.98**	1.84	2.13	0.07**	0.06	0.08
ref: ended co-residence before age 15									
16-20				1.07	0.96	1.19	0.74	0.44	1.24
21-25				0.99	0.89	1.11	0.88	0.51	1.50
26-30				0.91	0.79	1.05	1.3	0.69	2.43
>30				0.69**	0.59	0.80	4.64**	2.64	8.18
ref: not co-residing with parents									
Co-residing with parents	0.11**	0.09	0.12						
ref: Mother Death >45									
<10				0.98	0.87	1.09	1.29	0.80	2.09
10 to 19				0.96	0.88	1.05	1.56*	1.09	2.25
20 to 24				1.01	0.92	1.10	0.99	0.65	1.50
25 to 29				0.97	0.90	1.05	1.07	0.75	1.54
30 to 34				1.03	0.97	1.10	0.97	0.71	1.32
35 to 39				1	0.95	1.05	1.16	0.91	1.48
40-44				0.99	0.95	1.04	0.99	0.80	1.22
ref: Mother Dead									
Mother Alive	1.14**	1.06	1.23						
ref: Father Death >45									
<10				1.05	0.94	1.16	0.98	0.61	1.55
10 to 19				0.96	0.91	1.02	1.24	0.97	1.58
20 to 24				1	0.94	1.06	1.2	0.92	1.58
25 to 29				1	0.95	1.05	1.1	0.86	1.40
30 to 34				1.03	0.98	1.08	0.91	0.73	1.14
35 to 39				0.99	0.94	1.03	1.04	0.85	1.27
40-44				1.03	0.99	1.07	0.87	0.71	1.05
ref: Father Dead									
Father Alive	1.02	0.97	1.07						
Interactions									
Wealth x co-residence	1.24**	1.16	1.32						
Co-residence x partner status	2.43**	2.25	2.62						
ref: Wealth x ended co-residence before age 15									
Wealth x co-residence 16-20				0.95	0.88	1.04	1.07	0.71	1.60
Wealth x co-residence 21-25				1	0.92	1.09	0.96	0.64	1.46
Wealth x co-residence 26-30				0.99	0.88	1.11	0.9	0.54	1.49
Wealth x co-residence >30				1.14*	1.00	1.31	0.57*	0.34	0.94

rho (alpha for total fertility)	0.01	0.01	0.04
n	26,787	12,910	12,910

CI = confidence interval.

[a]Model controls for woman's age, time, and time square; number of siblings, number of siblings square; highest level of education, present education; country wealth; social mobility; and interactions between time, time square, partnership status, co-residence with parents, and wealth.

[b]Models control for woman's age, age square, country wealth, highest level of education, social mobility, number of siblings, and number of siblings square.

* p<=0.05; ** p<0.001

2.4.1 Fertility outcomes

The results of all 3 fertility models are presented in Table 2.2, as either odds ratios (ORs, for the analysis of the timing of first birth and the probability of childlessness) or incidence rate ratios (IRRs, for the Poisson model of number of children). Values greater than 1 represent a higher likelihood of the outcome (i.e., earlier first births, more children, or higher probability of childlessness), and values less than 1 represent lower likelihood of the outcome. The table includes a measure of intraclass correlation (ρ or α) for each model. In all cases, this value is very small, indicating that the variation in each fertility outcome within countries is rather small. We tested for differences between countries in the effects of our kin predictors and found no evidence to suggest that predictor variables behaved differently in different countries.

Co-residence with parents was correlated with delayed first births: in the analysis of first births, women who were still resident with their parents had much lower odds of a birth per unit time than did those who had left the parental home (OR = 0.11; P < 0.001). Women who remained co-resident with parents longer also had lower completed fertility and higher probability of childlessness after age 45 years than those who left the parental home early. The results of both the total fertility and probability of childlessness models suggested a roughly linear relationship between co-residence and the fertility outcomes, in that the longer the woman remained resident with her parents, the lower was her completed fertility and the higher was

her probability of childlessness. The only significant differences, however, were for the woman who remained co-resident with her parents after the age of 30 years (for total fertility, IRR = 0.69 for women who remained co-resident with parents after age 30 compared with those who moved out before age 15; $P < 0.001$; for the probability of childlessness, OR = 4.64 for women who were co-resident with parents until older than age 30 compared with those who moved before age 15; $P < 0.001$). The timing of first birth analysis included an interaction between co-residence and partner status. This interaction was statistically significant and demonstrated that having a partner slightly mitigated the negative effects of co-residence: partnered women, whether co-resident or not, were more likely to have a first birth per unit time than unpartnered women, but unpartnered women who were still co-resident with parents were much less likely than unpartnered women who were no longer co-resident. This suggests having a co-resident partner may be more important than co-residence with parents for predicting the timing of first birth.

Parental survival had more mixed effects than co-residence. Having a living mother was associated with earlier first births (OR = 1.14; $P < 0.001$), but having a living father had no effect on first birth timing. Examining the ORs for the probability of childlessness model suggests that women who lost their mothers in childhood were more likely to be childless at age 45 than those whose mothers lived longer, and there was a significant difference for women who experienced the death of a mother between the ages of 10 and 20 years compared with those with living mothers (OR = 1.56; $P = 0.02$). Father's survival status had no significant effect on the probability of childlessness. Parental survival, of neither mothers nor fathers, was significantly associated with total fertility. Overall then, having a longer-living mother was associated with pro-natal outcomes, a younger age at first birth, and lower probability of childlessness, but father's survival status appeared unimportant for fertility outcomes.

There is a possibility that any kin effects that we found might be confounded by maternal or paternal age effects because women whose parents were still living were likely to have had parents who were younger at the time of their births. To account for this, we ran all models again with a control for women's mothers' ages at the birth of the focal woman (essentially a generation-gap control). This did not change the direction or significance of our results, nor was mothers' age at birth a significant predictor of the outcome in either the probability of childlessness or total fertility models. The timing of first birth was significantly correlated with mothers' age at birth, but the magnitude of the effect was negligible (OR = 0.99; P = 0.048).

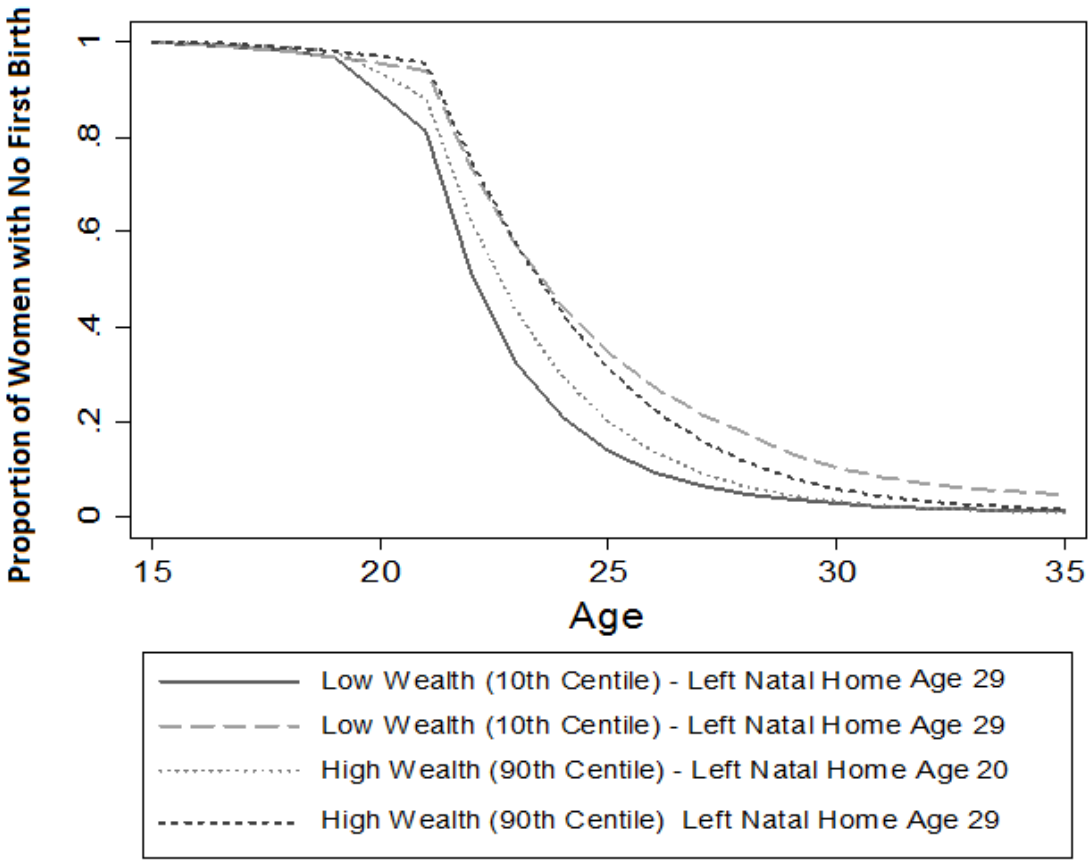

Figure 2.1: Predicted survival curves (estimated from model output) for timing of first birth by wealth and age of leaving natal home

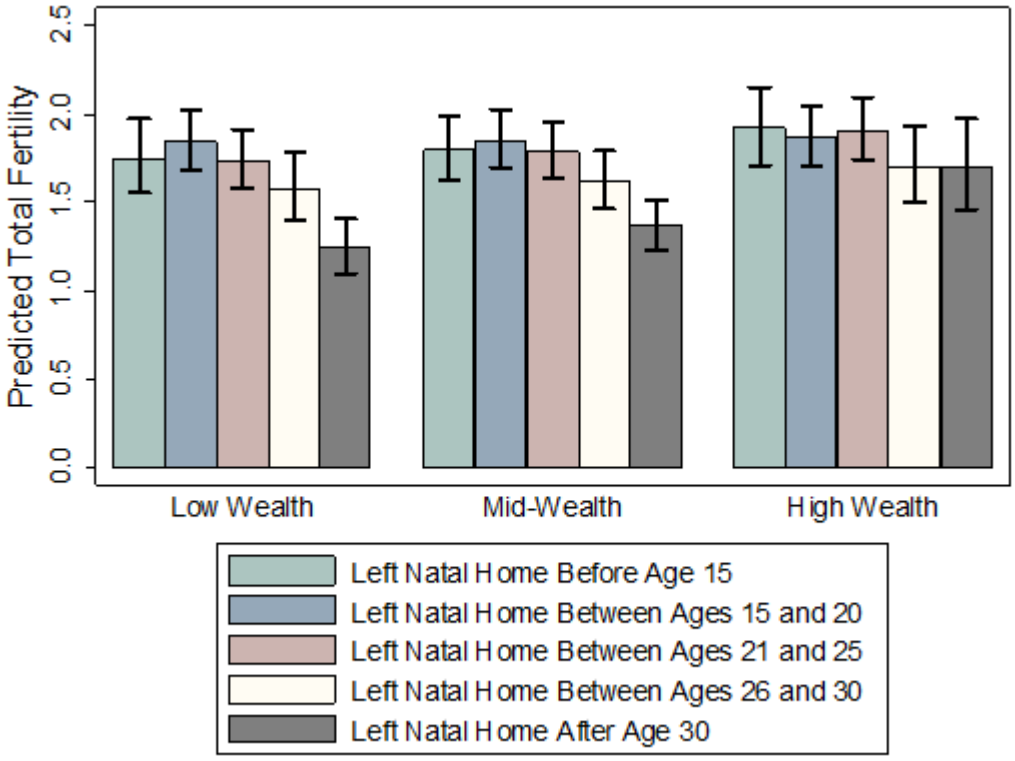

Figure 2.2: Predicted total fertility (estimated from model output) by wealth (low = 10th percentile; mid = 50th percentile; and high = 90th percentile) and age of leaving natal home, with 95% confidence intervals

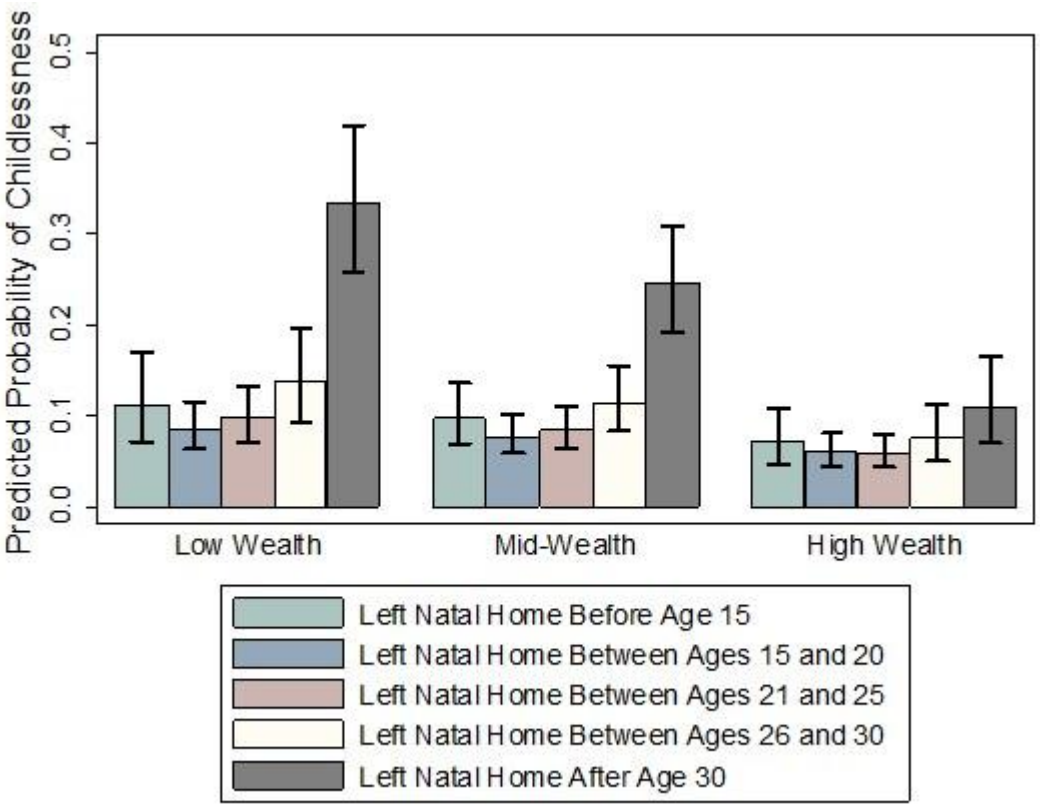

Figure 2.3: Predicted probability of childlessness (estimated from model output) by wealth (low = 10th percentile; mid = 50th percentile; and high = 90th percentile) and age of leaving natal home, with 95% confidence intervals

A wealth score was our main measure of resource availability. Higher wealth was associated with later first births (OR = 0.46; P < 0.001) but had no statistically significant relationship with the probability of childlessness or total fertility. For all 3 fertility models, we found a significant interaction between wealth and co-residence between women and their parents. In each case, the interaction suggested that the negative effects of co-residence on fertility were exacerbated for low-wealth women. Figure 2.1 illustrates the interaction between wealth and co-residence in the first birth model by plotting predicted survival curves for first births by women's wealth and the age at which they leave their natal home for the first time. This figure shows the proportion of women predicted (based on model output) not to have progressed to a first birth at each age (plotted for women who gained a partner at age 22, other variables

held at their means). We have plotted out these curves for high- and low-wealth women (defined as women in the highest and lowest deciles of wealth, respectively) and for women who left home at ages 20 and 29 (ages were chosen to represent women who leave home at a normative age and relatively late). We see that leaving home earlier (plotted for age 20) for both women of high and low wealth leads to earlier first births but that poorer women who leave home early progress more quickly to first births than wealthier women. Women of both high and low wealth who leave home late have later first births, but wealthy women who leave home late do "catch up" by age 35 with those women who leave home early. Low-wealth women who left their homes later, however, did not catch up in terms of progressing to a first birth by the age of 35 years, suggesting that low wealth exacerbates the fertility- inhibiting effect of co-residence. For total fertility, a similar pattern is exposed when we plot predicted fertility from the interaction (Figure 2.2). Women with lower wealth feel the negative effects of extended co-residence on their fertility more strongly than women with higher wealth. Low-wealth women who leave home later have significantly lower total fertility than wealthier women who leave their natal home at the same age. Finally, the effect of co-residence on the probability of childlessness is also most strongly felt by low-wealth women (Figure 2.3): poorer women who leave the natal home later are significantly more likely to remain childless than high-wealth women who leave the natal home at the same age.

2.5 DISCUSSION

Our results demonstrate that kin availability is correlated with fertility in our study population. The nature of these correlations, however, depends on the measure of kin availability used. Although maternal survival predicts early first births and maternal absence in early life increases the probability of childlessness, paternal survival has no significant effects on our fitness measures. The positive effects of maternal survival on women's fitness may be due to

the benefits of kin helping behavior known to enhance fitness across species (Clutton-Brock et al. 2001; Griffin and West 2003; Salomon and Lubin 2007; Sear and Mace 2008). We cannot entirely exclude the possibility that the positive correlations are due to a healthy family effect, whereby longevity and early reproduction are correlated because some families are simply healthier than others and are therefore good at both surviving and reproducing. Health, however, is not typically the strongest determinant of reproductive behavior in HILF societies, as it is in poorly nourished societies (Sear et al. 2003b). We also see no correlations between fathers' survival and the fertility of their daughters, which we might expect to see if a healthy family effect is influencing our results for mothers. An obvious extension of this research will be to explore more fully the pathways through which mothers may encourage their daughters to reproduce. For example, social pressure, the provision of childcare, emotional support, or financial transfers (or a combination of these) may be means by which mothers affect their daughters' fertility and thus enhance their own inclusive fitness. The first wave of the GGP does not allow us to adequately explore this issue further; however, the second and third waves of the survey will allow an analysis of how different types of kin investments in the first wave affect subsequent fertility outcomes.

In contrast with maternal survival, co-residence is correlated with lower fertility across all 3 of our outcome measures: later age at first birth, lower total fertility, and higher probability of childlessness. This is not expected if co-residence is an indicator of the availability of helpful kin, as it is often suggested to be in other parts of the world (Hank and Buber 2009; Smits, Van Gaalen, and Mulder 2010; Heylen et al. 2012), but it may perhaps be explained by co-residence being an indicator of competition between kin. Our study population is in a resource-abundant context, however, where resources are not limiting women's reproductive ability. Although it is possible that perceptions of resource scarcity relative to other individuals in the population

may well be influencing reproductive decisions, we are wary of concluding that competition between kin is the sole explanation for our results. We note that although co-residence implies kin availability, there are some challenges with the interpretation of this variable when considering our own species. For non-human animals, kin (or non-kin) sharing a territory will involve sharing a resource base and will allow both competitive and cooperative behavior, whereas once kin have dispersed to a different territory, they tend to be relatively independent of one another. For humans, it can be difficult to define a "territory." Co-residence within the same household certainly implies sharing a "territory" and does allow the opportunity for both competition and cooperation between kin, but non-co-resident kin also frequently share resources and are often involved in cooperative and sometimes competitive behaviors. This is particularly likely to be true in the high-income context that we study here because "resources" typically refer to monetary wealth or assets, which are easily transferable between individuals and households. Here, we suggest that self-selection of co-residers may also be a factor in the negative correlations we find between women's fertility outcomes and co-residence. It is normative for adult children to leave the parental home before reproducing, in the context of this study; hence, co-residence with parents beyond a normative age may indicate an inability or lack of desire to set up one's own home and is therefore perhaps an indicator of the "quality" of the individual (in terms of fitness potential).

One potential alternative explanation for our finding that co-residence is correlated with lower fertility is that women who do not wish to have children choose to stay at home longer than those who are keen to have children (i.e., reverse causation), but this begs the question of why certain women would like to have children, whereas others do not. The interaction that we find between wealth and co-residence makes improbable the possibility that women who extend co-residence are simply uninterested in reproduction at all. If this were the case, wealth would

not buffer the negative effects of co-residence on fertility. Based on the negative relationship between co-residence and fitness measures, along with the interaction between co-residence and wealth in all 3 fitness models, we suggest that co-residence is indicative of either possessing non-normative characteristics, which may decrease one's mate value, or some other characteristics associated with relatively low fitness potential, including adverse family circumstances (such as the need to care for a family member).

As mentioned above, we do, however, find ecological variation in these correlations between co-residence and fertility: across all 3 of our outcomes, co-residence has fitness-diminishing effects, but these effects are more strongly felt by poorer women than wealthier women. Wealth may mitigate these characteristics, if, for both poor and wealthy women, co-residence delays first births, but on exiting the parental home, being wealthy allows women to more quickly gain a home and partner—both tasks deemed important for entering adulthood in HILF settings (Furstenberg et al. 2004) —and to ultimately reproduce. This could occur if being wealthier would allow women to 1) purchase or rent a stable home more quickly on exiting co-residence (see Mulder 2013 for evidence of this), 2) be more readily able to enlist paid help for household help or childcare, or 3) more easily attract mates. Alternatively, long co-residence may mean something slightly different in poor and wealthy households: whereas in poor households, extended co-residence may be an indicator of relatively low fitness potential, compared with peers, in wealthy households, long co-residence may instead allow women to capitalize on the substantial amounts of parental investment they get from their wealthy parents (extending their education in order to improve their job prospects and subsequent earning power, e.g.: see Ellis 2004).

Our research contributes to a growing body of literature applying evolutionary approaches to human reproductive behavior. We are able to use a large, rich data set on our own species to explore ecological variation in reproductive behavior and find that, as predicted, resource environments modify relationships between indicators of kin availability and reproductive behavior. We find that co-residence, a common measure of kin presence/investments, does not result in enhanced fitness and suggest that the use of co-residence as a measure of kin cooperation or competition (Strassmann and Garrard 2011) may not always be appropriate in human evolutionary studies of kin and fertility, particularly in HILF contexts such as that explored in our study. Maternal survival positively relates to 2 fitness outcomes, suggesting that although fertility behavior is perhaps not optimized in HILF contexts, women still respond to evolved cues.

2.6 FUNDING AND ACKNOWLEDGEMENTS

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3 ALL SUPPORT IS NOT EQUAL: SOCIOECONOMIC POSITION, ALLOMATERNAL SUPPORT, AND THE DECISION TO HAVE A SECOND CHILD IN THE UNITED KINGDOM

RESEARCH PAPER COVER SHEET

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SECTION A – Student Details

Student	Susan B. Schaffnit
Principal Supervisor	Rebecca Sear
Thesis Title	Intergenerational Support and Women's Fertility in High-Income Countries: An Evolutionary Analysis

<u>If the Research Paper has previously been published please complete Section B, if not please move to Section C</u>

SECTION B – Paper already published

Where was the work published?	n/a		
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Where is the work intended to be published?	Evolution and Human Behavior or Demography
Please list the paper's authors in the intended authorship order:	Schaffnit & Sear
Stage of publication	Not yet submitted

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I am the first author on this paper. I was responsible for the research design, and conducted the statistical analysis. I was also primarily responsible for writing this work. My co-author supported this work in an advisory capacity and helping to edit the writing.

Student Signature: Susan B Schaffa **Date:**

Supervisor Signature: Rebecca Sear **Date:**

3.1 ABSTRACT

Research on how allomaternal support influences women's fertility in high-income, low-fertility settings shows variable results. This may be because the types of support investigated vary between studies, and because high-income data are collected from heterogeneous contexts including large wealth inequalities. In this paper, both problems are addressed firstly, by testing associations between different types of support and women's decision to have a second child in the United Kingdom, using data from the UK Millennium Cohort Study, paying special attention to the role of socioeconomic position (SEP). The categories of support type include a range of options available to women in the UK: support from families (parents or parents-in-law), support from partners, and support from non-relatives (paid childcare, other formal sources, and friends); included were both measures of material or practical support (financial help or childcare) and emotional support or perceptions of such support. In recognition of the heterogeneous reproductive decision-making landscapes in low-fertility countries, we explore whether socioeconomic position (SEP) modifies the availability of different types of support by (1) describing patterns of allomaternal support by SEP, and (2) testing how absence of key allomaternal support (that from partners) affects the availability of other support. Then, we use multimodel inference to test how allomaternal support after a first birth relates to the probability of having a second birth by SEP groups. Our results demonstrate that, while receiving some form of support is ubiquitous, low-income women receive less support than wealthy women; and that family and friend support increases in the absence of partner support, particularly for low-SEP women. When testing whether support predicts the likelihood of second births, we found broadly that receiving more practical support – financial support and paid childcare – is correlated with a lower probability of having a second birth, while receiving more non-practical or emotional support relates to higher probability of having a

second child in the United Kingdom. Associations were largely consistent across socioeconomic groups, with one exception: childcare from families positively predicts births in low-SEP groups, while the opposite is true for high-SEP women. Our results highlight that all support is not equal in the decision to have children, and that even in high-income contexts local SEP environments lead to different reproductive strategies.

3.2 INTRODUCTION

There is now considerable evidence for the hypothesis that humans are 'cooperative breeders', defined loosely as the requirement for women to receive allomaternal support for successful reproduction, which may include support from families and partners (Mace and Sear 2005; Hrdy 2009a; Sear and Coall 2011). This evidence is particularly strong when considering the beneficial impact of allocarers on child outcomes in low-income contexts (reviewed in: Sear and Mace 2008); studies correlating the presence of potential allomaternal support with successful reproduction show more mixed results when fertility is the outcome variable considered (Sear and Coall 2011), and when high-income contexts are investigated (e.g. Hank and Kreyenfeld 2003; Balbo and Mills 2011a; Aassve, Meroni, and Pronzato 2012; Waynforth 2012). Nevertheless, a number of studies on fertility in high-income contexts suggest that allomaternal support matters for reproduction (Kaptijn et al. 2010; Waynforth 2012; Mathews and Sear 2013a; Thomese and Liefbroer 2013; Mathews and Sear 2013b; Tanskanen et al. 2014). Part of the reason for inconsistent associations in high-income contexts might be that most literature on human cooperative breeding in high-income countries focuses on the role of family support, whereas new mothers in high-income countries typically have access to a wide variety of support, from partners, parents, in-laws, friends, professionals, and formal childcare providers, and may substitute support from non-relatives for that provided by more traditional sources (Thomese and Liefbroer 2013).

Further, mixed results may have been obtained in high-income countries because research in these contexts typically uses large-scale, nationally representative datasets which are very heterogeneous, including spanning a wide socioeconomic range. The United Kingdom, for example, has a large amount of socioeconomic inequality (OECD 2013). Socioeconomic position (SEP) is correlated with both reproductive schedules and levels of parental investment (Harris, Furstenberg, and Marmer 1998; Nettle 2008; Nettle 2010), as could be expected from life history theory if SEP is a proxy for environmental harshness (Adler and Ostrove 1999; Bajekal 2005). Life history theory predictions are less clear on, and less is known about, variation in allomaternal support across SEP groups, though we could expect that families may take on similar investment strategies to those of parents. Evidence suggests that the availability of family support (Nettle 2010; Thomese and Liefbroer 2013; Coall, Hilbrand, and Hertwig 2014), and partner availability (Séguin et al. 1995; Duncan and Magnuson 2005) varies by SEP. Partner availability and support is consistently lower in low SEP groups (Séguin et al. 1995; Harris, Furstenberg, and Marmer 1998; Nettle 2008; Nettle 2010). Family availability shows non-linear associations with SEP with those in the middle experiencing more contact with families (Nettle 2010). In the absence of one form of support others may step in (Meehan 2005; Thomese and Liefbroer 2013; Meehan, Helfrecht, and Quinlan 2014), so that lower SEP groups may rely more on kin for support than partners; alternatively, lower SES mothers may have to make do with less overall support. Economic context then alters a number of the parameters which influence both the availability of support to new mothers and, potentially, how women respond to this support in subsequent fertility decisions.

The *overarching aim* of this paper is to extend the cooperative breeding literature by comparing the influence of different kinds of support on a woman's decision whether or not to have a second birth in the United Kingdom: from her partner, her parents, her partner's

parents, and unrelated individuals. In addressing the overarching aim of this paper, we (1) describe patterns of support across socioeconomic groups and (2) test if absent partners – common supporters in high-income countries but often absent for some women (Séguin et al. 1995; Duncan and Magnuson 2005) – are substituted by support from families and unrelated individuals. Finally, (3) we explore how receiving various forms of support relates to women's decision to have a second child in the United Kingdom, taking into account potential variation due to SEP.

3.2.1 Support and women's fertility: who provides it, why, and with what effect?

As a cooperative breeding species, we expect that women need support to successfully reproduce (Hrdy 2009a). Availability of support for reproduction therefore has the potential to influence women's future fertility choices. Receiving support following the birth of a first child can reduce the energetic, time, and monetary costs of childrearing and thus incentivize further childbearing. Support surrounding childrearing can come in diversity of forms – childcare support, financial support, emotional support, etc. - and from many sources, particularly in high-income, low-fertility settings. It is not necessarily the case, however, that all support will have similar associations with women's fertility, as support may mean different things: receiving financial support may indicate financial need; emotional support may indicate the potential for help in times of need; or receiving childcare may free time for the pursuit of non-reproductive goals (e.g. career goals).

Though one might argue that many of the costs of childbearing are alleviated in resource-rich environments, like the UK, women might *perceive* that social support is necessary for successful reproduction, given that this would have been true for most of our evolutionary history. Further, childbearing still does come with considerable financial and time costs even in high-

income environments (Lawson and Mace 2011). Time costs may be particularly significant in a context where women can no longer combine childcare with their productive work; and the shift from investing in quantity to quality of children as environments become more benign means that children in high-income contexts require considerable financial investment to raise successfully to adulthood, even if childbearing will not result in material ruin for most women. We may expect, therefore, that women still respond to the availability of support for reproduction, even in low-fertility contexts where the humans no longer seem to be maximizing their fitness (Goodman, Koupil, and Lawson 2012). Below are outlined reasons why allomothers may choose to provide support and the known associations between support and reproduction in low-fertility countries. We firstly focus on support from women's families, then partners and finally, on that from other allomothers.

Families are common providers of allomaternal support, a pattern likely explained by kin selection; given overlapping fitness interests, family members can help improve their inclusive fitness through supporting reproductive women and their children (Hamilton 1964). Family fitness interests do of course diverge – e.g. because of differential relatedness or high reproductive costs of support– and family relations are not always cooperative (Borgerhoff Mulder 2007; Sear 2008; Strassmann 2011; Mace and Alvergne 2012; Moya and Sear 2014). Despite this, women's parents and parents-in-law are often the focus of the kin and fertility literature (Sear and Coall 2011) because of their high relatedness to the reproducing woman or her off-spring; further, they are frequently post-reproductive (culturally or biologically) making the cost to them supporting others' reproduction somewhat lower than for other family members.

The literature on the associations between family support and women's fertility in European high-income countries shows no clear patterns. Some studies show positive correlations between the availability of family and fertility outcomes (Del Boca 2002; Hank and Kreyenfeld 2003; Kaptijn et al. 2010; Waynforth 2012; Mathews and Sear 2013a; Thomese and Liefbroer 2013; Mathews and Sear 2013b), which is sometimes specific to particular family members (Tanskanen et al. 2014); a number show no evidence of associations between various forms of parental support or availability and women's fertility (Kertzer et al. 2009; Aassve, Meroni, and Pronzato 2012; Waynforth 2012; Thomese and Liefbroer 2013; Tanskanen et al. 2014); and a few find negative associations between family support and fertility (Rindfuss et al. 2007; Balbo and Mills 2011a; Waynforth 2012). The inconsistency of effects may partially be due to the great diversity of types of family support or availability (survival status, co-residence, financial support, childcare, emotional support, etc.) used as predictors for many different fertility outcomes (age at first births, parity progressions, length of birth intervals, total fertility, etc.). For example, correlations between parental availability and fertility outcomes are opposite depending on whether availability is measured as either co-residence or survival status in Europe (Schaffnit and Sear 2014): mother's survival status increases fertility, whereas co-residence with parents decreases fertility. In contrast, the literature on high-income, low-fertility Asian countries consistently demonstrates positive effects of co-residence with in-laws on women's reproductive outcomes (Chi & Hsin, 1996; Fukukawa, 2013; Nosaka, 2009; Thornton, Freedman, Sun, & Chang, 1986; Tsay & Chu, 2005). The consistency of the Asian literature is likely due to the consistency of predictor used (co-residence with family) and a strong cultural norm for post-marital residence with women's partner's parents (Chi and Hsin 1996).

Women's partners, fathers to her children, provide a large amount of allomaternal support making human males rare amongst other mammals (Geary 2001). By providing allomaternal care, women's partners gain direct fitness, but also can maintain mating access (Winking 2006). Support from partners is particularly common in European, HILF countries where there are long-standing norms of monogamy and neolocality, thus increasing pressure for investments from nuclear families (Rotkirch and Janhunen 2010). The literature associating partner alloparental support to fertility is varied. Partner support shows both positive (Fiori 2011; Balbo and Mills 2011b) and negative associations with birth intentions (Park, Cho, and Choi 2010; Park 2012), and further mixed associations with achieved fertility (Duvander, Lappegard, and Andersson 2010; Rijken and Thomson 2011).

High-income countries present an unusual ecology within which women make reproductive choices. Women in these contexts may rely upon a number of non-family allomaternal supporters during reproduction and childrearing, some of which are distinct from those available to women in natural fertility settings. Friends, formal child minders, and professionals (GP's, counselors, etc.) are potential sources of support other than women's genetically related families. These people may support women for various reasons including reciprocity (Ivey 2000), or monetary compensation (either from the benefiting family or the state). The large amount and diversity of cooperation surrounding reproduction from unrelated supporters make humans unique among cooperative breeders (Bogin, Bragg, and Kuzawa 2014), but we are by no means the only species to benefit from non-kin allocarers (Riehl 2013; Zöttl et al. 2013).

As with the literature on family support and fertility, the associations between non-familial support (support *not* from parents or in-laws) and women's fertility are varied. Emotional

support from friends and women's broader social networks relates positively to women's fertility intentions in Europe (Balbo and Mills 2011b), but effects on realized fertility are less clear. The impact of formal childcare on women's fertility outcomes is often estimated using area-level care availability with mixed associations (Del Boca 2002; Andersson, Duvander, and Hank 2004; Hank, Kreyenfeld, and Spiess 2004); individual-level use of paid childcare has been found to have no correlation to having additional births (Thomese and Liefbroer 2013). The diversity of measures of support and fertility (intentions, birth intervals, probability of birth, etc.) make these, like the family support studies, difficult to compare. In this research we compare associations between one fertility outcome and multiple forms of support – childcare, financial, emotional, and perceptions of support - from both genetically related and unrelated individuals allowing us the potential to tease apart different meanings associated with various forms of support.

3.2.2 The availability and effects of support on women's fertility by SEP

Within high-income countries, support is not equally available to all women, but rather variation in SEP results in different ecologies which may change the availability of support and modify women's reproductive decisions. Life history theory (LHT) predicts that environmental harshness will affect both reproductive schedules and parental investment strategies (Stearns 1992). With large wealth inequalities in the UK and other high-income countries (OECD 2013), socioeconomic factors are often used as measures of environmental harshness (Nettle 2008; Nettle 2010) because those with low SEP experience worse health, and increased morbidity and mortality rates (Mackenbach et al. 1997; Adler and Ostrove 1999; Bajekal 2005; Nettle 2010). In harsh environments, it is adaptive to start reproduction earlier (Low et al. 2008; Nettle 2010) in order to ensure successful reproduction before death or ill health intervenes; further, parental investment may be lower in such environments partly because parents may

benefit from investing in quantity rather than quality of offspring and, in the human context, because there are fewer opportunities for children to capitalize on intensive parental investment to increase their SEP (Kaplan, Lancaster, and Anderson 1998; Nettle 2008). LHT then predicts a negative correlation between environmental harshness and parental investment. Predictions regarding variation in allomaternal care across economic groups are less clear though we could expect that allomaternal investment will mirror parental investment strategies, and therefore may perhaps be lower in harsh environments. Further, under conditions of economic stress, family relationships may become less cooperative as there are fewer resources to share among family members.

Current evidence demonstrates variability in alloparental support by SEP: contact frequency with women's mothers – a proxy for support - is highest in middle to high SEP areas of the United Kingdom (Nettle 2010); and in Europe, women's education – a proxy for SEP – positively predicts receiving childcare from families (Thomese and Liefbroer 2013; Coall, Hilbrand, and Hertwig 2014). There is more consistent evidence that although reasonably high levels of paternal involvement with childrearing are common (Geary 2001; Rotkirch and Janhunen 2010; Huinink and Kohli 2014), economically disadvantaged mothers are more likely to be without a partner - in some cases up to half of low SEP mothers are unpartnered (Séguin et al. 1995; Duncan and Magnuson 2005) - or have a lower investing partner (Harris, Furstenberg, and Marmer 1998; Nettle 2008; Nettle 2010) than wealthier women. Fathers may disinvest in childrearing if paternity uncertainty is high or other mating opportunities are common, or if their ability to invest is low (Geary 2001); and mothers may be reluctant to pay the costs of partnership if partners are unreliable sources of support, because of low employment/wages or high rates of incarceration (Geronimus 1987; Carbone and Cahn 2014).

Though there is some research on variation in allomaternal and parental - particularly paternal - investment between socioeconomic groups, still little is known about whether the absence of support from some individuals changes investment from other individuals - such as family. Evidence from the Aka foragers of Central Africa gives us some reason to expect that in the absence of one form of support others will fill in: in the absence of maternal grandmothers – key Aka allocarers – other maternal kin fill in (Meehan, Helfrecht, and Quinlan 2014); and when maternal kin are not present, fathers (women's partners) increase their paternal investment (Meehan 2005). In contrast, in a HILF setting, Thomese & Liefbroer (2013) found no evidence that grandparental childcare substitutes for paid childcare. They suggest that childcare from grandparents and the state are not substitutable, but rather complementary in their study context.

In this research, we focus specifically on whether absence of partners is substituted by other allomaternal support. The substitution of paternal investment is the focus of this paper because (1) paternal investment tends to be high in humans (in contrast to other mammals), particularly in high-income, low-fertility settings (Geary 2001; Rotkirch and Janhunen 2010), but (2) is highly variable between SEP environments (Harris, Furstenberg, and Marmer 1998; Nettle 2008). In HILF contexts, the absence of paternal support could predict two different scenarios - substitution of support from other individuals or low overall support - depending upon the reason for low/absent paternal investment. Partners may be absent due to low expected returns from investment in their first child, particularly in low socioeconomic contexts (Kaplan, Lancaster, and Anderson 1998; Nettle 2008; Dotson et al. 2009). If paternal absence is due to low expected returns of investment, then other supporters may not substitute a withdrawal of partner support, and the child and mother would make do with low levels of overall support. If paternal absence is *not* due to low expected returns for investment in a child's fitness then

substitution may occur; support from families and others might be provided or sought when women experience the absence of male support. It could be expected that independently of a partner's expected returns to investments, women's parents may modify their investments in a given child or grandchild depending upon family structures and thus alternative avenues for allocating support. For example, grandparents with larger numbers of grandchildren invest less in each grandchild than those with fewer grandchildren (Coall et al. 2009), and more generally grandparents tend to invest in more sure certain kin (daughters' children over sons' children) (Danielsbacka et al. 2011). The latter may be less relevant in this study as only women's fertility is considered, though the presence of sisters (and brothers) could still disperse investments.

It is not clear if women in different SEP groups respond differently to the availability of various forms of support in their second birth decisions (but see Schaffnit and Sear 2014), making our aim to test interactions between SEP and support in the second birth decision partially exploratory. We could, however, make some predictions about the *relative importance* of different types of support in the decision to have a second birth based on SEP – a measure we estimate using multimodel inference (see methods). For example, family support may be more important for low SES women than other women because they are both less likely to receive support from partners and may not have the money to recruit other support. Paternal investment may be more important for wealthier women's decisions to have a second child as these women may have fewer kin in their support networks (Ajrouch, Blandon, and Antonucci 2005) and likely have more highly investing partners (Harris, Furstenberg, and Marmer 1998; Nettle 2008; Nettle 2010). It is unclear what would happen if partner support were not substituted for other support. A woman may choose to cease reproduction if the costs of continuing become too high. Alternatively, in the UK and other countries with strong social

security systems, poorer women without support may be likely to have a child anyway as her children's basic needs are expected to be covered (Lawson and Mace 2010).

3.3 METHODS

3.3.1 Data

Data come from the Millennium Cohort Study, a UK-wide longitudinal survey following over 18,000 children born between the years 2000 and 2001 (in Northern Ireland and Scotland sample collection continued until January 11, 2002). Sampling for the study is clustered geographically. Areas with high proportions of ethnic minorities and disadvantaged areas were oversampled, as were the smaller UK countries (Wales, Scotland and Northern Ireland). The first wave of data was collected about nine months after the birth of the cohort members (CM) and subsequent survey waves were collected about every two years. In this analysis we will use information collected in waves one through wave four, covering about an eight year time period since the birth of the CM.

Our main outcome of interest is whether or not participants had a second child in the eight years following their first birth. As such, the sample is limited to women for whom the CM was their first child and those in which the CM's genetic mother was the main respondent. With overall low fertility the decision to have a second child is an important determinant of lifetime reproductive success, in contrast to the timing of birth, which are more important in high-fertility settings where shorter birth intervals more clearly associate with higher completed fertility (Gibson and Mace 2002). In the UK, the majority of women who have a child go on to have a second birth, but a minority then progress to third or higher order births: of women born in 1967, 19% had no children, 15% stopped at one child, 37% of women stopped at two, and 28% had three or more (Office for National Statistics 2012). The median interval between

first and second births in the UK in 2012 was 36 months (Office for National Statistics 2014a). In our own sample, no second births occurred after 71 months (out of 101 months available) and we included only women who were interviewed both in wave one and wave four of data collection (82.5% of our first time mother sample) so as not to exclude women who will, but have not yet had a second child. Those who dropped out of the sample were slightly poorer, less educated, younger and more likely to be single at wave 1 than women who remained in the sample at wave 4. We excluded women whose first birth was a multiple birth (twins and triplets), as the decision to have another birth is presumably very different for those women compared to those who gave birth to singletons. Finally, mothers whose children died were excluded from the sample as the relationships between allomaternal support and future births may be muddled by this event. Due to our model averaging method (described below), it is essential that all models run have the exact same sample (Symonds and Moussalli 2011). The dataset has relatively little missing data: ten variables had missing values at a maximum of 2%. We conducted all analyses below with only complete cases; our final sample included 3,784 women.

3.3.2 Variables

Our outcome of interest was whether or not women had a second child between waves one and four. By studying second births, as opposed to first births, we can examine how support directed at raising a first child, as well as more general support, associates with further childrearing. Twelve support variables were the main predictors chosen based on their availability in the data set and with the intention of representing a number of different types of support (financial, childcare, and emotional) from a number of sources (partners, friends, families, and professionals). These included three types of family support (in five variables),

three partner support variables, and four variables related to support from unrelated individuals (both formal and informal sources).

3.3.2.1 Measures of Support

Family support included a categorical variable indicating whether women in wave one (when the CM were aged about 9 months) received childcare from: neither her parents nor parents-in-law, only her parents, only her parents-in-law, or both. Separately for women's parents and in-laws, two variables were included that measured the number of forms of financial support women received from their kin (0-6) including: buying essentials for the baby, lending money, buying gifts, paying for household costs, helping with childcare costs, and other financial support. Variables for support from parents-in-law were coded 0 when women did not have a partner. A control dummy variable for whether at least one parent was alive was also included, as support is obviously not available if both parents are dead. Only 50 women had neither a living mother nor father. No partnered women in our sample had both a dead mother-in-law and father-in-law, so that a control for having at least one living parent-in-law was not necessary.

We further measured women's contact frequency with her parents and parents-in-law. Contact frequency was measured in a categorical variable: never sees parents (or parents are dead), less than yearly contact, contact at least yearly, at least weekly, and co-resident. Women who were co-resident with her parents or in-laws (between 2% and 8% of the total wave one sample depending on which parent or in-law is co-resident) were included in our sample because co-residence is a common proxy for family support in high-fertility, low-income contexts (Morgan and Rindfuss 1984; Jamison et al. 2002; Snopkowski and Sear 2013; Schaffnit and Sear 2014). Previous research we have conducted in the European context found that co-

residence with parents tended to delay initiation of childbearing, particularly in lower SES families, perhaps because such non-normative behavior is an indicator of resource, or another type of, stress (Schaffnit and Sear 2014). The MCS data offered the opportunity to explore how co-residence *after* the birth of a child relates to continued, rather than initiation of, childrearing.

Support from women's partners, fathers of the CM, was measured in three ways. Firstly, the number of household and childrearing tasks that women's partners take part in equally or more often than the mother were added up to make a paternal investment variable (0-10). These tasks were: cooking meals, cleaning, doing laundry, managing the household money, home repairs, looking after child when ill, looking after child regularly, feeding the child, changing the child's nappy, and getting up in the night for the child. Secondly, a binary variable indicated whether the partner took leave from work after the birth of the CM. Finally, women's self-assessed relationship quality was also used as a measure of partner support (1=low through 7=high: women responded on a 7-point scale). Women without partners were coded with the lowest value for all partner support measures, and partnership status (described below) was controlled for in all analyses.

Four other support variables were included which measured either actual support –childcare or support sought from professionals – or a more indirect measure of support – contact with friends – was received from individuals who were not related to either the mother or her child. How often women had contact with friends was measured in a categorical variable: more than three times a week; one to two times a week; never or has no friends. A count of how many forms of formal support women sought after the birth of the CM (0- 5) was calculated based on the support women received from the following list: GP, health visitor, religious group, drop-in

center for families, or telephone advice lines. A binary measure for paid childcare was created to indicate whether at wave one or later waves (if the birth of a second child did not occur before the next wave) women received support with childcare for which they paid. This latter variable was the only variable for which we used data from waves other than the first wave: we did so because paid childcare tends to be relatively uncommon for young infants, so we may underestimate the importance of paid childcare if we restricted this variable to data collected during the first wave. Finally, one general measure of *feeling* supported was included indicating whether women disagreed, neither agreed nor disagreed, agreed, or were unsure whether they agreed or disagreed with the statement "There are other parents I can talk to about my experiences".

3.3.2.2 SEP and control variables

In addition to our key support variables, our analyses contained several control variables. Firstly, women's partnership status was recorded (1=single throughout; 2=single at wave one, partnered before birth of second child or final wave; 3=partnered at wave 1, single before birth of second child or final wave; 4=partnered throughout). Women were considered partnered only if their partners lived in the same household as the woman and their child; only 1.4% of women have a non-resident partner. We included a control for women's education (no qualifications (1), education until age 16 (2), education to age 18 (3), an undergraduate degree (4), and a graduate degree (5)) as this is a well-documented predictor of reproductive outcomes (Huber, Bookstein, and Fieder 2010; Fieder, Huber, and Bookstein 2011; Berrington and Pattaro 2014). Both women's and their partner's employment status was recorded (1=employed; 2=self-employed; 3=unemployed). Finally, we used household income equivalized for household composition (number of adults, for example) and size as our measure of SEP. This was split into three categories: households with annual incomes below

the 33rd centile; incomes between 33rd and 66th centile; and incomes over the 66th centile. Our analyses below are stratified by this income variable as we expect that the availability of different types of support, and relative importance of these types of support on the probability of having a second child may vary by SEP – a proxy for environmental harshness (Adler and Ostrove 1999; Bajekal 2005). Other measures of SEP are sometimes used in the literature including women's educational achievements (Mackenbach et al. 1997) and area level deprivation (Bajekal 2005; Nettle 2010). We chose to use equivalized household income as our main indicator of SEP because we felt that it is the clearest indicator of potential individual-level hardship or environmental harshness.

3.3.3 Analysis

3.3.3.1 How does support differ by SEP?

To document the prevalence of support after their first birth by wealth, we created a descriptive table containing the proportions of women receiving support and mean amounts of support by income (Table 3.1). Data included in variables related to paternal investment and support from women's in-laws are only for women with partners because women do not receive this support if they are partnerless. Family support data refer only to those women with at least one living parent.

3.3.3.2 Does support substitution occur in the absence of fathers?

We used logistic and poisson regressions (depending on the nature of the outcome variable) to test whether the absence of partner support predicts receiving other forms of support: childcare from parents (yes or no), amount of support from parents (0-6), weekly contact with parents (yes or no, excluding co-resident women), co-residence with parents (yes or no), formal childcare support (yes or no), amount of institutional support (0-5), frequency of contact with

friends (more or less than 3 times a week), and opinion on the statement "There are other parents I can talk to about my experiences" (agree or disagree/neutral). For each outcome, a first model was run with partner status and wealth as main effects and a second model with an interaction between the two predictors (Figure 3.1 and SMTable 3.1). In these models we controlled for women's employment status and age at first birth.

3.3.3.3 How do different types of support influence the likelihood of a second birth?

To determine whether the support variables were correlated with the probability of having a second child, and the relative importance of different types of support, we used natural model averaging. Model averaging, in contrast to traditional null hypothesis testing, takes into account information from a number of models representing probable associations between predictors and outcome thus reducing model selection uncertainty and producing robust parameter estimates (Johnson and Omland 2004). The method further allows for the estimation of relative variable importance which represents the probability that a given predictor is part of a best fitting model.

Using our 12 support predictors we generated 4,096 logistic regression models for probability of second birth containing every combination of these variables using the tuples command in Stata 13. Comparing a large number of models comes with some risk of identifying spurious effects (Johnson and Omland 2004), but all models compared represent possible associations between predictors and outcome and were thus not excluded; additionally, the utility of comparisons like this one has been demonstrated in other human behavioral ecological work (Borgerhoff Mulder and Beheim 2011; Shenk et al. 2013). Adjusted odds ratios for the associations between support and women's second births (not model averaged) are found in SMTable 3.2 and suggest that the model averaged parameter estimates reflect otherwise

present associations. Model generation was repeated for our full sample (n=3,784), and separately for each SEP tercile: low (n=1,249), middle (n=1,249) and high women (n=1,286). Models contained controls for SEP (only in the unstratified model), women's education, women's employment status, partner's employment status, partnership status, and parental survival. For each sample, AIC weights (wAIC) were calculated for the resulting models using methods outlined by Wagenmakers & Farrell (2004):

$$w_i(AIC) = \frac{exp\left\{-\frac{1}{2}\,\Delta_i\,(AIC)\right\}}{\sum_{K=1}^{K} exp\left\{-\frac{1}{2}\,\Delta_k\,(AIC)\right\}}$$

where w_iAIC represents the probability that a model i is the best model given the data and other available models, K is the number of candidate models and

$$\Delta_i\,(AIC) = AIC_i - \min\text{AIC}$$

These models were then ranked by AIC weight from highest to lowest. The parameters from models accounting for 95% of the aggregate AIC weight (43 models for full sample; 315 for the low wealth sample; 202 for the middle wealth sample; and 157 for the high wealth sample) were then used to calculate robust parameter estimates in R using the AICmodavg package. The complete sets of models (models accounting for 100% of wAIC) were used to estimate variable importance. The relative importance of each form of support in the decision to have a second child was calculated as the cumulative weight of models containing each variable (Symonds and Moussalli 2011). This value can be interpreted as the probability that the variable is part of the "best" model for the data; variables with an importance close to one are more probably in a best model than variables with an importance nearer to zero. Robust parameter estimates were calculated as per the methods of Symonds & Moussalli (2010):

$$\hat{\bar{\beta}} = \frac{\sum_{i=1}^{R} w_i \hat{\beta}_i}{\sum_{i=1}^{R} w_i}$$

and the weighted average standard error for a given parameter is:

$$\widehat{se}\left(\hat{\bar{\beta}}\right) = \sum w_i \sqrt{\widehat{var}(\hat{\beta}_i) + \left(\hat{\beta}_i - \hat{\bar{\beta}}\right)^2}$$

The resultant standard error takes into account error in parameter estimation as well as model selection error. (For a fuller discussion of AIC model averaging in behavioral ecology see Burnham, Anderson, & Huyvaert, 2010; Burnham & Anderson, 2002; Richards, Whittingham, & Stephens, 2010; Richards, 2005; Symonds & Moussalli, 2010; and for examples of its use in human behavioral ecology see Alvergne et al. 2011; Borgerhoff Mulder and Beheim 2011; Alvergne et al. 2013).

3.4 RESULTS

3.4.1 Does SEP relate to the types of support new mothers receive?

Women in the lowest SEP group received less support from partners and formal sources than women in the mid-SEP group who in turn receive less than women in the highest SEP category (Table 3.1). Poorer women were less likely to have a partner than wealthier women. Of low SEP women with partners, they received less partner support and rated their relationship quality lower than higher SEP women. Similarly poorer women were less likely to use paid childcare for their first child and they received fewer formal sources of support on average than wealthy women. Further, with decreasing SEP women were more likely to indicate that they did not feel they had other parents to speak to suggesting some feelings of isolation. Contact frequency with friends provided less clear associations with SEP. Middle and low SEP women reported having no friends or never seeing their friends more often than the high SEP group, but the

women in the lowest SEP group were more likely to see their friends often (more than three times a week) than wealthier women.

Unlike partner and formal support, the association between family support and SEP was not always linear. Lower SEP women receive more financial support from, and are more likely to be co-resident with, their parents and parents-in-law than women with higher household incomes suggesting that family support can be need-based. In contrast, frequent contact with, and childcare from, families was most common for mid SEP women, with less frequent contact and childcare from families for wealthier and poorer women, as has been noted in other research (Nettle 2010).

Table 3.1: Descriptive statistics by SEP

	Equivalized Household Income			
	Low	Mid	High	Total
N	1249	1249	1286	3784
Had 2nd Birth (%)	46.84	61.41	67.96	58.83
Mean age at first birth (years)	22.84	27.41	30.56	26.97
Childcare family (%)				
Neither	60.13	46.28	54.74	53.73
From parents only[1]	36.05	43.75	37.29	39.01
From parents-in-law only[2]	17.19	27.16	21.51	22.08
Both[2]	8.32	15.83	12.74	13.10
Mean amount of Financial Support from Parents[1]	2.11	1.69	1.36	1.70
Mean amount of Financial Support from In-laws[2]	1.47	1.42	1.24	1.35
Contact frequency with parents[1] (%)				
Never	1.54	0.49	2.33	2.22
Less than yearly	2.83	2.11	1.87	2.25
At least yearly	13.50	20.86	34.68	22.99
At least weekly	60.71	72.40	60.19	63.87
Co-resident	21.42	4.14	0.93	8.67
Contact frequency with parents-in-law[2] (%)				
Never	5.18	1.29	0.71	1.82
Less than yearly	8.53	2.84	1.58	3.44
At least yearly	25.08	27.34	48.42	35.70
At least weekly	56.35	67.15	47.86	56.96
Co-resident	4.85	1.38	1.42	2.08
Partner Status (%)				
Single	42.43	5.52	1.48	16.33
Single -> Partnered	9.69	1.36	0.23	3.73
Partnered -> Single	4.56	4.08	2.49	3.70
Partnered	43.31	89.03	95.80	76.24
Mean amount of Partner Support[2]	3.85	4.21	4.46	4.24
Paternity Leave Taken[2] (%)				
No	41.47	18.66	13.05	20.83
Yes	58.53	81.34	86.95	79.17
Mean relationship Quality[2]	5.64	5.74	5.88	5.78
Formal Childcare (%)				
No	79.10	58.13	37.25	57.95
Yes	20.90	41.87	62.75	42.05
Mean amount of Formal Support	0.92	1.14	1.34	1.13
Frequency of Contact with Friends (%)				
More than 3 times a week	29.54	21.78	26.98	26.11
1-2 times a week	43.88	50.92	50.47	48.44
Never/no friends	26.58	27.3	22.55	25.45
Has Other Parents to Speak to (%)				
Don't know	2.24	1.12	0.78	1.37
Agree	74.06	82.95	88.72	81.98
Neither Agree nor Disagree	11.05	6.57	3.58	7.03
Disagree	12.65	9.37	6.92	9.62

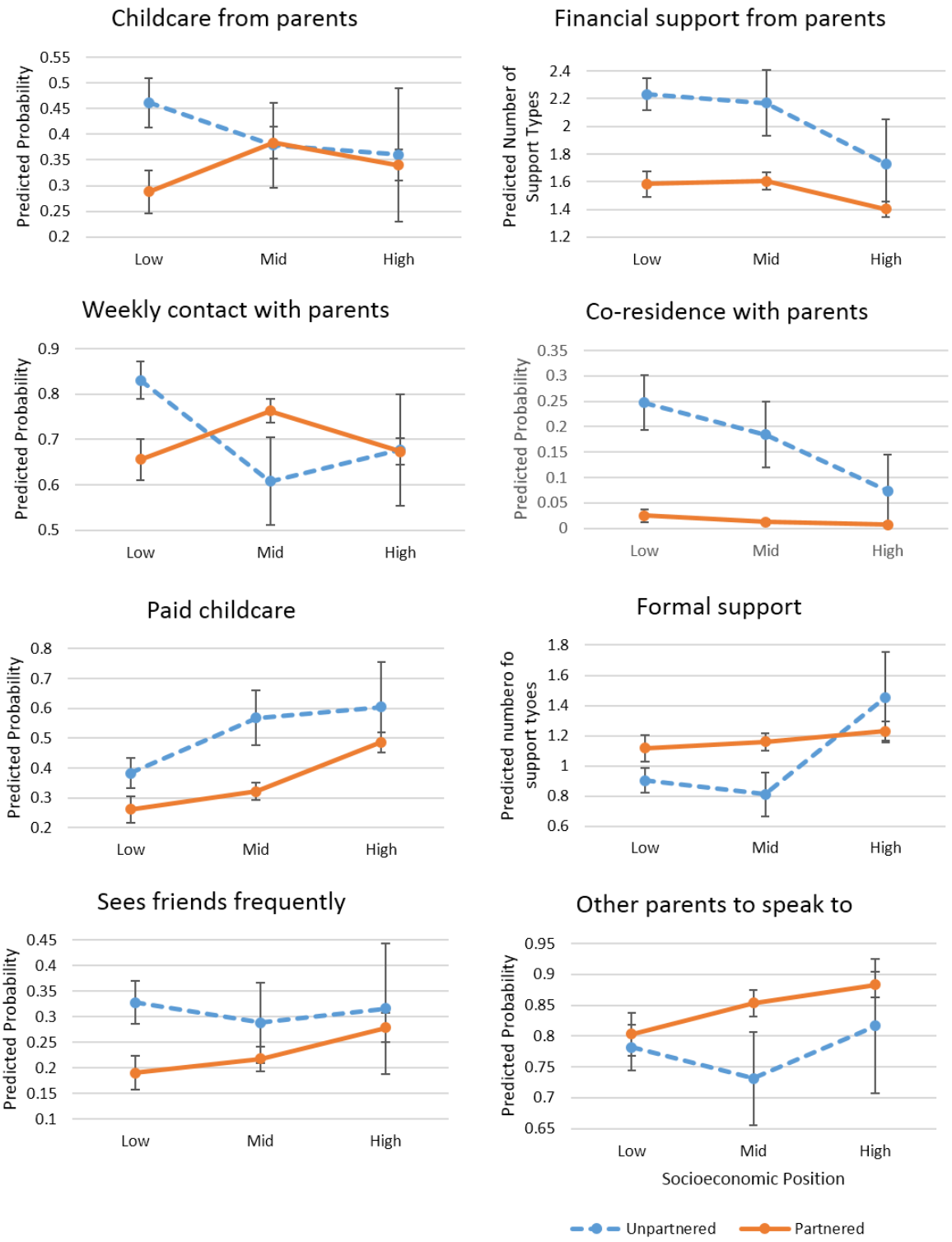
[1]For women with at least one living parent; [2]For women with partners

3.4.2 Is paternal absence substituted with other forms of support?

In the absence of partner support, women have a higher probability of receiving a variety of support types (Figure 3.1). This is particularly true for poorer women who are most likely to be partnerless. Women without partner support have a higher probability of receiving childcare from parents or paid sources, have higher expected levels of financial support from families, are more likely to live with their parents, and are more likely to see their friends frequently than women with partners. Given that women do not live with their parents, weekly contact is more common for unpartnered poorer women than partnered poor women, but the association changes for wealthier women. The probability of weekly contact is actually lower for unpartnered middle wealth women, and there is no difference for the wealthiest women. In only one instance, that of formal support, partnerless middle and low SEP women expected to receive less support than partnered women. Despite overall evidence of substitution for absent partner support, women without partners are less likely to feel that they have other parents to speak to.

Country-level analyses suggest that strong care institutions negatively relate to the prevalence of frequent family provided childcare (Hank and Buber 2009). On an individual level data have not confirmed substitution between formal and family provided care (Thomese and Liefbroer 2013). For this reason, we also tested whether paid childcare predicted receiving childcare from parents. Results (available in SMTable 3.3 and SMFigure 3.1) show that in our sample, women who are not receiving paid childcare are more likely to receive childcare from parents, particularly for wealthier women.

Figure 3.1: Predicted probabilities of receiving and predicted values of support with 95% confidence intervals for women with (solid line) and without (dashed line) partners by SEP



3.4.3 Associations between support and the decision to have a second child in the United Kingdom: variation by SEP?

We present associations between the different types of support and the probability of having a second child for the total sample and stratified by household income. Results are presented as odds ratios (OR) in Table 3.2; Table 3.3 shows parameter importance, or the probability that a given type of support is important in predicting second births for women in each income group.

In general, the model-averaged results suggest that receiving practical support – childcare and financial support – after the birth of a first child is associated with lower odds of having another child. Women receiving financial support from families had 18%-31% lower odds of having a second birth, while those receiving paid childcare had 48%-54% lower odds of having a second birth than those not using paid childcare. In contrast, receiving non-practical or more emotionally oriented support predicts higher odds of having a second child. Non-practical or emotional support includes the variables: frequent contact with friends, relationship quality, and having other parents to speak to. Women who ranked their relationship quality more highly had 11%-16% higher odds of birth and those receiving support from formal sources (GPs, counselors, etc.) had 6%-20% higher odds of birth. Contact with families had slightly mixed effects. Moderate levels of contact with parents-in-law associated with 8%-47% higher odds of birth than women who had more frequent contact. In the mid SEP group a very strong positive association between never seeing parents and having a birth was recorded, but it is important to note that only 0.49% (n=6) of mid SEP women with a living parent fall into this category, so that little weight should be attached to this finding.

The general negative associations between practical support and births and positive associations between non-practical support and births are consistent across SEP groups with

one exception. There is weak evidence that low SEP women receiving childcare from both parents and parents-in-law have 90% higher odds of having a second birth than women not receiving childcare from their families. For high SEP women, the opposite is true: those receiving childcare support from families have 34% lower odds of having a second child than women not receiving childcare from their family.

The variable importance estimates (Table 3.3) suggest that some forms of support are equally important in predicting births for all women regardless of SEP, while other forms of support are more important for some women than others. We focus on variables with over a probably of greater than 0.50 of being in a best model given the data and predictors. The + indicates pro-natal associations between support and fertility, the – represents anti-natal associations. In the case of contact with parents and parents-in-law +/- indicates that only *moderate* levels of support are positively associated with births. Paid childcare, relationship quality, and financial support from parents had a high probability (0.79-1.00) of being important in all SEP groups. Frequency of contact with friends only had an importance value greater than 0.50 for low SEP women, while financial support from parents-in-law had an over 0.50 importance value for low and mid SEP groups – those receiving the highest mean amount of financial support. Formal and partner support were important predictors but only for mid and high SEP women – again the same women most likely to be receiving these forms of support. Finally, contact frequency with parents-in-law and having other parents to speak to were important only in the high SEP group.

Table 3.2: Model averaged odds ratios, 95% confidence intervals, and p-values for logistic regressions on having a second child by SEP

	Equivalized Household Income											
	Low Wealth			Mid Wealth			High Wealth			Total Sample		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Childcare from family (ref: none)												
From parents only	0.98	(0.73-1.31)	0.87	1.06	(0.76-1.47)	0.73	1.00	(0.71-1.4)	0.99	1.02	(0.85-1.22)	0.83
From parents-in-law only	1.63	(0.78-3.41)	0.20	0.96	(0.62-1.49)	0.86	0.83	(0.5-1.39)	0.49	1.00	(0.73-1.37)	0.99
Both	1.90	(0.91-3.98)	0.09	0.87	(0.58-1.31)	0.52	0.66	(0.42-1.04)	0.08	0.91	(0.69-1.19)	0.49
Financial support from parents	0.81	(0.73-0.9)	<0.001	0.82	(0.73-0.93)	<0.001	0.69	(0.6-0.8)	<0.001	0.79	(0.73-0.84)	<0.001
Financial support from parents-in-law	0.82	(0.69-0.98)	0.03	0.90	(0.78-1.03)	0.14	0.94	(0.79-1.11)	0.46	0.88	(0.81-0.97)	0.01
Contact with parents (ref: weekly)												
Never	0.65	(0.24-1.75)	0.39	13.30	(1.09-162.07)	0.04	0.25	(0.04-1.5)	0.13	0.80	(0.36-1.74)	0.57
Less than yearly	1.05	(0.46-2.36)	0.92	0.64	(0.25-1.64)	0.35	0.81	(0.29-2.31)	0.70	0.77	(0.46-1.29)	0.32
At least yearly	1.24	(0.82-1.88)	0.30	1.10	(0.78-1.55)	0.59	1.01	(0.74-1.39)	0.93	1.12	(0.92-1.37)	0.26
Co-resident	0.87	(0.62-1.23)	0.44	1.69	(0.75-3.77)	0.20	5.16	(0.57-46.88)	0.14	0.99	(0.73-1.33)	0.93
Contact with parents-in-law (ref: weekly)												
Never	1.00	(0.41-2.46)	1.00	1.38	(0.4-4.8)	0.61	0.27	(0.06-1.26)	0.10	0.77	(0.41-1.44)	0.41
Less than yearly	2.77	(1.19-6.42)	0.02	1.23	(0.52-2.92)	0.64	0.88	(0.32-2.45)	0.81	1.43	(0.87-2.37)	0.16
At least yearly	1.08	(0.67-1.76)	0.75	1.13	(0.83-1.54)	0.45	1.47	(1.1-1.96)	0.01	1.26	(1.05-1.53)	0.02
Co-resident	0.64	(0.27-1.54)	0.32	1.01	(0.31-3.31)	0.99	0.88	(0.27-2.81)	0.83	0.79	(0.44-1.39)	0.41
Paternal investments	0.96	(0.89-1.05)	0.38	0.95	(0.9-1)	0.07	0.95	(0.9-1.01)	0.13	0.95	(0.92-0.99)	0.01
Paternity leave	1.40	(0.92-2.13)	0.11	1.02	(0.72-1.45)	0.92	0.86	(0.57-1.29)	0.46	1.10	(0.89-1.37)	0.39
Relationship quality	1.14	(1.01-1.29)	0.04	1.13	(1.03-1.23)	0.01	1.11	(1.01-1.22)	0.03	1.12	(1.06-1.19)	<0.001
Paid childcare support	0.52	(0.37-0.73)	<0.001	0.46	(0.35-0.6)	<0.001	0.46	(0.34-0.63)	<0.001	0.48	(0.4-0.57)	<0.001
Formal support	1.06	(0.93-1.22)	0.37	1.11	(0.97-1.27)	0.13	1.20	(1.05-1.36)	0.01	1.13	(1.04-1.21)	<0.001
Sees friends (ref: never/no friends)												
More than 3 times a week	1.44	(1.03-2.02)	0.03	1.32	(0.91-1.91)	0.15	0.88	(0.59-1.3)	0.51	1.20	(0.97-1.48)	0.09
1-2 times a week	1.03	(0.75-1.4)	0.87	1.29	(0.96-1.73)	0.09	0.77	(0.55-1.08)	0.13	1.01	(0.84-1.2)	0.93
Has other parents to speak to (ref: agree)												
Don't know	1.04	(0.43-2.52)	0.93	0.90	(0.26-3.07)	0.87	0.68	(0.16-2.93)	0.60	0.85	(0.45-1.6)	0.61
Neither agree nor disagree	1.04	(0.7-1.56)	0.83	0.64	(0.38-1.06)	0.08	0.53	(0.27-1.03)	0.06	0.78	(0.59-1.04)	0.09
Disagree	0.70	(0.47-1.02)	0.07	0.69	(0.45-1.08)	0.10	0.54	(0.33-0.87)	0.01	0.65	(0.51-0.83)	<0.001

All models control for age at first birth, woman's education and employment status, partner's employment status, partner status, and survival status of parents

Table 3.3: Variable importance and direction of association between variable and second birth. Direction of association are shown in parentheses for variables with a low probability (less than 0.50) of being in the best model by SEP.

	Equivalized Household Income							
	Low		Mid		High		Total	
	Imp	Sign	Imp	Sign	Imp	Sign	Imp	Sign
Variable								
Childcare from kin	0.12	(+)	0.03	(+)	0.12	(-)	0.03	(-)
Amount of financial support from parents	***1.00***	-	***0.97***	-	***1.00***	-	***1.00***	-
Amount of financial support from in-laws	***0.84***	-	***0.53***	-	0.33	(-)	***0.94***	-
Contact with parents	0.03	(+/-)	0.25	(+/-)	0.09	(+/-)	0.03	(+/-)
Contact with in-laws	0.22	(+/-)	0.01	(+/-)	0.69	+/-	0.61	+/-
Amount of partner support	0.35	(-)	***0.66***	-	***0.54***	-	***0.86***	-
Paternity leave taken	0.32	(+)	0.12	(-)	0.15	(-)	0.22	(+)
Relationship quality	***0.79***	+	***0.91***	+	***0.80***	+	***1.00***	+
Formal childcare	***1.00***	-	***1.00***	-	***1.00***	-	***1.00***	-
Frequency sees friends	**0.53**	+	0.21	(+)	0.15	(+)	0.38	(+)
Amount of formal support	0.35	(+)	***0.54***	+	***0.95***	+	***0.98***	+
Has other parents to talk to	0.11	(+)	0.19	(+)	***0.65***	+	***0.96***	+

3.5 DISCUSSION

We demonstrate in this paper three main points: (1) patterns of support vary between socioeconomic groups: low SEP women receive less support than wealthier women, particularly from partners and formal sources; and family support is most common for mid SEP groups; (2) there is evidence of substitution of support in that women without partners broadly have a higher probability of receiving other forms of support, though these patterns vary somewhat by SEP and support type; and (3) several forms of support have significant associations with the likelihood of having a second child – broadly, material forms of support decrease while non-material forms of support increase the likelihood of a second child – but again some relationships and their importance vary by women's SEP.

The lower paternal investment and formal support received by low-SEP groups supports the LHT prediction that when environments are harsh, mothers may seek less support (reflective of a low investment strategy) and allomaternal carers may be less likely to offer support. Low paternal presence (Séguin et al. 1995; Duncan and Magnuson 2005) and investments (Nettle, 2008, 2010) among poor groups are commonly noted in high-income,

low-fertility settings and reflected in our results. In contrast, the vast majority of high-income women have partners, and highly investing partners at that, likely reflecting both the high perceived costs of raising high-SEP children (and thus need for bi-parental care) (Lawson and Mace 2010), but also the high expected returns to investments in these children (Kaplan, Lancaster, and Anderson 1998; Nettle 2008; Dotson et al. 2009). Use of formal support is also lower for low-SEP women in our sample: fewer receive paid childcare; and fewer formal sources of support like GPs, counselors, and community leaders. The former is likely due to inaccessibility of paid childcare due to poverty while the latter may be because low-SEP women are less likely to seek this type of support following a birth (Sword 2003; Sword and Watt 2005) further supporting the LHT prediction. Beyond levels of actual support, low income women in our sample were more likely to report feeling that they do not have other parents to speak to about their experiences than other women, suggesting feelings of isolation following a birth. Our results reflect others in which low SEP women receive fewer types of support during and after pregnancies, receive support from fewer people (Séguin et al. 1995) and generally experience lower social support than women with higher SEP (Ajrouch, Blandon, and Antonucci 2005). Despite this, certain types of family support are more common for low SEP women than other women - particularly financial support and co-residence with parents or parents-in-law – suggesting that families provide support to women in response to financial need even in harsh environmental conditions where the general investment strategy may be low.

We find some evidence of the substitutability of allomaternal support, but this is most evident amongst the poorest tercile of women. For these women (those most likely to be without a partner and those receiving the lowest amount of other support in general) not having a partner positively predicts receiving childcare and financial support from parents, seeing parents weekly or living with them, receiving paid childcare, and seeing friends more

frequently. Women in other income groups also show similar trends (except for childcare from and weekly contact with parents) but these tend to be less significant, primarily for the highest income women (though few high-income women are without partners). Overall then, we find that poorer women's families pick up some of the slack for missing partners. These results suggest that allomaternal support may partially be reduced due to low expected returns for investments similarly to parental investment, but that – since some substitution of support occurs - paternal disinvestment may not be entirely due to low expected returns for the child's fitness, but may stem from other factors as well – such as biased male sex ratios or paternity uncertainty. What we cannot tell from these data is whether mothers are making up for any lack of support by investing more in their first child themselves, or if poor mothers rely on fewer sources of support, but receive more intense support from these sources.

Our results on fertility outcomes presents one notable contradiction to the LHT prediction that a low investment strategy relates to more closely spaced reproductive episodes as women focus more on child quantity than child quality or self-maintenance. We do find evidence that poor women in our sample began reproduction earlier than wealthy women by nearly eight years (five if they were partnered), as expected in harsher environments. However, in contrast to predictions of LHT we found that a higher proportion of high-SEP women progressed to a second birth in our study period than women in the low-SEP group (SMTable 3.4). Previous indirect evidence has suggested the contrary (Nettle, 2010 found a negative correlation between neighborhood quality and number of children living in a household), but others have noted similar results (Rendall and Smallwood 2003) including with the MCS data (Jokela 2010; Tanskanen et al. 2014). The high rate of partnerlessness among low SEP women is one possible explanation for the result. Even so, poor women were more likely to have a second child without having a partner than wealthier women

(33.15% of low SEP [n=240] compared to 16.07% of the highest SEP group [n=9]). It is possible that the exclusion of censored cases could have biased our results because wealthy women sometimes have second births more quickly after their first to account for delayed initiation of reproduction (Rendall and Smallwood 2003). But we think this is unlikely for two reasons: firstly, no births occurred in the most recent 30 months for which we have data in our sample suggesting that we have not excluded (many) censored cases; and secondly, other evidence on timing of second births using the MCS also noted a positive association between SEP and childbearing (Tanskanen et al. 2014).

The associations between support and second births are varied and demonstrate that all support is not equal in the decision to have a second child. In contrast to a simplistic prediction from the cooperative breeding hypothesis that support would increase the likelihood of a second birth, we find that some forms of support are positively correlated with the likelihood of a second birth but that others *negatively* predict second births. The source of support – parents, parents-in-law, partners, or non-kin - did not seem to matter in terms of identifying patterns of associations. Rather, broadly our results suggest that (1) practical support – financial support and childcare – negatively relates to having a second child; in contrast, (2) non-material or emotional types of support – relationship quality, having other parents to speak to, seeing friends often, and relying on formal support – positively predicts having a second birth. Our finding bolsters those of Tanskanen & Rotkirch (2014), who note that women receiving emotional support, rather than practical support, from their families are more likely to have positive fertility intentions in several European countries. Here we find evidence that emotional support linked to fertility intentions may play out in terms of women's achieved fertility while practical support does not. Practical support is likely linked to need on the part of the reproductive woman and, when present, her partner. This pattern – of practical support negatively relating to births

and fertility intentions – could indicate that despite having controlled for financial status (a measure of financial need) other unmeasured needs could be driving these effects. Need is a difficult thing to measure as needs can often be perceived rather than "real". Future qualitative research on the psychology of reproductive decision making may add to our understandings of needs as well as the meanings of different types of support to women. It is possible that practical support may actually positively associate with women's fertility were need able to be adequately accounted for. Amongst the general consistency of associations between support and fertility among SEP groups, we did find one form of support, childcare from families, which varied between the groups. We consider the general trends and discrepancy below.

The contrasting associations between support and fertility may be because receiving different forms of support indicates different decision-making contexts for first time mothers. Again, patterns of associations were inconsistent between *providers of support*, but *types of support* – practical or emotional/non-practical - seemed to provide more consistent cues. For example, receiving high paternal investments in household and childcare tasks may suggest that partners are unemployed and that the mother may be a primary family earner thus reducing the probability of future reproduction. Paid childcare represents a financial loss and may indicate that women are focusing on employment rather than further childrearing. Childcare from families may represent different opportunities depending upon SEP: women of high-SEP may use the time-freeing support to invest in a career, while lower-SEP women are less likely to be employed and may focus their saved time into further reproduction. Financial support may be an indicator of greater financial need, and may also present an opportunity to invest in the quality of a first child at cost to having more children. Emotional support – indicated by frequent contact with friends, high relationship quality, other parents to speak to, and utilization of formal

supporters – may represent the possibility of (unspent) support should the need arise, making an uncertain future with more children less daunting. Though not investigated here, the role of state provided childcare may also be a source of support which could influence women's second birth progression. Lending support to this idea is our finding that the median time to second birth is 36 months, which matches nearly exactly when the availability of free childcare from the UK government becomes available to mothers (UKGov 2015).

One form of support – contact frequency with parents-in-law – deserves special attention. As found previously using MCS data (Tanskanen et al. 2014), contact with women's parents-in-law associates positively with second births – both probability of birth and timing. Tanskanen et al. (2014) interpreted their result as evidence that family support encourages further reproduction, though actual forms of support were not measured in that study. In this study, we find that *moderate* levels of contact from women's parents-in-law associate with having an additional child while controlling for other forms of support received from parents-in-law and others. Small differences in associations between this study and theirs may be because contact frequency was coded slightly differently, information on mothers(-in-law) and fathers(-in-law) was collapsed in the present study, or because Tanskanen et al. (2014) analyzed each individual grandparents contact in separate models. It may also suggest, that once removing the effects of actual support from families and other allomothers, seeing families *less* frequently, but not never, associates with having a birth. This could be explained by data limitations: without controls for parental health or age, frequent contact may be indicative of support being given, rather than received, by first time mothers to the older generation. Women in our sample were first time mothers with a mean age of 26.97 (S.D.= 5.84), meaning that parents are not expected to be very aged, but we know that grandparental age (women's parents) negatively associates with support

given (Coall, Hilbrand, and Hertwig 2014). This interpretation is potentially further supported by the fact that the positive association between moderate (but not frequent) contact with parents-in-law and births has a higher probability of being important (see discussion of variable importance below) for high-SEP women than any other SEP group. Women with high-SEP are older than those in the poorer groups by an average of eight years meaning that their parents-in-law (even more than their own parents) are likely aged and the upward family support is likely more intense. Thus the negative association between frequent contact (as opposed to moderate contact), representing upward family transfers, and fertility is most strongly felt for high-SEP women (as seen by the higher importance value).

Even with general consistency in the associations between support and fertility, we find that women in different SEP groups sometimes rely on different forms of support in their decision to have a second child (as mentioned above in relation to contact frequency above). Across SEP groups, financial support from parents, paid childcare, and relationship quality, all have a high probability of importance. Partner support is most likely important, and negatively related to fertility, for middle and high SEP women. These women are more likely than low-SEP women to (1) have a partner, (2) be employed particularly if their partner is unemployed and investing more heavily in childcare and household tasks and thus (3) not be in a position to have another child. Formal support has successively higher importance scores as SEP goes up, to some extent reflecting the fact that with each unit increase in SEP women are more likely to be seeking or utilizing this form of support.

Our research expanded the cooperative breeding literature to include a direct comparison of a broad variety of support types and their relationship to women's second births in the United Kingdom. Even within high-income countries, SEP relates to the availability and patterns of allomaternal support and presents distinct ecologies within which women make

reproductive decisions. Poorer women receive less support from partners and formal providers but the absence of partner support is somewhat made up for by others, particularly families. Our research demonstrated that with a diversity of support available to first time mothers in the UK, not all support is equal; different types of support likely represent distinct contexts and circumstances from which women make decisions regarding further reproduction. Our results both serve as a caution in using any form of support as a proxy for another in studies of support and fertility, but also open the doors to further research into the more specific circumstances which inform women's reproductive choices in low-fertility contexts.

SMTable 3.1: Odds/incidence rate ratios, 95% confidence intervals and p-values for logistic and poisson regressions for receiving different forms of support depending upon SEP and partner status

			Receives childcare from parents			Financial support from parents			Sees family weekly		
			OR	95% CI	P	IRR	95% CI	P	OR	95% CI	P
Model 1	Partner stat. (ref: none)	Partnered	1.56	(1.28-1.91)	<0.001	1.38	(1.30-1.46)	<0.001	14.31	(9.72-21.08)	<0.001
	Wealth (ref: middle)	Low	0.80	(0.65-0.99)	0.04	1.00	(0.94-1.07)	0.92	1.64	(1.09-2.48)	0.02
		High	0.87	(0.73-1.03)	0.11	0.87	(0.83-0.92)	<0.001	0.47	(0.24-0.93)	0.03
Model 2	Partner stat. (ref: none)	Partnered	0.98	(0.68-1.42)	0.92	1.35	(1.20-1.52)	<0.001	18.15	(9.70-33.98)	<0.001
	Wealth (ref: middle)	Low	0.65	(0.51-0.83)	0.00	0.99	(0.92-1.06)	0.70	2.06	(1.03-4.11)	0.04
		High	0.83	(0.69-0.99)	0.04	0.87	(0.83-0.92)	<0.001	0.60	(0.25-1.44)	0.25
	Partner status x Wealth	0#Low	2.16	(1.37-3.41)	0.00	1.05	(0.91-1.20)	0.53	0.71	(0.32-1.58)	0.39
		0#High	1.11	(0.56-2.20)	0.76	0.91	(0.73-1.14)	0.43	0.58	(0.14-2.42)	0.46
			Co-residence with parents			Paid childcare			Amount of formal support		
			OR	95% CI	P	OR	95% CI	P	IRR	95% CI	P
Model 1	Partner stat. (ref: none)	Partnered	1.42	(1.09-1.85)	0.01	2.03	(1.62-2.55)	<0.001	0.83	(0.75-0.90)	<0.001
	Wealth (ref: middle)	Low	0.79	(0.61-1.01)	0.06	0.67	(0.53-0.84)	<0.001	0.97	(0.89-1.06)	0.46
		High	0.70	(0.59-0.85)	<0.001	1.91	(1.60-2.27)	<0.001	1.09	(1.02-1.16)	0.01
Model 2	Partner stat. (ref: none)	Partnered	0.48	(0.31-0.74)	0.001	2.77	(1.87-4.11)	<0.001	0.70	(0.58-0.84)	<0.001
	Wealth (ref: middle)	Low	0.59	(0.46-0.76)	<0.001	0.74	(0.57-0.97)	0.03	0.96	(0.88-1.06)	0.44
		High	0.64	(0.53-0.78)	<0.001	1.99	(1.66-2.39)	<0.001	1.06	(0.99-1.13)	0.09
	Partner status x Wealth	0#Low	5.32	(3.07-9.22)	<0.001	0.63	(0.39-1.04)	0.07	1.16	(0.93-1.44)	0.20
		0#High	2.10	(1.03-4.30)	0.04	0.58	(0.27-1.24)	0.16	1.70	(1.28-2.24)	<0.001
			Sees friends frequently			Has other parents to speak to					
			OR	95% CI	P	OR	95% CI	P			
Model 1	Partner stat. (ref: none)	Partnered	1.77	(1.44-2.17)	<0.001	0.72	(0.57-0.90)	0.00			
	Wealth (ref: middle)	Low	0.95	(0.76-1.19)	0.64	0.83	(0.64-1.07)	0.15			
		High	1.41	(1.16-1.70)	<0.001	1.38	(1.08-1.76)	0.01			
Model 2	Partner stat. (ref: none)	Partnered	1.46	(0.97-2.19)	0.07	0.47	(0.31-0.71)	<0.001			
	Wealth (ref: middle)	Low	0.85	(0.65-1.10)	0.21	0.70	(0.53-0.93)	0.01			
		High	1.39	(1.14-1.69)	0.00	1.30	(1.01-1.68)	0.04			
	Partner status x Wealth	0#Low	1.43	(0.88-2.32)	0.15	1.88	(1.14-3.09)	0.01			
		0#High	0.82	(0.40-1.70)	0.59	1.26	(0.54-2.94)	0.60			

SMTable 3.2: Adjusted odds ratios, 95% confidence intervals and p-values for predicting second births by SEP

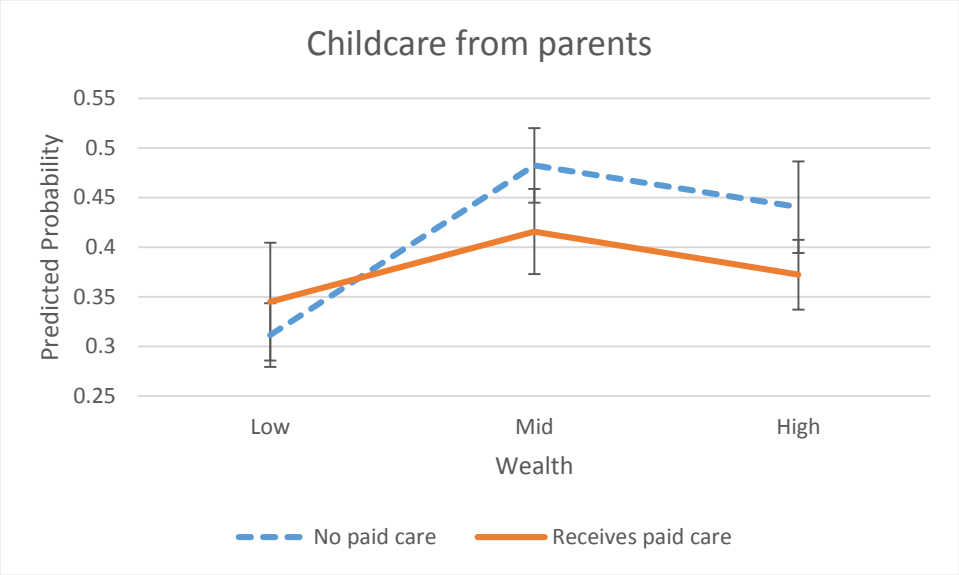
	Equivalized Household Income											
	Low Wealth			Mid Wealth			High Wealth			Total Sample		
Outcome: Had 2nd birth	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Childcare from family (ref: none)												
From parents only	0.91	(0.69-1.20)	0.49	1.09	(0.80-1.48)	0.60	0.93	(0.68-1.28)	0.67	0.97	(0.82-1.16)	0.75
From parents-in-law only	1.24	(0.64-2.39)	0.52	1.00	(0.66-1.54)	0.99	0.82	(0.52-1.29)	0.38	0.93	(0.71-1.23)	0.63
Both	1.44	(0.72-2.87)	0.30	0.99	(0.68-1.45)	0.97	0.69	(0.46-1.02)	0.06	0.91	(0.71-1.17)	0.46
Financial support from parents	0.80	(0.72-0.88)	<0.001	0.82	(0.73-0.92)	0.00	0.71	(0.62-0.82)	<0.001	0.78	(0.73-0.84)	<0.001
Financial support from parents-in-law	0.78	(0.67-0.91)	0.00	0.88	(0.77-1.00)	0.06	0.88	(0.76-1.03)	0.11	0.84	(0.77-0.91)	<0.001
Contact with parents (ref: weekly)												
Never	0.95	(0.36-2.51)	0.92	11.59	(0.97-138.32)	0.05	0.39	(0.08-1.96)	0.25	1.03	(0.48-2.22)	0.94
Less than yearly	1.38	(0.63-3.01)	0.42	0.73	(0.30-1.79)	0.49	1.02	(0.39-2.66)	0.97	0.99	(0.60-1.61)	0.95
At least yearly	1.35	(0.91-2.00)	0.14	1.04	(0.75-1.45)	0.83	1.13	(0.85-1.50)	0.40	1.13	(0.94-1.36)	0.19
Co-resident	0.81	(0.59-1.13)	0.21	1.54	(0.71-3.36)	0.28	4.92	(0.63-38.60)	0.13	0.90	(0.67-1.19)	0.45
Contact with parents-in-law (ref: weekly)												
Never	1.23	(0.54-2.82)	0.62	1.30	(0.39-4.40)	0.67	0.29	(0.07-1.26)	0.10	0.90	(0.49-1.64)	0.73
Less than yearly	3.31	(1.50-7.29)	0.00	1.30	(0.57-2.93)	0.53	0.92	(0.36-2.39)	0.87	1.70	(1.06-2.74)	0.03
At least yearly	1.17	(0.75-1.82)	0.50	1.01	(0.75-1.37)	0.93	1.42	(1.08-1.85)	0.01	1.21	(1.01-1.45)	0.04
Co-resident	0.69	(0.31-1.52)	0.36	1.03	(0.33-3.27)	0.95	1.05	(0.34-3.21)	0.94	0.81	(0.47-1.40)	0.44
Paternal investments	0.97	(0.90-1.05)	0.45	0.96	(0.90-1.01)	0.09	0.94	(0.89-1.00)	0.04	0.95	(0.92-0.99)	0.01
Paternity leave	1.36	(0.91-2.02)	0.13	0.99	(0.71-1.39)	0.97	0.86	(0.59-1.26)	0.44	1.06	(0.86-1.31)	0.56
Relationship quality	1.16	(1.03-1.31)	0.01	1.14	(1.05-1.25)	0.00	1.11	(1.01-1.21)	0.03	1.13	(1.07-1.20)	<0.001
Paid childcare support	0.52	(0.37-0.73)	<0.001	0.46	(0.35-0.59)	<0.001	0.50	(0.37-0.67)	<0.001	0.49	(0.41-0.58)	<0.001
Formal support	1.03	(0.90-1.17)	0.67	1.05	(0.92-1.19)	0.51	1.15	(1.02-1.30)	0.02	1.08	(1.01-1.16)	0.03
Sees friends (ref: never/has no friends)												
More than 3 times a week	1.43	(1.03-1.98)	0.03	1.45	(1.01-2.07)	0.04	1.03	(0.71-1.49)	0.87	1.33	(1.09-1.63)	0.01
1-2 times a week	0.99	(0.74-1.34)	0.97	1.31	(0.99-1.75)	0.06	0.82	(0.60-1.13)	0.23	1.05	(0.89-1.25)	0.57
Has other parents to speak to (ref: agree)												
Don't know	1.07	(0.46-2.50)	0.88	0.77	(0.23-2.54)	0.66	0.66	(0.16-2.67)	0.56	0.84	(0.45-1.55)	0.57
Neither agree nor disagree	0.97	(0.66-1.42)	0.86	0.60	(0.37-0.98)	0.04	0.52	(0.27-0.98)	0.04	0.74	(0.56-0.97)	0.03
Disagree	0.73	(0.50-1.05)	0.09	0.68	(0.45-1.04)	0.08	0.55	(0.34-0.87)	0.01	0.65	(0.52-0.83)	<0.001

All models adjusted for age at first birth, education, employment (of woman and partner), partner status, income, and parental survival

SMTable 3.3: Odds ratios, 95% confidence intervals and p-values for logistic regressions for receiving family childcare support depending upon SEP, use of paid care and partner status

			Childcare from parents		
			OR	95% CI	P
Model 1	Paid care (ref: none)	Receives	0.84	(0.73-0.97)	0.02
	Partner stat. (ref: none)	Partnered	1.71	(1.41-2.06)	<0.001
	Wealth (ref: middle)	Low	0.55	(0.45-0.66)	<0.001
		High	0.82	(0.70-0.96)	0.02
Model 2	Paid care (ref: none)	Receives	0.76	(0.60-0.96)	0.02
	Partner stat. (ref: none)	Partnered	1.71	(1.41-2.06)	<0.001
	Wealth (ref: middle)	Low	0.49	(0.39-0.61)	<0.001
		High	0.84	(0.67-1.06)	0.16
	Paid care x Wealth	1#Low	1.53	(1.06-2.20)	0.02
		1#High	0.99	(0.71-1.37)	0.94

SMFigure 3.1: Predicted probabilities of receiving family childcare support with 95% confidence intervals for women receiving (solid line) and not receiving (dashed line) paid childcare by SEP



SMTable 3.4: Model averaged odds ratios, 95% confidence intervals, and p-values for base variables from logistic regressions on having a second child by SEP (base controls from Table 3.2)

	Equivalized Household Income									Total Sample		
	Low Wealth			Mid Wealth			High Wealth					
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Age at first birth	0.94	(0.92-0.97)	<0.001	0.94	(0.92-0.97)	<0.001	0.88	(0.85-0.91)	<0.001	0.92	(0.91-0.94)	<0.001
Education (ref: left at 16)												
no qualifications	1.63	(0.97-2.76)	0.07	0.95	(0.44-2.02)	0.89	0.50	(0.17-1.43)	0.19	1.01	(0.72-1.43)	0.93
left at age 18	1.63	(1.02-2.62)	0.04	0.93	(0.63-1.38)	0.73	0.73	(0.47-1.14)	0.16	1.00	(0.79-1.27)	0.99
Undergraduate	2.17	(1.19-3.95)	0.01	1.42	(0.93-2.17)	0.10	1.17	(0.76-1.78)	0.47	1.51	(1.17-1.95)	<0.001
Graduate	3.82	(1.25-11.66)	0.02	2.08	(0.82-5.29)	0.12	1.38	(0.78-2.46)	0.27	1.89	(1.25-2.87)	<0.001
Woman's employment status (ref: employed)												
Self-employed	0.71	(0.25-2.03)	0.52	1.07	(0.47-2.43)	0.87	1.12	(0.63-2.01)	0.70	0.99	(0.65-1.5)	0.95
Not working	0.85	(0.63-1.15)	0.30	1.00	(0.73-1.39)	0.98	1.00	(0.65-1.52)	0.98	0.91	(0.75-1.1)	0.31
Partner's employment status (ref: employed)												
Self-employed	1.36	(0.71-2.58)	0.35	1.13	(0.75-1.69)	0.56	0.99	(0.68-1.45)	0.97	1.08	(0.84-1.39)	0.52
Not working	1.08	(0.66-1.78)	0.75	2.06	(0.84-5.05)	0.12	0.58	(0.2-1.68)	0.32	1.02	(0.71-1.46)	0.93
Household income (ref: low)												
Mid	-	-	-	-	-	-	-	-	-	1.25	(0.99-1.57)	0.06
High	-	-	-	-	-	-	-	-	-	1.66	(1.28-2.15)	<0.001
Partner Status (ref: partnered)												
Single	0.34	(0.12-0.96)	0.04	0.08	(0.02-0.29)	<0.001	0.95	(0.08-11.65)	0.97	0.32	(0.15-0.7)	<0.001
Single -> partnered	0.39	(0.13-1.18)	0.10	0.22	(0.05-1)	0.05	-	-	-	0.40	(0.18-0.92)	0.03
Partnered -> single	0.09	(0.04-0.2)	<0.001	0.07	(0.03-0.18)	<0.001	0.05	(0.02-0.15)	<0.001	0.07	(0.04-0.12)	<0.001
Parental Survival	1.22	(0.33-4.55)	0.77	0.24	(0.01-5.66)	0.38	0.77	(0.19-3.17)	0.72	0.78	(0.41-1.49)	0.46

Model averaged results come from models also including variables for kin childcare, financial support from parents and parents-in-law, contact with parents and parents-in-law, paternal investments, paternity leave, relationship quality, paid childcare, formal support, frequency of contact with friends, and if respondent has other parents to speak to

4 THE ROLE OF FAMILY SUPPORT IN THE FULFILLMENT OF FERTILITY INTENTIONS IN THE UNITED KINGDOM

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SECTION A – Student Details

Student	Susan B. Schaffnit
Principal Supervisor	Rebecca Sear
Thesis Title	Intergenerational Support and Women's Fertility in High-Income Countries: An Evolutionary Analysis

<u>If the Research Paper has previously been published please complete Section B, if not please move to Section C</u>

SECTION B – Paper already published

Where was the work published?	n/a		
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Where is the work intended to be published?	Demographic Research or Advances in Life Course Research
Please list the paper's authors in the intended authorship order:	Schaffnit & Sear
Stage of publication	**Not yet submitted**

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I am the first author on this paper. I was responsible for the research design, and conducted the statistical analysis. I was also primarily responsible for writing this work. My co-author supported this work in an advisory capacity and helping to edit the writing.

Student Signature: Susan B Schaffer **Date:**

Supervisor Signature: Rebecca Sear **Date:**

4.1 ABSTRACT

In high-income, low-fertility (HILF) countries women often intend to have more children than they do, which has led to the suggestion that there is an 'unmet need' for children in such countries. Much research on the socioeconomic and demographic determinants of fulfilling fertility intentions has been conducted, in order to understand the gap between fertility intentions and fertility. The role of family support is understudied, despite good evidence that this type of support can be independently related to intended and achieved fertility in HILF settings. In this study two hypotheses are tested using Millennium Cohort Study data from the UK: that family support will help women achieve pro-natal intentions after the birth of a first child; and that associations between achieved fertility and family support will be muted for women who do not intend to have a second child. Our results show that, while family support sometimes relates positively to the intention to have a second child, there is no evidence that family support helps women achieve pro-natal intentions. In fact, receiving financial support from family *hinders* second birth progressions. Further, we find evidence that associations between family support and women's fertility are largely similar regardless of fertility intention. Our results suggest that support which lowers the costs of childrearing, does not remove barriers preventing women from fulfilling fertility intentions.

4.2 INTRODUCTION

In high-income, low-fertility (HILF) countries there is a persistent gap between women's intended and achieved fertility at aggregate and individual levels (Westoff and Ryder 1977; Berrington 2004; Lutz 2007; Harknett and Hartnett 2014). Even among women with explicitly pro-natal intentions, many have fewer children than they intend (Goldstein, Lutz, and Testa 2003; Quesnel-Vallée and Morgan 2003; Philipov 2009a; Spéder and Kapitány 2009; Philipov 2009b), causing some concern that there is an unmet need for babies in HILF

contexts (Philipov 2009b). A possible reason for this unmet need is that insufficient support around reproduction is in place to allow women to achieve their fertility intentions. Here we explicitly examine the role of family support. A sizable amount of research from HILF countries has demonstrated that family support predicts intended (Lehrer and Kawasaki 1985; Miller 1992; Bühler 2005; Raymo et al. 2010; Fiori 2011; Modena and Sabatini 2011; Tanskanen and Rotkirch 2014) and achieved fertility (Del Boca 2002; Hank and Kreyenfeld 2003; Kaptijn et al. 2010; Waynforth 2012; Mathews and Sear 2013a; Thomese and Liefbroer 2013; Mathews and Sear 2013b; Schaffnit and Sear 2014; Tanskanen et al. 2014). However, the role of family support in the *fulfillment* of fertility intentions is understudied (Balbo and Mills 2011a). Further, the general literature shows mixed associations between family support and fertility outcomes, and surprisingly some studies have found negative associations between support and fertility (Balbo and Mills 2011; Waynforth 2012; Schaffnit and Sear 2014; Chapter 3). Women hold many competing personal and professional goals, each of which affect their reproductive outcomes; this is magnified in HILF contexts where women's goals are often less compatible with childrearing than in low-income, high-fertility countries (Philipov 2009a). The inconsistent findings of the literature on family support and fertility could stem from not accounting for women's fertility intentions, for example, if family support helps women achieve their goals, whether reproductive or not. In this paper we test the hypotheses that (1) for women with pro-natal intentions following a first birth, family support will facilitate achieving fertility intentions in the United Kingdom, and (2) associations between family support and women's fertility may be muted for women who do not intend to have another child. By focusing on the associations between family support and the fulfillment of fertility intentions we can contribute to the literature in two main ways: firstly, by clarifying a possible reasons for mixed associations between family support and women's fertility in HILF countries; and secondly, by increasing our understanding of potential barriers between women and achievement of fertility intentions.

Section 4.2.1 provides a brief summary of how fertility intentions are defined and measured, and the characteristics of women who fulfill them in HILF countries. The following section (4.2.2) more specifically addresses the role of families in fertility decision-making. Here, the possible associations between family support and fulfillment of fertility intentions are first discussed, and secondly, the current literature linking family support to intended and achieved fertility is outlined, highlighting the possibility that mixed results could stem from not taking into account women's intended reproductive behavior.

4.2.1 Fertility intentions in low-fertility countries

With concern of an unmet need for babies, a large amount of research has gone into both assessing the validity of fertility intention measures and identifying factors associated with achieving fertility intentions (Quesnel-Vallée and Morgan 2003; Toulemon and Rita Testa 2005; Rossier and Bernardi 2009; Spéder and Kapitány 2009; Harknett and Hartnett 2014). Fertility intentions change over time as people update their intentions to changing life circumstances (Berrington 2004; Liefbroer 2009; Iacovou and Tavares 2011). As such, measures of short-term fertility intentions are generally better predictors of behavior than long-term intentions, and parity progression intentions (intention to have a/another child) are better predictors than quantum intentions (intended completed family size) (Schoen et al. 1999; Philipov 2009b; Balbo, Billari, and Mills 2013; Harknett and Hartnett 2014). Further, studies which account for intensity of intention hold more predictive power (Schoen et al. 1999; Berrington and Pattaro 2014; Harknett and Hartnett 2014). Even so, fertility intentions are found to be consistently, if not perfectly, correlated to reproductive outcomes, indicating that they are somewhat realistic approximation of future plans.

To fulfill fertility intentions implies the alignment of circumstances which could include financial capability, availability of a mate, status of competing life goals, or perceived control over one's own behavior (Philipov 2009a). Research on the fulfillment of intentions

has focused largely on the socioeconomic and demographic characteristics of women, with little research on the role of women's family support which could modify some of these circumstances. The primary factors considered include women's educational achievements, employment status, partnership status, parity, and age. Socioeconomic factors may be linked both to women's sense of control over reproduction and access to resources which could allow for the fulfillment of intentions. Factors such as education and employment are linked to the fulfillment of intentions, but with mixed associations (Toulemon and Rita Testa 2005; Berrington and Pattaro 2014). The contradictory findings could suggest that women with high education have access to greater information on the control of fertility than other women but also have more competing goals which could hinder intention realization. Unsurprisingly, having a partner positively associates with fulfilling fertility intentions (Schoen et al. 1999; Quesnel-Vallée and Morgan 2003; Harknett and Hartnett 2014); a partner is obviously necessary on a biological level but may also contribute to financial and emotional security which all contribute to the circumstances which play into the reproductive decision-making process. Being a mother, as opposed to a childless woman, is also associated with increased probabilities of achieving fertility intentions (Quesnel-Vallée and Morgan 2003; Berrington 2004; Toulemon and Rita Testa 2005; Spéder and Kapitány 2009; Harknett and Hartnett 2014); first time mothers have both more competing intentions and a less clear idea of the changes that will come with the initiation of childrearing than mothers, thus reducing the accuracy of their plans. Finally, women's age is also an important component in predicting the fulfillment of fertility intentions, but associations are mixed (Berrington 2004; Harknett and Hartnett 2014). Mixed associations may reflect mixed predictions: younger women have higher fecundity yet have many future reproductive years; older women are less fecund, but may try harder to have another child before being unable to do so.

4.2.2 The role of families in reproductive decision-making: intended and achieved fertility

As members of a cooperative breeding species, support from a woman's family is expected to be an important determining factor in her ability to reproduce (Hrdy 2009a; Sear and Coall 2011). More generally, women's families are expected to be particularly supportive due to their shared genes and thus shared fitness interests (Hamilton 1964). Family support is thus a strong potential factor which may modify the landscape within which women attempt to achieve fertility intentions and affect her probability of success (Balbo and Mills 2011a). It is not clear, however, whether we should expect family support to have similar effects on women's fertility for those with different fertility intentions. Families, through their support or other means, may reinforce or encourage pro-natal norms and behavior, regardless of women's reproductive intentions, due to shared inclusive fitness interests. In this situation, families would buffer women from anti-natal messages from the larger society, as suggested by Newson et al. (2005) who note that "kin may be necessary to keep behavior directed toward competing for reproductive success" (p. 371). Alternatively, family support may lead to increased fertility *only* for women who plan or intend to have a child. For women who do not intend to have children the association between family support and fertility may weaken and support from families may help women fulfill non-reproductive, for example status-seeking (Alvergne and Lummaa 2014), goals as these may have been associated with fitness in past environments (Kaplan et al. 2002). It is possible that women's parents and in-laws could encourage different reproductive goals and or behavior. For example, some researchers suggest that maternal kin (women's parents) may encourage child quality over quantity while paternal kin (women's parents-in-law) may prioritize child quantity (Sear, Mace, and Mcgregor 2000; Sear, Mace, and McGregor 2003; Leonetti, Nath, and Hemam 2007; Borgerhoff Mulder 2009). Only one study has previously tested the relationship between family and achieving fertility intentions. The study found

that the strength and quality of ties with families negatively predicted having a child given that having a child was intended (Balbo and Mills 2011a). While this previous study focused on emotional ties with families, in our paper we test how practical support from families – financial help or childcare – relates to the probability of achieving fertility intentions, and how women with both pro- and anti-natal intentions respond to family support.

Although little is known about the role of family support in the fulfillment of fertility intentions, there is a substantial amount of research which tests for associations between families and fertility intentions, and separately, families and achieved fertility in HILF countries. This literature demonstrates inconsistent associations between support and fertility outcomes – both intended and achieved - in the UK (Mathews & Sear, 2013a, 2013b; Tanskanen, Jokela, Danielsbacka, & Rotkirch, 2014; Waynforth, 2012; Chapter 3) and other high-income, low-fertility settings (Lehrer and Kawasaki 1985; Miller 1992; Del Boca 2002; Hank and Kreyenfeld 2003; Bühler 2005; Kertzer et al. 2009; Kaptijn et al. 2010; Raymo et al. 2010; Fiori 2011; Modena and Sabatini 2011; Aassve, Meroni, and Pronzato 2012; Thomese and Liefbroer 2013; Schaffnit and Sear 2014; Tanskanen and Rotkirch 2014). Women's fertility intentions have been positively linked to number of measures of family support: emotional (Tanskanen and Rotkirch 2014), childcare (Lehrer and Kawasaki 1985; Tanskanen and Rotkirch 2014), household support (Fiori 2011), and proximity (Bühler 2005; Raymo et al. 2010). Many null (Miller 1992; Bühler 2005; Raymo et al. 2010; Tanskanen and Rotkirch 2014) and a few negative associations are also noted (Balbo and Mills 2011a; Modena and Sabatini 2011). The literature then suggests that families may influence the formation of intentions, although associations are inconsistent.

The literature on achieved fertility does not clarify whether the link between family support and intentions manifests itself in achieved fertility. Particularly surprising from the achieved fertility literature are negative relationships between family support and fertility (Schaffnit

and Sear 2014), with three studies specifically noting negative associations between support and additional births in the UK (Waynforth 2012; Tanskanen et al. 2014; Chapter 3). These findings seem to contradict basic predictions generated by the hypothesis that humans are cooperative breeders. However, pro-natalism from families may be seen in an improvement in a first child's quality rather than the production of further off-spring. The former is particularly relevant in HILF countries where children benefit from intense parental investment and the trade-off between child quality and quantity is not off-set by higher wealth or socioeconomic position (Lawson and Mace 2011). Children and infant mortality is low in HILF countries (UNICEF Office of Research 2013), meaning other child outcomes like education or mental development (Coall and Hertwig 2010) may be where the benefits of family support are seen. Further, family support may enable women to fulfill their non-reproductive goals. For these reasons, separating women by fertility intentions is a good way to tease apart one factor which may alter associations between family support and women's fertility.

The majority of previous studies in HILF contexts on families and fertility are undertaken using large demographic data sets. Inconsistencies in results suggest that variation in reproductive strategies within these heterogeneous populations may modify how women respond to their family support. Previous work has demonstrated the utility of taking into account variation in socioeconomic position (Schaffnit and Sear 2014; Tanskanen and Rotkirch 2014; Chapter 3), women's employment status (Kaptijn et al. 2010; Fiori 2011) and family structure (Aassve, Meroni, and Pronzato 2012) in teasing apart the complex relationships between family support and women's intended and achieved fertility in HILF countries. If reported fertility intentions are good approximations of real reproductive strategies then some of these mixed (and sometimes negative) relationships between family support and fertility could be explained by variation in women's reproductive

intentions not being taken into account. When intentions are ignored, we assume that family support will have the same effect on women's reproductive choices no matter her own life goals. In reality women pursue many reproductive and non-reproductive goals, and family support may have a number of associations with fertility depending on these. In this study we will test specifically if variation in reproductive goals modifies these associations between family support and second births and may explain some of the mixed and even negative relationships noted in the UK.

4.3 METHODS

Data from the Millennium Cohort Study (MCS) were used to test our hypotheses. The MCS follows over 18,000 children born in the UK between the years 2000 and 2002. The first wave of data collection occurred nine months after the cohort member's (CM) birth; subsequent waves of data were collected every two to three years. As our outcome of interest was whether or not a woman had a second birth, our sample included only women for whom the CM was their first child. Previous research on family support and second births in the UK have demonstrated mixed results (Waynforth 2012; Mathews and Sear 2013b; Tanskanen et al. 2014; Chapter 3) giving us a prime opportunity to attempt to tease apart these associations by fertility intentions. Further, by studying second births rather than first births, we can focus on the influence of support directed at childrearing on subsequent childbearing, rather than more general support. Finally, as noted earlier fertility intentions are more accurate for women who already have children than those without children.

Only women present in wave 4 of data collection, approximately eight years after the birth of the cohort member, were included to reduce the probability of excluding women who will go on to have, but had not yet had, another child. The median first to second birth interval was 36 months in the UK in 2012 (Office for National Statistics 2014a), and in our

sample no births occurred more than 71 months after the first birth suggesting this was an appropriate amount of time. Women who were pregnant with a second child at the time of the first wave of data collection and women who had a twins or triplets at their first birth were excluded from the analysis. Our resultant sample included 3,142 women.

4.3.1 Variables

Our main dependent variable was a binary indicator of whether or not each woman did or did not have a second birth before wave four of data collection. Fertility intentions were measured at wave one of data collection when the CM was nine months old. Women were asked "Do you plan to have any more children?" and could respond "yes" (65.9%), "no" (17.7%), or "I don't know" (15.4%). In this analysis we focus only on women who responded yes or no as these women were assumed to have stronger preferences. In our sample, 78.9% of women intended to have a second child and 21.1% did not (Table 4.1). Women who responded "I don't know" were similar to those who responded "yes" or "no" in terms of age and socioeconomic status, but an intermediate proportion went on to have a second birth (44.0%). Unfortunately, time-dependent intentions were not available in this data set.

Our main independent variables were indicators of the practical support women receive from their families, which were chosen based on their availability in the data set. A measure of contact frequency with parents and parents-in-law was also included which has previously been linked with second births in the UK using this dataset (Tanskanen et al. 2014). A count of the types of financial support (help buying essentials for the first child, lending money, paying for household costs, etc.) was created separately for women's parents and parents-in-law (0 through 6). A categorical childcare variable indicated whether or not women received childcare from their families for their first child: none, from parents only, from parents-in-law only, or both. Contact frequency was measured separately for

women's parents and parents-in-law in categorical variables: no contact, contact less than yearly, at least yearly, at least weekly contact, and co-resident. Because family support is obviously dependent upon their survival (for example, see Gibson & Mace, 2005; Voland & Beise, 2002), we included a binary indicator or whether each family member – mother, father, mother-in-law, and father-in-law – was alive. Parent-in-law support, contact, and survival variables were coded 0 when women were without a partner.

In our analysis we include several control variables all of which are known correlates with reproductive outcomes and are important determinants of fulfilling fertility intentions. We control for women's education (no qualifications (1), education until age 16 (2), education to age 18 (3), an undergraduate degree (4), a graduate degree (5) or other qualifications (6)), and activity status (not employed (1), on leave (2), and employed (3)). A categorical variable for household wealth was created with incomes less than the 33rd centile in one group, those between the 33rd and 66th centile in another group, and finally those with incomes above the 66th centile together. Women's partnership status was also controlled for. The measure of partnership status included wave two information when women either did not have a second child or had their second child after the second wave. Our final measure indicated whether women were permanently single (0), were single but became partnered after the first wave (1), were partnered but became single (2), or were permanently partnered (3). Finally, we included a control for the woman's age at the birth of her first child.

4.3.2 Analysis

We firstly, generated a descriptive table by women's fertility intentions. To test our hypotheses regarding the fulfillment of fertility intentions, we used a Hackman probit analysis accounting for sample selection (similarly to Balbo & Mills, 2011b). This method helps account for sample selection bias, or the fact that unobserved factors which predict

having a given fertility intention also likely affect having a child. The method estimates two probit models: an outcome model (for probability of having a second birth) and a selection model (for probability of having positive/negative fertility intention). We ran two sets of probit models for sample selection. The first tested the association between family support and having a second birth *given that a second child was intended* and the second tested for an association between support and having a birth *given that a second child was not intended*. In both outcome and both selection models we controlled for women's partnership status, employment status, education, and family income. Our main predictors of interest were the support women received from her family: amount of financial support, whether she received childcare from her parents and parents-in-law, and contact frequency with family. We additionally controlled for the survival status of each parent/in-law.

In addition to the our predictors of interest, we included an exclusion restriction because evidence suggests that the Heckman model is more accurate with its inclusion (Sartori 2003). An exclusion restriction is a variable included in the selection model, but not the outcome model, which predicts a woman's intention to have a second child (i.e. their selection into the sample) but not whether or not a woman has a second child (the outcome) other than through fertility intentions. The length of women's stay in the hospital after their first birth was identified as our exclusion restriction by running separate probit models on birth and fertility intentions (see SMTable 4.1 and associated text for models used for identification and brief explanation of the selection method). Women who had shorter hospital stays after their first birth (hours, versus days or weeks) were more likely to want a second birth and slightly more likely to have a second birth, but the association with the outcome (birth) was completely explained by women's fertility intentions. Length of hospital stay is a pseudorandom allocation into a fertility preference group; it likely represents a socioecological or genetic factor associated with the difficulty of a first birth

(and thus fertility intentions) but is not associated with fecundity. As evidence of this, if length of stay in hospital were associated with both fecundity and complications during birth/fertility intentions we would expect that age would explain or reduce the effect of length of hospital stay on probability of birth because women who are older are less fecund. Age does not explain the association, therefore suggesting that there is not a clear causal mechanism that links length of hospital stay to fertility outcomes other than through its effect on fertility intentions.

Because in Chapter 3, we found that childcare had different associations with births by wealth groups, we ran models identical to those described above, but with an interaction between wealth and family childcare. While a similar interaction was found as in chapter 3 (care positively associated with births for poor women, but negatively for wealthy women), the substantive results from these models were not very different than models without the interaction. Figures plotting the probability of intending to have a birth (selection probability) and conditional probability of birth given fertility intention are shown and discussed in this chapter's supplementary materials (SMFigure 4.1).

Table 4.1: Descriptive statistics by women's fertility intentions

	Intends to have 2nd child:		Total
	Yes	No	
n (%)	2479 (78.9%)	663 (21.1%)	3142
Mean age at first birth (years)	27.1	26.0	26.8
Had 2nd birth	71.2	25.5	61.6
Childcare from parents	38.7	37.9	38.5
Childcare from parents-in-law[1]	24.2	19.0	23.4
Mean amount of financial support from parents	1.6	1.9	1.7
Mean amount of financial support from parents-in-law[1]	1.2	0.8	1.1
Contact with parents			
Never	1.8	3.5	2.2
Less than yearly	1.9	1.8	1.8
At least yearly	24.4	16.9	22.8
At least weekly	66.0	62.3	65.2
Co-resident	6.0	15.5	8.0
Contact with parents-in-law[1]			
Never	1.3	3.1	1.6
Less than yearly	3.4	2.8	3.3
At least yearly	34.9	33.8	34.8
At least weekly	58.2	58.9	58.3
Co-resident	2.1	1.4	2.0
Mother Alive	95.2	95.3	95.2
Father Alive	88.8	86.1	88.2
Mother-in-law Alive[1]	93.4	94.7	93.6
Father-in-law Alive[1]	86.8	84.9	86.5
Partner Status			
Single	9.4	36.0	15.1
Single -> Partnered	1.7	5.4	2.5
Partnered -> Single	4.1	4.5	4.2
Partnered	84.8	54.0	78.3
Family Income			
Low	24.2	46.0	28.8
Mid	34.9	27.3	33.3
High	40.9	26.7	37.9
Education			
No qualifications	6.7	15.8	8.6
Left at age 16	42.5	51.7	44.5
Left at age 18	11.5	11.3	11.5
Undergraduate	33.8	18.6	30.6
Graduate	5.4	2.6	4.8
Employment status of woman			
Not employed	33.6	44.6	36.0
On leave	2.5	2.7	2.5
Employed	63.9	52.6	61.5

[1] includes data for partnered women only

4.4 RESULTS

The majority of mothers in the sample planned to have a second child when asked at nine months following their first births (Table 4.1). Of women who planned to have a child the majority (71.2%) succeeded. Of women who did not plan to have another child, just over a quarter still did. Controlling for all covariates, women who intended to have a child had a 68% chance of fulfilling their intention. Family support was not clearly associated with fertility intentions one way or another. A slightly higher proportion of women who intended to have a child received childcare from parents and parents-in-law than women who did not plan another birth. Women who did not want to have another child were both more likely to never see their parents or be co-resident with parents than women who planned to have another child. These women likewise were more likely to be single, have low household income, and have lower educational qualifications than women who intended to have children.

In both Heckman probit models, rho, the measure of correlation between the error terms of the outcome and selection models, was not statistically significant. This indicated that sample selection would probably not bias our estimated effects. We chose to continue with the probit models accounting for sample selection as a conservative precaution because there is still some probability of sample selection bias. Further, upon running traditional probit models on probability of second birth for women stratified by fertility intentions we did find evidence that parameter estimates may be biased by not taking into account sample selection (SMTable 4.2 shows results from a traditional probit model; note that the association between wealth and birth given fertility intention is over estimated in the traditional probit model).

Coefficients, 95% confidence intervals and p-values from the models accounting for sample selection are shown in Table 4.2. Both selection and outcome models are shown firstly for

women who intend to have a second child and then for women who do not intend to have another child. The selection models show predictors of having a given fertility intention (to have a child or not) and as such the selection models for women who intend to have a child and do not intend to have a child are inverses of one another (i.e. the coefficients are nearly identical, but have opposite signs). The outcome models show parameter estimates from the models predicting having a second birth *given a woman intend to have a second child or did not intend to have a second child*. For ease of interpreting these associations, they are shown in three figures. Firstly, selection probabilities – the probability that a woman intends to have a birth - were plotted by family support measures (Figure 4.1). Secondly, conditional probabilities were calculated and plotted for each type of family support; these represent the probability of having a second child *given that a woman intends to have a second child* (Figure 4.2) and *given that a woman does not intend to have a second child* (Figure 4.3). Selection and conditional probabilities with 95% confidence intervals are shown in table format in the supplementary material (SMTable 4.3).

Table 4.2: Coefficients, 95% confidence intervals, and p-values from Heckman probit for sample selection for women who intend to have a second child and women who do not intend to have a second child. Selection (fertility intention) and outcome (second birth) models are shown.

	Intends to have second child						Does not intend to have second child					
	Outcome Model: Had 2nd birth			Selection Model: Fertility Intentions			Outcome Model: Had 2nd birth			Selection Model: Fertility Intentions		
	Coef.	95% CI	P	Coef.	95% CI	P	Coef.	95% CI	P	Coef.	95% CI	P
Age at first birth	-0.03	(-0.05,-0.01)	<0.001	-0.03	(-0.05,-0.02)	<0.001	-0.06	(-0.09,-0.04)	<0.001	0.03	(0.02,0.05)	<0.001
Partner Status (ref: partnered)												
Single	-0.73	(-1.47,0.02)	0.06	-0.81	(-1.30,-0.31)	0.00	-0.03	(-1.56,1.50)	0.97	0.80	(0.30,1.30)	0.00
Single->Partnered	-0.45	(-1.22,0.31)	0.25	-0.74	(-1.30,-0.17)	0.01	-0.11	(-1.57,1.34)	0.88	0.73	(0.17,1.29)	0.01
Partnered -> Single	-1.71	(-2.15,-1.26)	0.00	-0.21	(-0.47,0.04)	0.10	-1.10	(-1.98,-0.22)	0.01	0.21	(-0.05,0.46)	0.11
Family Income (ref: mid)												
Low	-0.11	(-0.28,0.07)	0.24	-0.08	(-0.26,0.09)	0.35	-0.20	(-0.58,0.17)	0.28	0.10	(-0.07,0.27)	0.26
High	0.14	(-0.00,0.28)	0.05	0.02	(-0.13,0.16)	0.84	0.08	(-0.23,0.38)	0.62	-0.01	(-0.15,0.13)	0.88
Education (ref: left at age 18)												
No qualifications	-0.11	(-0.41,0.19)	0.48	-0.31	(-0.54,-0.08)	0.01	0.79	(-0.31,1.88)	0.16	0.31	(0.08,0.54)	0.01
Left at age 16	-0.04	(-0.23,0.14)	0.64	-0.04	(-0.22,0.13)	0.62	0.33	(-0.17,0.83)	0.20	0.04	(-0.13,0.21)	0.63
Undergraduate	0.14	(-0.06,0.35)	0.17	0.28	(0.09,0.47)	0.00	0.37	(-0.06,0.81)	0.09	-0.28	(-0.47,-0.09)	0.00
Graduate	0.26	(-0.07,0.59)	0.12	0.40	(0.08,0.72)	0.02	0.20	(-0.75,1.15)	0.68	-0.39	(-0.71,-0.07)	0.02
Activity status (ref: not employed)												
On leave	-0.25	(-0.60,0.10)	0.16	0.17	(-0.18,0.52)	0.35	0.04	(-0.65,0.72)	0.92	-0.17	(-0.52,0.17)	0.33
Employed	-0.14	(-0.29,0.01)	0.07	-0.12	(-0.26,0.02)	0.10	0.00	(-0.35,0.34)	0.98	0.12	(-0.02,0.26)	0.09
Mother Alive	-0.18	(-0.48,0.12)	0.23	-0.08	(-0.35,0.20)	0.58	0.37	(-0.41,1.14)	0.36	0.08	(-0.19,0.36)	0.56
Father Alive	0.02	(-0.16,0.20)	0.82	0.08	(-0.09,0.25)	0.37	0.08	(-0.27,0.43)	0.65	-0.08	(-0.24,0.09)	0.38
Mother-in-law Alive	0.13	(-0.12,0.38)	0.31	-0.14	(-0.41,0.12)	0.29	-0.24	(-0.81,0.33)	0.41	0.15	(-0.12,0.41)	0.29
Father-in-law Alive	0.07	(-0.11,0.24)	0.46	-0.02	(-0.20,0.16)	0.85	0.46	(-0.15,1.07)	0.14	0.02	(-0.15,0.20)	0.79
Financial support from parents	-0.13	(-0.20,-0.05)	<0.001	-0.08	(-0.13,-0.02)	0.01	-0.13	(-0.23,-0.03)	0.01	0.08	(0.02,0.13)	0.01
Financial support from parents in-law	-0.08	(-0.15,-0.01)	0.02	0.00	(-0.07,0.07)	0.92	-0.11	(-0.30,0.08)	0.25	0.00	(-0.07,0.07)	0.93
Childcare from family (ref: none)												
From parents only	0.02	(-0.14,0.17)	0.83	0.11	(-0.03,0.25)	0.12	0.01	(-0.28,0.30)	0.95	-0.10	(-0.24,0.04)	0.14
From parents-in-law only	-0.01	(-0.23,0.20)	0.90	0.12	(-0.10,0.35)	0.28	-0.25	(-0.91,0.41)	0.46	-0.11	(-0.34,0.11)	0.33
From parents and parents-in-law	-0.07	(-0.27,0.13)	0.49	0.22	(0.01,0.43)	0.04	0.17	(-0.34,0.67)	0.52	-0.23	(-0.44,-0.01)	0.04

Contact with parents (ref: weekly)												
Never	-0.10	(-0.59,0.39)	0.70	-0.35	(-0.74,0.04)	0.08	0.04	(-0.89,0.96)	0.94	0.36	(-0.03,0.74)	0.07
Less than yearly	-0.32	(-0.76,0.12)	0.15	-0.17	(-0.58,0.23)	0.41	-0.26	(-1.03,0.52)	0.52	0.17	(-0.24,0.57)	0.43
At least yearly	-0.03	(-0.19,0.14)	0.75	0.05	(-0.1,0.21)	0.51	-0.03	(-0.37,0.3)	0.84	-0.06	(-0.21,0.1)	0.49
Co-resident	-0.09	(-0.35,0.16)	0.49	0.04	(-0.17,0.24)	0.74	-0.05	(-0.39,0.3)	0.79	-0.04	(-0.24,0.17)	0.72
Contact with parents-in-law (ref: weekly)												
Never	0.08	(-0.42,0.59)	0.75	-0.41	(-0.82,0.01)	0.05	-0.75	(-1.63,0.12)	0.09	0.41	(0,0.82)	0.05
Less than yearly	0.29	(-0.09,0.67)	0.14	0.14	(-0.24,0.51)	0.47	0.13	(-0.71,0.96)	0.77	-0.15	(-0.52,0.23)	0.44
At least yearly	0.18	(0.03,0.34)	0.02	0.03	(-0.12,0.18)	0.66	0.02	(-0.29,0.34)	0.88	-0.04	(-0.19,0.11)	0.63
Co-resident	-0.02	(-0.46,0.41)	0.91	0.10	(-0.38,0.57)	0.69	0.12	(-0.93,1.18)	0.82	-0.11	(-0.59,0.38)	0.67
Length of hospital stay (ref: weeks)												
Days				0.22	(0.04,0.40)	0.02				-0.21	(-0.39,-0.03)	0.02
Hours				0.32	(0.00,0.63)	0.05				-0.34	(-0.64,-0.03)	0.03
Constant	1.87	(1.05,2.69)	<0.001	1.27	(0.52,2.01)	0.00	0.81	(-2.37,3.99)	0.62	-1.27	(-2.01,-0.52)	0.00
athrho	-0.449 (-1.44,0.54)						-0.580 (-2.52,1.36)					
rho	-0.421 (-0.89, 0.50)						-0.523 (-0.99, 0.88)					
Observations	3142						3142.					

4.4.1 Does family support associate with intending to have a second child?

We can see from Figure 4.1 that, in some cases, family support predicted planning to have a second child. Financial support from women's parents negatively predicts intending to have more children. Women receiving four or more forms of financial support from parents had a probability of planning to have another child of 0.72 (95% CI 0.67-0.77) versus 0.81 (95% CI 0.79-0.83) for those receiving only one form of financial support. Receiving childcare from both parents and in-laws was positively associated with intending to have another child; the probability of intending to have another birth increased from 0.84 (95% CI .082-0.86) when no childcare from families was received to 0.89 (0.85-0.92) when childcare from both parents and parents-in-law was received. There was weak evidence that women who see their parents or parents-in-law weekly were more likely to intend to have another child than women who never see their families. Of women with partners, the probability of intending to have a child increased from 0.75 (95% CI 0.62-0.88) for those who never see their parents-in-law to 0.85 (95% CI 0.83-0.87) for women who see their parents-in-law weekly. There appears to be a positive association between contact with women's parents and fertility intentions in Figure 4.1; the association was not quite statistically significant (p=0.08).

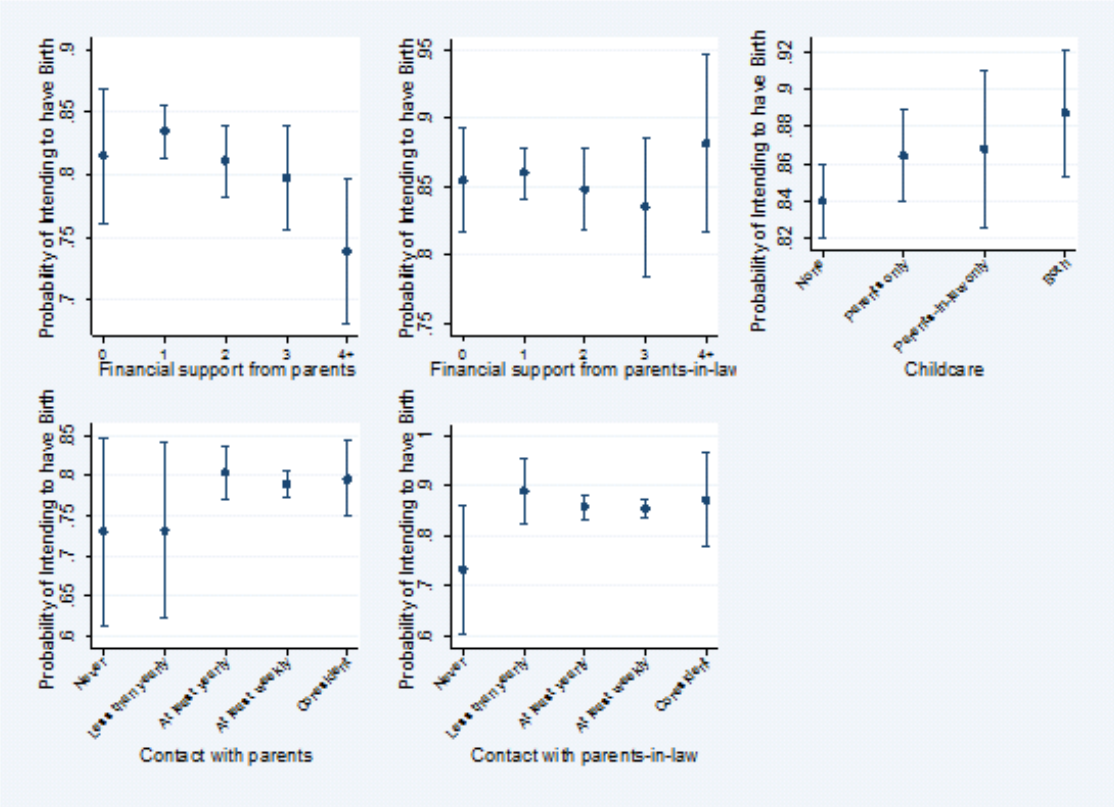


Figure 4.1: Predicted probability of intending to have a second child and 95% confidence intervals by famlily support and contact

4.4.2 Does support from families help women with pro-natal goals achieve their fertility intentions?

While some forms of support positively related to intending to have a second child, this did not translate into achieved fertility intentions (having a second birth when one was intended). In fact, women receiving greater financial support from her parents were both less likely to intend to have a second birth and, given that they did intend to have a birth, less likely to fulfill the intention (Figure 4.2). Those receiving four or more forms of financial support from parents had a conditional probability of birth of 0.54 (95% CI 0.46-0.61) versus 0.76 (95% CI 0.70-0.82) for women receiving no financial support. The same support received from parents-in-law did not associated with intentions, but predicted lower probabilities of birth given women intended to have a child. As found previously (Chapter 3), moderate levels of contact with parents-in-law relates to a higher probability of birth compared to more frequent contact. Those seeing parents at least yearly, had a conditional

probability of birth at 0.81 (95% CI 0.78-0.84) while those with weekly contact had a lower probability of intention fulfillment (cond.prob. = 0.76; 95% CI 0.73-0.78). Taken together, we reject our first hypothesis that family support helps women have second children when women intend to continue childbearing.

We now shift attention to the more traditional measures associated with the fulfillment of fertility intentions. Socio-demographic factors like age, household income, education and partnership status were to varying degrees related to women's pro-natal fertility intentions and their fulfillment. Age had a small but significant negative association with both planning to have another child and fulfilling this intention. As other studies have demonstrated, having a partner was positively associated with intending to have a second child and was the strongest predictor of achieving the intention to have a second child. Education positively predicted planning to have a second child, but did not associate with having another child given a pro-natal intention. Wealthier women who planned to have a child were more likely to do so than poorer women. There was weak evidence that being employed negatively associated with the fulfillment of pro-natal fertility intentions.

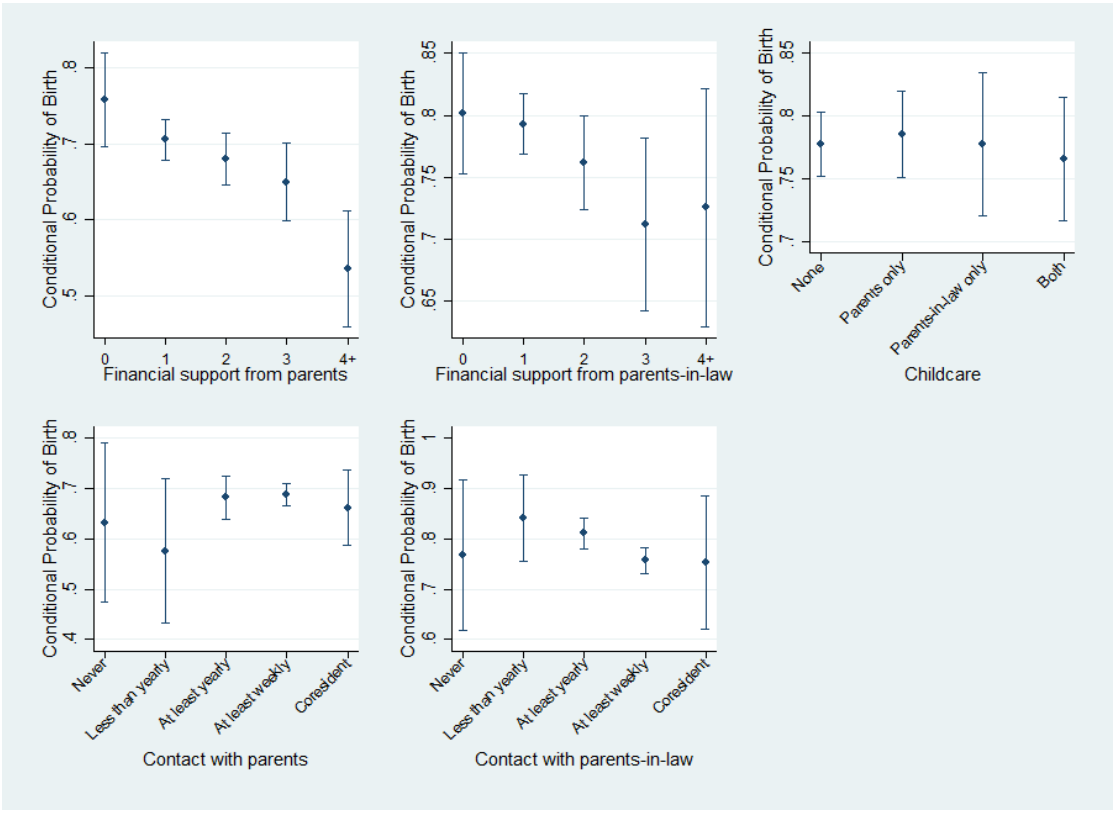


Figure 4.2: Predicted conditional probabilities of birth and 95% confidence intervals for women who intended to have a second child

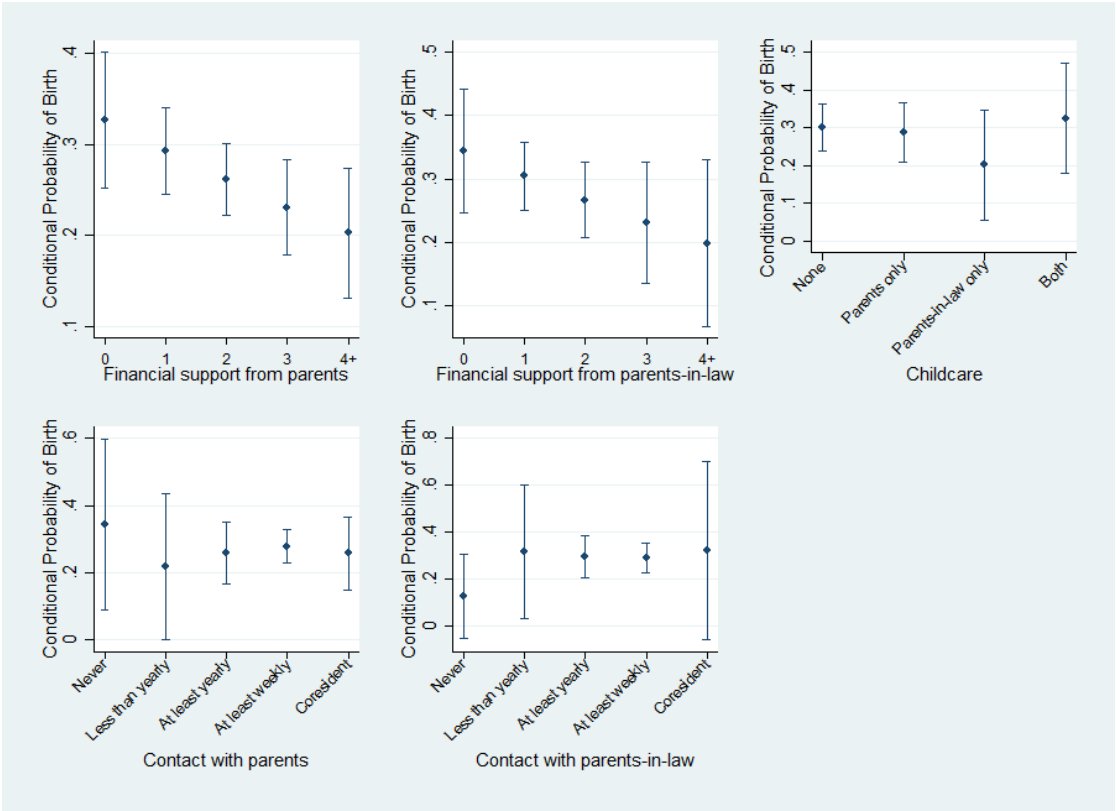


Figure 4.3: Predicted conditional probabilities of birth and 95% confidence intervals for women who did not intend to have a second child

4.4.3 Do fertility intentions modify women's response to family support?

Having rejected our first hypothesis that families help women achieve fertility intentions, we then tested whether family support has different associations with achieved fertility depending upon women's fertility intentions. Specifically, we suggested that associations between support and fertility may be muted when women do not intend to have a second child as family support would likely be used to accomplish non-reproductive intentions. Our results suggest that counter to our prediction, associations between family support and fertility are largely similar regardless of fertility intention (Figure 4.2). A significant negative association between financial support from parents and having a second birth was found for both women who had pro-natal intentions and those who didn't intend to have a second child. For women not intending to have a child, those receiving four or more types of financial support from parents had a probability of birth of 0.18 (95% CI 0.10-0.25) versus 0.31 (95% CI 0.23-0.39) for women receiving no financial support. As for women who intended to have a second child, those who did not were less likely to have a birth when they received greater financial support from parents-in-law, and were more likely to have a birth when they had moderate levels of contact with parents-in-law. The associations, however, were only statistically significant for women who intended to have a second birth; the sample of women who did not want to have another child was small (n=663) perhaps explaining the difference in statistical significance. Financial support from family therefore seems to be consistent in reducing women's fertility intentions and their achieved fertility, regardless of intention.

4.5 DISCUSSION

Contrary to our hypotheses (1) family support does not help women achieve pro-natal intentions, and (2) associations between family support and women's second births do not vary significantly by women's fertility intentions. This suggests that the mixed and negative

associations between family support – particularly financial support - and second births found in the UK (Waynforth 2012; Tanskanen et al. 2014; Chapter 3) are not due to variation in reproductive goals. Further, the mechanisms relating support to fertility are likely similar between the fertility intention groups. Finally, while support from families may reduce costs associated with raising a child, it does not eliminate barriers between women achieving their fertility intentions.

Our results reflect those of Balbo and Mills (2011) who found that given that women wanted to have another child, those with higher family social capital were less likely to do so than women with weaker or lower quality ties with their family. They interpret that women adopt a satisficing strategy (Simon 1956) in which they give up their pro-natal intentions so as not to compromise their already satisfactory situation for the unknown. This is an unsatisfying explanation from an evolutionary perspective as we expect that human behavior, as for any other species, is evolved to optimize fitness and not satisfaction. Below we discuss alternative explanations.

Family support may to some extent encourage pro-natal norms, evidenced by the positive associations between receiving childcare from families and having a pro-natal intention and a weak relationship between seeing with parents-in-law and intending to have another child. However, financial support from parents negatively predicts planning to have another child. As discussed in Chapter 3, the reasons for associations between support and fertility outcomes - in this case intended – may indicate that different types of support represent different things to women in their decision to have a child. Financial support, associated with financial need, may indicate that the environment is not ideal to continue reproduction. Contact with families and childcare from them may reduce time and monetary costs of reproduction or serve as a means to transmit pro-natal messages to women thus increasing the likelihood of planning a second child. It is not clear, however,

why such positive effects of these family support variables on intentions are not translated into achieved fertility. In this study, family support and fertility intentions were both measured at the same time point, making the causal relationships particularly difficult to untangle.

While receiving financial support and childcare from families both presumably reduce costs of childrearing, some have suggested that reduced costs are only effective at encouraging fertility when paired with increased social rewards for childbearing and rearing (Newson 2009). It is argued that with families in close proximity (which receiving support implies is the case) the social rewards to reproduction would increase (Newson et al. 2005; Newson 2009). That some forms of support positively predict intending to have another child could be interpreted as evidence of families enforcing pro-natal norms. That this support does not result in a higher probability of birth does not necessarily mean that families are anti-natal; women receiving support may be choosing to increase investments in the first child. One often-used measure of maternal investment is breastfeeding. Breastfeeding is associated with many positive cognitive and health outcomes for children (Mortensen 2002; Quigley, Kelly, and Sacker 2007; Kramer et al. 2008) and we could expect that family support would allow women the time and energy to increase this form of investment. Evidence from the MCS suggests that this is not the case and in fact, greater contact with families reduces women's probability of initiating and continuing breastfeeding (Emmott, in prep). Investments could come in any number of forms other than breastfeeding, however, including focusing on one's own career to raise the family income, saving money for a better home, or putting money aside for the first child's future.

One particularly surprising result of this study is that regardless of fertility intention, receiving financial support from parents negatively predicts having another child. Associations with financial support and contact with parents-in-law are only significant

predictors of having a second birth *given that one was intended,* although the direction of associations were the same between fertility intention groups. Previous research has not only linked financial support to lower fertility (Waynforth 2012) in the UK, but in Chapter 3 we demonstrated that across socioeconomic position groups the measure had a high probability of being an important predictor of second births. Financial support is associated with financial need (Chapter 3) and in the UK, lower financial security – real and perceived - negatively predicts having additional children (Tanskanen et al. 2014; Chapter 3). Even when controlling for financial status, the measure persists as an important and statistically significant factor negatively predicting continued childrearing. Qualitative research on reproductive decision-making may illuminate some of the reasons why financial support from parents holds such a negative association with fertility.

Our results highlight the overall importance of partnership status in both the formation and fulfillment of fertility intentions. Unsurprisingly, and as demonstrated many times previously (Schoen et al. 1999; Quesnel-Vallée and Morgan 2003; Harknett and Hartnett 2014), we found that women without consistent partners were all less likely to intend to have a child, and given that intention, were in general less likely to have a second child than women with consistent partners. Compared to consistently partnered women, women who were partnered but became single were only slightly less likely to plan on having a second child, but were significantly less likely to do so. Alternatively, women who were single but became partnered, were significantly less likely than partnered women to plan on having a second child, but not less likely to have one. This is likely because the acquisition of a new partner in later waves reignited their desire for children perhaps to legitimize the new relationship.

A limitation of this study is that women's fertility intention is not time-dependent and was only measured at one time-point. It is very possible that women's intentions changed over time. Any number of circumstances could have changed in the years following the CM's birth leading to the revision of intentions: the loss of a partner or parent, a job promotion, or greater experience mothering the first child. Further, the strength of intention is unknown. Women may have intended to have another child, but in receiving support from their family decided to prioritize other competing goals. Considering most women who intended to have another child did so (a 0.68 probability controlling for all covariates), these limitations may not be a big problem for our analyses. Another limitation, as in Chapter 3, is the lack of information on parent and parent-in-law characteristics which may confound associations between support and women's fertility outcomes including their health status and age. By measuring actual forms of support, particularly childcare, we hopefully have captured some measure of health as this form of support requires one to be able-bodied.

In conclusion, not only do we find no evidence that family support helps women achieve pro-natal intentions, but fertility intentions do not moderate associations between family support and women's second births in the UK. It is possible that family support is translated into other fitness metrics such as the cohort member's mental, emotional or physical well-being. This study and others (Emmott, in prep; Waynforth 2012; Tanskanen et al. 2014; Chapter 3) highlight the need for a better understanding of what receiving various forms of support means to women during the reproductive decision-making process in the UK, and elsewhere in HILF contexts.

SMTable 4.1: Coefficients, 95% confidence intervals and p-values from probit models used to identify fertility exclusion. Model 2 contains a control for mothers' age at first birth.

		Intends to have another child			Had 2nd birth			Had 2nd birth		
		Coef.	95% CI	P	Coef.	95% CI	P	Coef.	95% CI	P
Model 1	Length of hospital stay (ref: weeks)									
	Days	0.238	(0.08,0.40)	0.003	0.130	(-0.01,0.26)	0.058	0.091	(-0.06,0.25)	0.251
	Hours	0.382	(0.11,0.66)	0.006	0.124	(-0.09,0.34)	0.272	-0.017	(-0.27,0.23)	0.892
	Fertility intention (ref: no)									
	Yes							1.145	(1.04,1.25)	<0.001
	Constant	0.584	(0.43,0.74)	<0.001	0.102	(-0.02,0.23)	0.118	-0.687	(-0.86,-0.52)	<0.001
Model 2	Length of hospital stay (ref: weeks)									
	Days	0.244	(0.08,0.40)	0.003	0.132	(-0.00,0.27)	0.054	0.093	(-0.06,0.24)	0.241
	Hours	0.401	(0.13,0.68)	0.004	0.130	(-0.09,0.35)	0.248	-0.011	(-0.26,0.24)	0.930
	Fertility intention (ref: no)									
	Yes							1.140	(1.03,1.25)	<0.001
	Mother's age at first birth	0.014	(0.01,0.02)	<0.001	0.001	(-0.00,0.01)	0.129	0.005	(-0.00,0.01)	0.173
	Constant	0.194	(-0.06,0.45)	0.136	-0.030	(-0.24,0.18)	0.783	-0.820	(-1.07,-0.57)	<0.001

This table works through the steps taken to identify women's length of stay in the hospital after their first birth (abbreviated from here as LOS for "length of stay") as the exclusion restriction variable.

Beginning with Model 1: Firstly, we established that LOS associated with women's fertility intentions (in column headed "Intends to have another child"). Women who stay in the hospital for days or hours were more likely to intend to have another child than women with longer hospital stays. Secondly, we established that LOS is associated with having a second child (middle column, headed "Had 2nd birth"). We found weak evidence (p=0.058) that women who stayed in the hospital for days rather than weeks were more likely to have a second child. Finally, we added a control for fertility intentions to test whether intentions explained the association between LOS and fertility (final column, headed "Had 2nd birth"). The association between LOS and births weakened and became less statistically significant when intentions were controlled for (p=0.251).

Model 2: To establish that LOS associated with births through intention rather than fecundity we repeated the above steps with a control for the woman's age at first birth (a proxy for fecundity).

SMTable 4.2: Coefficients, 95% confidence intervals, and p-values from probit mode for having second birth without accounting for sample selection for a) women who intend to have a second child and b) women who do not intend to have a second child

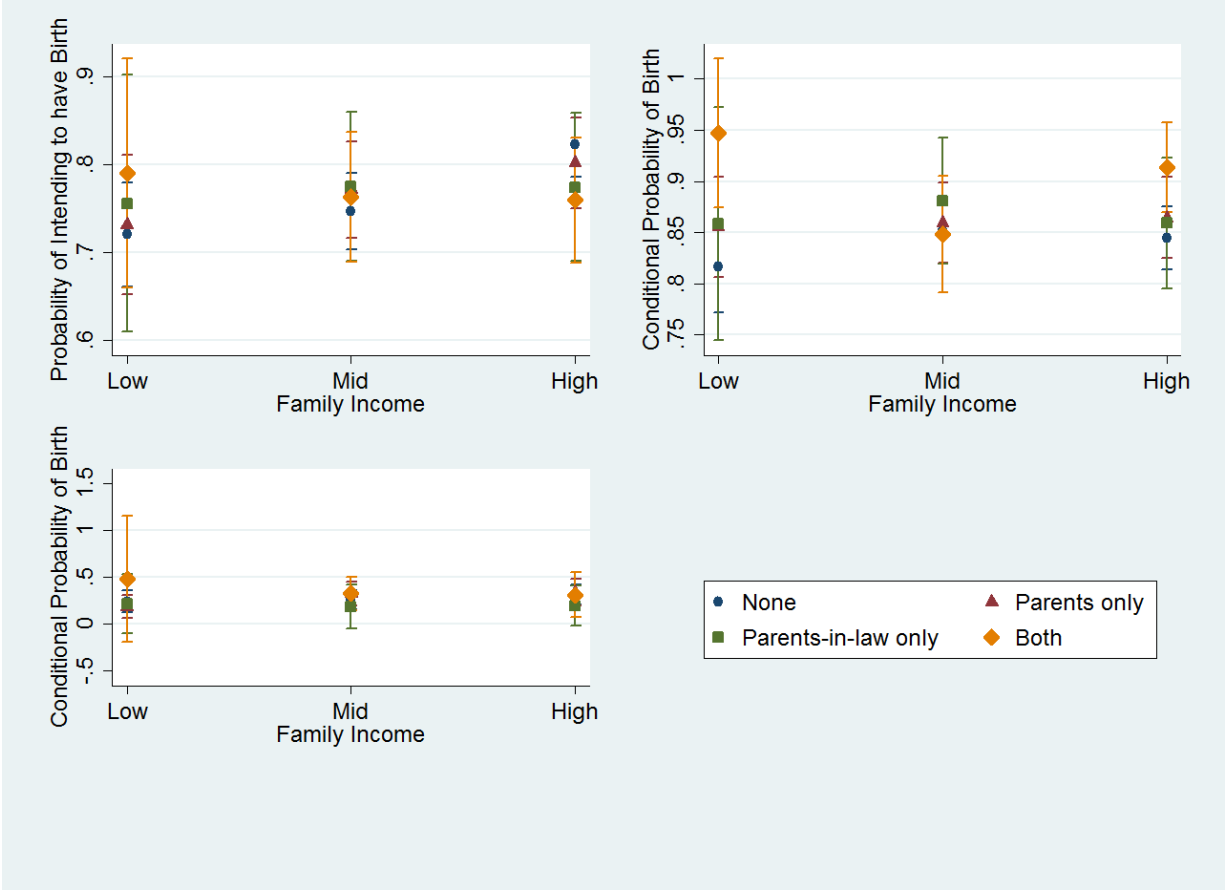
	Intends to have second child			Does not intend to have second child		
	Coef.	95% CI	P	Coef.	95% CI	P
Age at first birth	-0.03	(-0.05,-0.02)	<0.001	-0.06	(-0.08,-0.03)	<0.001
Partner Status (ref: partnered)						
Single	-0.94	(-1.53,-0.36)	0.00	0.30	(-0.89,1.48)	0.62
Single->Partnered	-0.65	(-1.33,0.03)	0.06	0.16	(-1.11,1.43)	0.80
Partnered -> Single	-1.81	(-2.12,-1.49)	<0.001	-1.16	(-1.97,-0.36)	0.01
Family Income (ref: mid)						
Low	-0.12	(-0.30,0.05)	0.17	-0.17	(-0.58,0.24)	-0.43
High	0.15	(0.01,0.29)	0.04	0.08	(-0.26,0.41)	-0.65
Education (ref: left at age 18)						
No qualifications	-0.16	(-0.43,0.12)	0.26	1.02	(0.55,1.49)	<0.001
Left at age 16	-0.04	(-0.22,0.14)	0.67	0.41	(0.00,0.81)	0.05
Undergraduate	0.20	(0.00,0.39)	0.05	0.29	(-0.18,0.76)	0.22
Graduate	0.33	(0.01,0.64)	0.04	0.05	(-0.90,1.00)	0.92
Activity status (ref: not employed)						
On leave	-0.26	(-0.61,0.09)	0.15	-0.03	(-0.74,0.68)	0.93
Employed	-0.17	(-0.31,-0.02)	0.03	0.06	(-0.26,0.39)	0.71
Mother Alive	-0.21	(-0.51,0.09)	0.18	0.45	(-0.27,1.17)	0.22
Father Alive	0.05	(-0.14,0.23)	0.63	0.05	(-0.33,0.42)	0.81
Mother-in-law Alive	0.11	(-0.14,0.36)	0.40	-0.21	(-0.84,0.43)	0.52
Father-in-law Alive	0.09	(-0.09,0.26)	0.35	0.55	(0.07,1.03)	0.02
Amount of financial support from parents	-0.15	(-0.21,-0.08)	<0.001	-0.11	(-0.22,0.00)	0.05
Amount of financial support from parents in-law	-0.09	(-0.16,-0.02)	0.01	-0.12	(-0.31,0.06)	0.19
Childcare from family (ref: none)						
From parents only	0.04	(-0.12,0.19)	0.64	-0.03	(-0.31,0.25)	0.85
From parents-in-law only	0.00	(-0.22,0.22)	0.97	-0.35	(-0.94,0.25)	0.26
From parents and parents-in-law	-0.04	(-0.24,0.16)	0.69	0.07	(-0.42,0.57)	0.77
Contact with parents (ref: never)						
Less than yearly	-0.20	(-0.80,0.40)	0.51	-0.43	(-1.47,0.62)	0.43
At least yearly	0.15	(-0.33,0.64)	0.54	-0.27	(-1.07,0.53)	0.51
At least weekly	0.17	(-0.31,0.65)	0.49	-0.21	(-1.00,0.59)	0.61
Co-resident	0.09	(-0.45,0.63)	0.75	-0.26	(-1.12,0.61)	0.56
Contact with parents-in-law (ref: never)						
Less than yearly	0.30	(-0.31,0.91)	0.33	0.87	(-0.34,2.07)	0.16
At least yearly	0.16	(-0.35,0.68)	0.53	0.66	(-0.30,1.63)	0.18
At least weekly	-0.02	(-0.53,0.48)	0.93	0.65	(-0.32,1.62)	0.19
Co-resident	-0.03	(-0.70,0.63)	0.92	0.72	(-0.79,2.23)	0.35
Constant	1.85	(1.02,2.69)	<0.001	-0.19	(-1.86,1.48)	0.82
Observations	2503			666		
Pseudo R-squared	0.14			0.12		

SMTable 4.3: Probabilities of birth conditional on fertility intention, selection probabilities, and 95% confidence intervals by family support measures

	Intends to have 2nd child				Does not intend to have 2nd child			
	Cond. Prob.	95% CI	Sel. Prob.	95% CI	Cond. Prob	95% CI	Sel. Prob	95% CI
For full sample	0.68	(0.66-0.70)	0.79	(0.78-0.80)	0.27	(0.23-0.31)	0.21	(0.20-0.22)
Financial support from parents								
0	0.76	(0.70-0.82)	0.79	(0.74-0.84)	0.31	(0.23-0.39)	0.15	(0.13-0.18)
1	0.71	(0.68-0.73)	0.81	(0.79-0.83)	0.27	(0.22-0.32)	0.17	(0.16-0.19)
2	0.68	(0.65-0.71)	0.79	(0.76-0.82)	0.24	(0.20-0.28)	0.19	(0.18-0.21)
3	0.65	(0.60-0.70)	0.77	(0.74-0.81)	0.21	(0.15-0.26)	0.22	(0.19-0.24)
4+	0.54	(0.46-0.61)	0.72	(0.67-0.77)	0.18	(0.10-0.25)	0.24	(0.20-0.28)
Financial support parents-in-law*								
0	0.80	(0.75-0.85)	0.85	(0.81-0.89)	0.33	(0.23-0.43)	0.14	(0.11-0.16)
1	0.79	(0.77-0.82)	0.86	(0.84-0.88)	0.29	(0.23-0.34)	0.14	(0.12-0.15)
2	0.76	(0.72-0.80)	0.85	(0.82-0.88)	0.25	(0.18-0.31)	0.14	(0.12-0.15)
3	0.71	(0.64-0.78)	0.83	(0.78-0.89)	0.21	(0.11-0.31)	0.14	(0.11-0.17)
4+	0.73	(0.63-0.82)	0.88	(0.82-0.95)	0.18	(0.04-0.31)	0.14	(0.09-0.18)
Childcare from family*								
None	0.78	(0.75-0.80)	0.84	(0.82-0.86)	0.30	(0.23-0.36)	0.16	(0.14-0.18)
From parents only	0.78	(0.75-0.82)	0.86	(0.84-0.89)	0.28	(0.21-0.36)	0.14	(0.11-0.16)
From parents-in-law only	0.78	(0.72-0.83)	0.87	(0.83-0.91)	0.20	(0.06-0.35)	0.13	(0.09-0.18)
From parents and parents-in-law	0.77	(0.72-0.81)	0.89	(0.85-0.92)	0.33	(0.18-0.47)	0.11	(0.08-0.15)
Contact with parents								
Never	0.63	(0.47-0.79)	0.72	(0.60-0.84)	0.34	(0.09-0.6)	0.31	(0.19-0.43)
Less than yearly	0.58	(0.43-0.72)	0.75	(0.64-0.86)	0.22	(0.00-0.44)	0.26	(0.14-0.37)
At least yearly	0.68	(0.64-0.72)	0.80	(0.77-0.83)	0.26	(0.17-0.35)	0.20	(0.17-0.23)
Weekly	0.69	(0.67-0.71)	0.79	(0.77-0.80)	0.28	(0.23-0.33)	0.21	(0.19-0.23)
Co-resident	0.66	(0.59-0.74)	0.80	(0.75-0.84)	0.26	(0.15-0.36)	0.20	(0.15-0.25)
Contact with parents-in-law*								
Never	0.77	(0.62-0.92)	0.75	(0.62-0.88)	0.13	(-0.05-0.3)	0.26	(0.13-0.38)
Less than yearly	0.84	(0.75-0.93)	0.88	(0.81-0.95)	0.32	(0.03-0.60)	0.12	(0.05-0.19)
At least yearly	0.81	(0.78-0.84)	0.86	(0.83-0.88)	0.30	(0.21-0.38)	0.14	(0.12-0.16)
Weekly	0.76	(0.73-0.78)	0.85	(0.83-0.87)	0.29	(0.23-0.36)	0.15	(0.13-0.17)
Co-resident	0.75	(0.62-0.89)	0.87	(0.77-0.96)	0.32	(-0.06-0.70)	0.13	(0.03-0.22)

*for women with partners only

SMFigure 4.1: Selection and conditional probabilities and 95% confidence intervals showing an interaction between wealth and family childcare



The above figure shows that poorer women have a higher probability of intending to have a second child when they received childcare from their families (upper left graph). The opposite is true for wealthy women; those receiving childcare support from families have lower probability of intending to have a second child than those not receiving this support. The association is marginally significant for poor women, but not statistically significant for wealthier women. For women who intend to have another child (upper right graph), poor women receiving childcare from both parents and parents-in-law are more likely to do so than poor women not receiving support. The pattern appears similar for wealthy women, but the association is not statistically significant. Finally, for women who do not intend to have a second birth (bottom left graph), there are no differences in associations between births and childcare from families across the wealth groups. These graphs suggest that the different associations we find between kin child care and births in chapter 3 may be partially explained through fertility intentions.

5 FOSTERING RELATIONS: FIRST SEX AND MARITAL TIMINGS FOR CHILDREN RAISED BY KIN AND NON-KIN CARERS

RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Susan B. Schaffnit
Principal Supervisor	Rebecca Sear
Thesis Title	Intergenerational Support and Women's Fertility in High-Income Countries: An Evolutionary Analysis

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	Evolution and Human Behavior		
When was the work published?	2014		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	**Yes**	Was the work subject to academic peer review?	**Yes**

The published version can be found on-line at: http://www.ehbonline.org/article/S1090-5138%2813%2900139-6/abstract

SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	

Stage of publication	Choose an item.

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I am the second author on this paper, though as noted on the published version (*http://www.sciencedirect.com/science/article/pii/S1090513813001396*), the first author and I contributed equally to this work and authorship was determined randomly. The research question and analysis plan was co-developed with the first author, Paula Sheppard. Due to restrictions from the Kinsey Institute only Paula was authorized to access the data. For this reason, Paula conducted the analyses with consultations between the two of us continuing throughout the process. I was responsible for writing the paper. Paula Sheppard, and the other two authors (Justin Garcia and Rebecca Sear) all took part in editing later versions.

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Supervisor Signature: Rebecca Sear **Date:**

5.1 ABSTRACT

Kinship fostering is generally preferred to non-kin fostering by policy makers in the U.S. and elsewhere. Researchers and policy makers alike tend to provide several proximate reasons for why this may be, generally neglecting an ultimate evolutionary framework. However, kin selection theory predicts that in the absence of genetically related parents, care from kin will result in the most similar life history outcomes. In low-fertility settings, parents typically favor increased investment in embodied capital and thus delayed reproductive life history strategy. Using archival data from the original Kinsey survey, collected in the U.S. from 1938 to 1963, we used survival analyses to compare the effects of living with kin and non-kin fosterers in childhood on timings of first sex and marriage. Our results support a kin selection hypothesis showing that while fostered children have accelerated life histories compared to children from "intact families", kin fosterers buffer children from early sexual and reproductive behaviors, compared to children cared for by non-kin.

5.2 INTRODUCTION

Fostering by kin – genetically related family – is often assumed to be preferable to fostering by non-kin, despite inconsistent evidence of the superiority of either method (Carpenter et al. 2001; Sakai, Lin, and Flores 2011; US Department of Health & Human Services 2013); though policy preferences in the US have changed in the past century: Daly and Perry 2011). Policy makers and non-evolutionary researchers have suggested a variety of proximate reasons for why this may be the case: continuity for foster children (in their community, school, culture, etc.) (Cuddeback 2004); greater opportunity for contact with children's genetically related parents and families (although, in some cases this could also be considered a problematic aspect of kin care); reduced separation anxiety for children (Carpenter et al. 2001); and the belief that, on average, foster parents are likely to care more for related children

(Vanschoonlandt et al. 2012). Several recent studies have measured the outcomes of fostering by kin versus non-kin carers, with no clear trends indicating a superiority of either fostering method (Cuddeback 2004). Studies have considered outcomes including foster children's behavior (Sakai, Lin, and Flores 2011; Vanschoonlandt et al. 2012), mental health(Sakai, Lin, and Flores 2011; Vanschoonlandt et al. 2012), adolescent sexual behavior (Carpenter et al. 2001), first pregnancies (Carpenter et al. 2001; Sakai, Lin, and Flores 2011), contact frequency with parents (Vanschoonlandt et al. 2012), education attainments (del Valle et al. 2011), and placement stability (Perry, Daly, and Kotler 2012). Yet, these studies are primarily descriptive, and lack a clear theoretical framework from which predictions may be formed and results understood, though Daly and Perry (2011) provide a compelling case for the utility of evolutionary perspective in child welfare. Evolutionary theory provides a more comprehensive ultimate explanation as to why we could expect genetically related foster parents to improve children's developmental, behavioral, and health outcomes.

In the current study, we are interested in understanding the effects of fostering by kin and non-kin on males' and females' reproductive life history strategies, specifically, their progressions to sexual debut (first sexual intercourse) and first marriage. In the absence of genetic parents, we expect kin carers to more closely represent the adaptive interests of genetic parents than non-kin carers. According to kin selection theory, genetically related individuals are expected to act more altruistically towards, and invest more heavily in, one another than less closely or unrelated individuals (Hamilton 1964). By helping family members, individuals are able to enhance their own inclusive fitness.

Abundant evidence has shown that children who grow up in homes with their genetic parents are physically safer than those children not raised in such "intact families" (Daly and Wilson

1985). Children raised in non-intact homes are also more likely to partake in risky behavior, sexual (Lenciauskiene and Zaborskis 2008) and otherwise (Daly and Wilson 1985). The presence of genetic parents appears to have a protective effect on children, in terms of both physical well-being and decision-making. Despite frequent and often substantial parenting effort, stepparents (non-kin) have on average been associated with more negative consequences for children's' health (Case and Paxson 2001) and safety (Wilson, Daly, and Weghorst 1980). This literature suggests that while any caregivers are better than none and, regardless of genetic relation, attentive caregivers are better than inattentive ones, on average intact genetically related families are best at buffering against childhood harm. In line with kin selection theory, we therefore predict that in the absence of genetic parents, kin should confer a similar, though not as strong, buffering effect on foster children's outcomes, when compared with those children who are fostered by unrelated carers. In other words, the outcomes of children in kin care should look more like those of children from intact families, compared to children in non-kin care.

Two previous studies focusing specifically on the effects of kin versus non-kin fostering during childhood on subsequent sexual and reproductive behavior have found that those placed in kin care experience earlier pregnancies both compared to children in non-kin foster care (Sakai, Lin, and Flores 2011) and compared to other sexually active non-fostered youth (Carpenter et al. 2001). One of these studies also found that individuals raised in kin care experience younger ages at first consensual sex compared to non-fostered individuals (Carpenter et al. 2001). Not all of these results are perhaps what we would expect assuming kin fostered children should be more similar to those raised by intact families (i.e., non-fostered children) than those fostered by non-kin.

While informative, these two studies (Carpenter et al. 2001; Sakai, Lin, and Flores 2011) suffer from several methodological shortcomings, possibly accounting for the unexpected direction of these findings. Sakai et al. (2011) thoroughly consider the effects of kin versus non-kin foster care on children's behavior and mental health while controlling for baseline behavioral problems and mental health. Their study, however, captures only a three year period after placement, and with only about 20% of the sample over age 11 years at the time of baseline assessment, few participants had reached sexual maturity by the follow up three years later, making this a less than ideal sample for studying first sex and first births. On the other hand, Carpenter et al. (2001) use multiple linear regressions to predict both age at first consensual sex and age at first birth, but only use data for females and exclude all individuals who are not sexually active at time of interview (i.e. they ignore censored cases), introducing a bias towards females whose first sexual activity occurs at younger ages. Additionally, Carpenter and colleagues (2001) run models for the effects of kin and non-kin fostering separately. In each model, females in foster care (kin or non-kin) are compared to females in the comparison group of not being in foster care. This analysis makes the results difficult to interpret as the two fostering groups are not compared to one another directly.

The methodological complications outlined above are problems common in much of the literature on the effects of fostering on children. Orme and Buehler (2001) reviewed 34 studies on effects of fostering on a variety of outcomes – home environment, family functioning, temperament, mental health, etc. – and also note the concerns we raise here, in addition to several others. At the time of their review, the studies reviewed primarily used cross-sectional data and lacked meaningful comparison groups for those in foster care. Additionally, few studies differentiated between kin and non-kin fostering despite, as Orme and Buehler (2001)

note, substantial rates of kin fostering in past decades as well as concerns raised regarding the quality of kin fostering environments (Berrick 1997; Sakai, Lin, and Flores 2011).

5.2.1 Current Study

The current study attempts to examine the effects of kin versus non-kin care on children, while also addressing several of the described methodological problems found in earlier studies. We use discrete-time event history analyses, a technique which allows us to include censored cases – those for whom events (first sex or marriage) have not yet occurred – leading to more accurate prediction of timings of each event (Singer & Willett, 1993). Our sample includes both males and females aged 18 years and over, an ideal sample to consider sexual and reproductive behavior. Children fostered by kin and non-kin are compared directly in our models, and we also compare kin and non-kin fostered children to those from intact families. Family composition (intact, kin fostered, non-kin fostered) is measured from ages six to 14 years for theoretical and data related reasons (see Methods). We also consider the status of participants' parents (whether alive, dead, or divorced) before age six, in order to control for other family disruption prior to when the fostering arrangement came about. We do not have available information on the circumstance that led to the child being placed in foster care, but by controlling for death or divorce of the child's natural parents we are able to partly eliminate the known confounding effects of family stress in general on both males' and females' sexual and reproductive timings (Alvergne, Faurie, and Raymond 2008; Amato and Kane 2011). The current study is designed within an evolutionary framework, allowing for a theory-driven approach to the observed patterns of fostering effects on males' and females' sexual and reproductive behavioral strategies. The aim of this research is to not only further our understanding of evolutionary behavioral responses to early life environments, but also add to

an important body of literature exploring the practical consequences of fostering on child development.

We hypothesize that kin care buffers the effects of fostering by serving as a close proxy for being raised by genetically related parents. Specifically, we expect kin carers to slow males' and females' progressions to sexual debut relative to non-kin carers; this has several health implications, as earlier age at first sex is on the whole associated with more risk due to associations with sexually transmitted infections, unintended pregnancies, and higher probability of the first sexual experience occurring under duress (Wellings et al. 2001). Something important to note, however, is that while early sexual and reproductive behavior is often considered unfavorable by policy makers, healthcare practitioners, and families, from an evolutionary life history theory viewpoint, early reproduction can be a logical (though not necessarily conscious) fitness-enhancing strategy under certain environmental conditions (Coall, Dickins, and Nettle 2011).

As there is strong cultural sentiment within the U.S. for sexual and reproductive behaviors to most favorably occur within the context of a marital relationship

(Laumann et al. 1994; Finer 2007; Kantor et al. 2008; Garcia and Kruger 2010), we would expect kin to promote a later age at marriage and slower progression to birth. In this perspective, marriage is an institutional contract intended to signal reductions in mate search and to formalize romantic pair-bonds, the context within which most sexual and reproductive behaviors historically and cross-culturally occur (Gray and Garcia 2013). Kin may encourage delayed sexual and reproductive behavior to be able to invest in the embodied capital of their foster children, much as intact families tend to do in high-income, low-fertility societies (Anderson, Kaplan, and Lancaster 1999). Embodied capital concerns investment in physical

growth and health, but also includes investment in skills and education which are important in a wage market economy for giving young adults a competitive advantage, particularly in the mating market (Kaplan et al. 1995; Kaplan et al. 2002). In contemporary industrialized settings, highly invested in children will therefore not only postpone marriage (due to social and career advancement), but also be able to acquire a higher quality mate before investing their own embodied capital in reproduction (Hill and Kaplan 1999). Considerable research in high-income countries has shown that parental absence in childhood results in earlier age at first sex (Ellis et al. 2003a; Quinlan 2003; Alvergne, Faurie, and Raymond 2008), earlier age at marriage (Michael and Tuma 1985), and earlier first birth (Kiernan 1992; Pesonen et al. 2008; Sheppard and Sear 2012).

5.3 METHODS

5.3.1 Data

In the current study, we use historical data from the original Kinsey survey collected in the United States from 1938 to 1963, by the then named Institute for Sex Research at Indiana University. Kinsey and colleagues interviewed participants for several hours about detailed aspects of their sexual lives, resulting in the initial publication of The Kinsey Reports (Kinsey, Pomeroy, and Martin 1948; Kinsey et al. 1953). Detailed information on demographics, socioeconomics, childhood family structure, health, and education was also amassed from individuals during this survey: for full details of the survey questions, see Gebhard and Johnson (1979). Here we analyze data from the 6518 males and 5334 females who were aged eighteen years or older at the time of interview.

5.3.2 Variables and Analysis

We performed two sets of discrete-time event history analyses to determine the influence of foster care on subsequent reproductive outcomes: one for the timing of first sex (here defined as first sexual intercourse), and the second for the timing of first marriage. In this historical

population timing of first marriage is used as a measure of institutionally formalizing romantic pair-bonds, and as such, a proxy measure for timing of reductions in mate search and initiation of family formation. For the timing of first sex model, time was measured as years since age ten. Cases were censored after the age at which 90% of first sex occurred (age 27 years for females and age 25 years for males), to reduce the amount of data from 'long-term survivors' (i.e. individuals who reported never having sexual intercourse, or who have an atypically late sexual debut), the inclusion of which can cause problems for this particular statistical method. Progression to first marriage was modeled from age 12 years, and cases were censored at age of interview or the ninetieth percentile (age 31 years for males and age 30 years for females). For both models, both time and time squared were included to account for the non-linear relationship between age and sexual and reproductive behaviors.

The same predictor variables were used in both models. The key independent variable of interest is a categorical variable indicating respondents' living situation from age six to 14 years: either raised by intact family, fostered by kin, or fostered by non-kin. We chose to use children from intact families (families with two genetic parents) as a reference rather than all non-fostered children, as our research is aimed at specifically understanding kin effects. Although not part of the current analyses, the data set includes non-fostered children from a variety of home situations (single parent, step-parent, adoptive parent, etc.) thus presenting too many confounding factors to interpret (but see Sheppard, Garcia, and Sear 2014 for a detailed analysis of how growing up in step-parent and single parent families influence subsequent sexual and reproductive behaviors in this sample).

We chose individuals who had been in the same living situation for the full nine year period from age six to 14 years (though the period could be longer if children began their living

situation before age six) in order to ensure that the kin and non-kin fostered groups were as similar as possible, and to gauge the effects of kin versus non-kin fostering rather than potentially measuring effects driven by general disruption to family circumstances, which have themselves been linked to the development of faster life history strategies (Donahue et al. 2011; Nettle, Coall, and Dickins 2011).We used 14 years as the maximum age, as after this point the children began to move away from their childhood living situations as well as begin engaging in sexual behavior. To further this end, we also included a categorical variable for family disruption prior to age six years. This variable had three categories: parental death (one or both), parental divorce, and a reference category of neither disruption. While death and divorce are not the usual initiates of fostering, we were unable to control for other factors as such information was unavailable in the current dataset. Initially, all models were also run with a categorical variable controlling for when the child entered foster care (between birth and age two years, between age three years and age five years, or from age six years) to further control for childhood instability. With the inclusion of this control several of the models did not converge as the data were severely fragmented (only seven females who were fostered between the ages of six and 14 years began fostering from age six to eight years, for example). For the models that did successfully run, our results were similar to the models run without this control, so we only present models without this control for age at fostering.

Additionally, we controlled for age at pubertal onset in all models as other studies have shown that puberty is positively correlated with age at first sex (Belsky et al. 2010; Gaudineau et al. 2010). Models were run separately for males and females, as the puberty variable is calculated using different measurements and thus not comparable between sexes. For females, an age of pubertal onset score was derived by averaging (summing and dividing by three) age at menarche, age at breast development, and age at onset of pubic hair. For males, we used the

same method of calculating age of pubertal onset score but the pubertal age was derived by averaging age at voice breaking, age at onset of pubic hair, and age at first ejaculation.

Additionally, the number of siblings each respondent had is included in our models to account for heritable fecundity as best possible, as this may influence age at first birth. The sibling variable, however, includes both genetically related siblings and surrogates if raised with the respondent (Gebhard and Johnson 1979). We were not able to discern, however, whether children in foster care actually lived with their genetic siblings within the foster care arrangement. Moreover, we included respondents' birth order and birth order squared (measured when respondents were aged 14 to 17 years—the only time period data were collected for in the original Kinsey survey), age at time of interview, race (dichotomously as white or non-white, consistent with original data collection, as non-white sample sizes became too small to analyze separately), years of completed education, and a standardized measure of birth year (mean =0, std. dev. =1). Socioeconomic status was also included in our models, derived by interviewers based on questions regarding the perceived financial security of the respondent's family (whether genetic or not) between the ages of 14 to 17 years, on a 1-to-8 scale with 1 being the poorest category and 8 the wealthiest category. Where socioeconomic status was unclear, the interviewers probed for more detail and then estimated the respondent's socioeconomic class (see Gebhard and Johnson 1979). Table 5.1 shows descriptive statistics for the substantive variables in our models.

Table 5.1: Descriptive statistics for men and women by early family context

	Women			Men		
	Intact Family	Non-Kin Fostered	Kin Fostered	Intact Family	Non-Kin Fostered	Kin Fostered
Sample size	5181	50	98	6304	61	146
Median years:						
Age at first sex	22	17	17	19	16	16
Age at marriage	26	26	23	26	26	23
excluding censored cases:						
SES categories	5	4	4	5	4	4
Puberty years	12	12.17	12	13.33	13.67	13.67
Years of education	15	9	10	15	10	10
Number of siblings	2	1	1	2	1	1
Birth order	2	1	1	2	1	1
Age at interview (IQR)	25 (20-35)	23.5 (18-28)	30 (22-36)	26 (22-36)	29 (25-42)	28 (23-37)
Proportions: % (n)						
White	93.36 (4,837)	80 (40)	57.14 (56)	91.53 (5,770)	81.97 (50)	62.33 (91)
Non-White	6.64 (344)	20 (10)	42.86 (42)	8.47 (534)	18.03 (11)	37.67 (55)
No Disruption	100 (5,177)	18.42 (7)	17.89 (17)	100 (6,288)	25 (9)	24.44 (33)
Divorce	0	39.47 (15)	24.21 (23)	0	16.67 (6)	25.19 (34)
Death	0	42.11 (16)	57.89 (55)	0	58.33 (21)	50.37 (68)

IQR = interquartile range

5.4 RESULTS

Table 5.2 presents the results of our statistical models. Odds ratios above 1 indicate faster progression to the event (first sex or first marriage), and odds ratios below 1 indicate slower progressions. As predicted, for both males and females we found that fostering by kin had a weaker effect on progression to first sex than did fostering by non-kin compared to the reference category of "intact family". While both fostering situations were associated with faster progressions to first sex compared with those who lived with an intact family, the odds ratios were higher and only statistically significant for non-kin fostered children. Similarly, the odds of progressing to marriage were higher for those fostered by both non-kin and kin compared with those living in an intact family, and only consistently statistically significant for non-kin fostered children. For this outcome, females fostered by kin were also significantly different from children from intact families, though they were still slower to progress than children from non-kin foster homes. In order to directly compare the effects of non-kin fostering and kin fostering, we also ran models in which kin fostering was the reference category to which non-kin fostering and intact families were compared (kin effects from the models inTable 5.3). Compared to kin fostering, non-kin fostering consistently results in faster progressions to first sex and marriage for both males and females; however, the difference between kin and non-kin fostered children is only statistically significant for age at marriage for males.

Table 5.2: Results from event history analyses for first sex and marriage

	Progression to first sex (Model 1)						Progression to marriage (Model 2)					
	Women			Men			Women			Men		
Foster situation ages 6-14:	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
ref: intact family												
Non-kin fostered	2.75**	1.26	6.04	2.62**	1.36	5.07	3.10**	1.34	7.18	2.60*	1.22	5.53
Kin fostered	1.47	0.73	2.99	1.51	0.8	2.86	2.14*	1.01	4.51	1.14	0.54	2.4
Prior family disruption:												
ref: no disruption												
Divorce	0.84	0.37	1.91	0.59	0.26	1.33	0.45	0.19	1.1	1.04	0.4	2.71
Death of parent(s)	1.34	0.61	2.92	0.58	0.29	1.15	0.45	0.19	1.04	0.5	0.23	1.13
Controls:												
Age	0.99	0.98	1.01	0.99	0.99	1.01	0.99	0.98	1.01	1.01	0.99	1.01
White	0.43***	0.36	0.51	0.36***	0.31	0.43	0.86	0.7	1.05	0.66***	0.55	0.79
Socioeconomic status	0.97	0.93	1.01	1.01	0.98	1.04	1.01	0.97	1.05	0.97	0.93	1.01
Age at puberty	0.94**	0.9	0.97	0.91***	0.88	0.94	0.95**	0.91	0.99	0.93***	0.89	0.97
Years of education	0.83***	0.81	0.84	0.89***	0.87	0.89	0.93***	0.82	0.85	0.96***	0.95	0.98
Number of siblings	1.02*	1	1.06	1.04**	1.02	1.07	0.99	0.97	1.03	1.04*	1.01	1.06
Birth order	0.91*	0.85	0.98	1	0.93	1.07	0.95	0.87	1.04	0.95	0.87	1.04
Birth order^2	1.01***	1	1.02	0.99	0.99	1.01	1.01	0.99	1.01	1.01	0.99	1.01
Time	3.34***	2.96	3.76	3.85***	3.43	4.32	4.24***	3.7	4.87	4.64***	3.97	5.41
Time^2	0.98***	0.97	0.98	0.97***	0.97	0.97	0.97***	0.96	0.98	0.97***	0.96	0.98
Std. year of birth	1.08	0.91	1.3	1.01	0.9	1.12	0.9	0.9	0.09	1.01	0.88	1.16
Intercept	0	0	0	0	0	0	0	0	0	0	0	0

Note: OR= odds ratios, CI= confidence intervals, *** p<0.001, **p<0.010, *p<0.050

Early death or divorce of parents does not appear to be correlated with the progressions we have modeled, in contrast to previous research (Ellis et al. 2003a; Amato and Kane 2011). As expected, individuals with more years of completed education delay first sex and marriage. Additionally, larger family size (more siblings) appears to speed up progression to first sex and marriage.

5.5 DISCUSSION

The current study examines the role of intact family, kin, and non-kin care on the development of children's reproductive life history strategies, and aims to extend the existing literature on kinship fostering. We predicted that the presence of both genetic parents (i.e. growing up in an intact family) would result in the greatest buffer against accelerated development with respect to earlier first sex, and earlier age at first marriage. We then predicted that, of children fostered by carers other than genetic parents, reproductive life history development outcomes of those raised by kin as compared to raised by non-kin, would most closely resemble those raised by intact families. Again, this is based on the evolutionary principles of kin selection theory, as genetic kin relatives share genetic interests in the children's survival and reproduction, and thus their reproductive life history strategies.

Table 5.3: Results: testing for statistical differences between the effects of early family context

	Progression to first sex (Model 1)						Progression to marriage (Model 2)					
	Women			Men			Women			Men		
Foster situation ages 6-14:	**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**		**OR**	**95% CI**	
ref: intact family (0)												
Non-kin fostered (1)	2.75**	1.26	6.04	2.62**	1.36	5.07	3.10**	1.34	7.18	2.60*	1.22	5.53
Kin fostered (2)	1.47	0.73	2.99	1.51	0.8	2.86	2.14*	1.01	4.51	1.14	0.54	2.4
ref: kin fostered (2)												
Intact family (0)	0.87	0.33	1.37	0.66	0.35	1.26	0.47*	0.22	0.98	0.87	0.42	1.83
Non-kin fostered (1)	1.87	0.98	3.56	1.74	0.91	3.33	1.44	0.69	3.03	2.27*	1.1	4.77

Note: OR= odds ratios, CI= confidence intervals, *** p<0.001, **p<0.010, *p<0.050; All models control for: age, race, socioeconomic status, age at puberty, years of education, number of siblings, birth order, birth order squared, time, time squared, and standardized year of birth

In high-income countries where investment in embodied capital is important to be competitive in the labor and marriage markets, children surrounded by kin are expected to avoid early sexual and reproductive behavior (sex and marriage) more than those with less kin support. Additionally, early sexual debut is generally conceptualized as risky behavior due to its correlation with increased overall number of sexual partners and resultant higher risks of sexually transmitted infections and unintended pregnancies (Lenciauskiene and Zaborskis 2008). Absence of kin networks during development may lead to greater participation in high-risk behaviors. Growing up in intact families has previously been found to shield children from a variety of risk behaviors, including premature sexual activity (Lenciauskiene and Zaborskis 2008), and heavy alcohol and other drug use (Ledoux et al. 2002; Hemovich, Lac, and Crano 2011). Further, growing up in intact families has been associated with better self-control (Phythian, Keane, and Krull 2008), and fewer negative mental health outcomes (Garnefski and Diekstra 1997; Kessler et al. 2010).

One potential mechanism that may contribute to delayed sex, at least for girls, is what is known as daughter-guarding (Flinn 1988). Acquisition of embodied capital, promoted through reproductive delay, may lead to a greater ability to attract an investing mate, thus helping explain genetically related parents' delaying effects on sexual debut. Another potential mechanism may involve children indirectly (and, again, not necessarily consciously) assessing their social environment and regulating their reproductive life history strategy based on challenge and disruption (Nettle 2010; Ellis et al. 2011; Cameron and Garcia 2013; Hochberg and Belsky 2013); thus with diminishing parental and kin support, children may accelerate development of sexual and reproductive behavior to more quickly begin investment in their own reproductive fitness (Hill and Kaplan 1999).

We found that children from intact families progressed more slowly to first sexual intercourse than those who lived with non-kin foster carers. Children from kin fostered families fall somewhere in between (statistically different from neither the intact family nor non-kin fostered groups). Likewise, children from intact families progressed significantly slower to marriage compared to children fostered with non-kin (who had earlier ages at first marriage), while kin fostered children progressed to first marriage at rates intermediate to children in intact families and non-kin fostered families. In this case, kin fostered females did progress significantly more quickly than those in intact families (though the effect was smaller than for non-kin fostered females). It is important to note that because births were likely to occur largely within marriage during the period of data collection in the United States (1938 to 1963), we cautiously interpret the progression to marriage outcome as a proxy for progression to the beginning of family formation. If this is the case, then those fostered by non-kin are also likely to begin family formation earlier than those fostered by kin and those from intact families. We are unable to test this directly in our dataset as detailed birth histories were not available.

In the current study, we compared the effects of kin and non-kin fostering directly to one another, rather than only to an intact family (or non-fostered) category. In only one case (men's progression to marriage) do we find that the effects of foster context are statistically significantly different from one another. Despite this, we see consistency in the directions of the associations: overall, we see that kin buffer children from participating in relatively earlier sexual (first sex) and reproductive (marriage) behaviors. These delays in sexual and reproductive behavior in kin compared to non-kin fostered children suggest a potentially greater emphasis on development of embodied capital by kin fosterers. One measure of embodied capital is education. In the original Kinsey survey, data are available as to whether each respondent completed an undergraduate degree; note that in their original formulation,

Kinsey and colleagues felt level of education had substantive influences on sexuality (Kinsey, Pomeroy, and Martin 1948; Kinsey et al. 1953). However, there were too few foster children (fostered by kin and non-kin) who completed an undergraduate degree to conduct formal regression analyses, so we are limited in our ability to test whether fostering context affects this form of embodied capital. We see that while 68% of male (n = 3770) and 72% of female (n = 4336) respondents from intact families had at least begun an undergraduate education, far fewer fostered children had done the same. This unusually high proportion of college attendance for those from intact families is partly due to the sampling methods of the data, which originally focused on university students. Among females, 26.0% (n = 13) of those fostered by kin and 19.4% (n = 19) fostered by non-kin had a college education. Among males, 21.3% (n = 13) of kin fostered and 23.9% (n = 35) fostered by non-kin are college educated. With these small sample sizes it is hard to interpret whether fostering context is affecting this measure of embodied capital, though the raw percentages may suggest that any kind of fostering reduces the probability of higher education.

Little of the previous literature takes into consideration the potential effects of other early life disruption (prior to moving to foster care) independent of the presence of kin or non-kin (Cuddeback 2004). Previous studies have found that early life disruptions are positively related to faster reproductive strategies (Chisholm 1993b; Nettle, Coall, and Dickins 2011). Likewise, kin are known to impact total fertility and birth timings (Hank and Kreyenfeld 2003; Sear and Coall 2011; Waynforth 2012). Our study somewhat teases these two concepts apart by controlling for two types of early life disruption: parental death and divorce. In order to further verify whether children fostered by kin are systematically different from those fostered by non-kin, we tested whether early disruption (death or divorce) predicted type of foster care (results not shown here, but available on request). Neither parental death nor divorce was significantly

associated with foster situation. We find then that independent of other early life family disruption, the effects of genetic parents are more similar to those of kin fosterers than non-kin fosterers, as predicted by kin selection theory.

It is perhaps noteworthy that we do not find associations between familial disruption before age six and subsequent sexual and reproductive behaviors, as previous studies have demonstrated such relationships (Ellis et al. 2003a; Amato and Kane 2011). This may be explained by the fact that we have only investigated family disruption in early childhood. However, many studies of familial disruption have in fact found that disruption during early childhood is of primary importance (Donahue et al. 2011; Ermisch and Francesconi 2012). Though this is not always the case (Ellis et al. 1999; Alvergne, Faurie, and Raymond 2008)—some research has shown that the timing of disruptive events can have different effects on children's later outcomes. For example, Shenk and Scelza (2012) found that father absence in contemporary Bangalore had a stronger effect on various child outcomes if the father became absent during later childhood. Quinlan (2003), using data collected from U.S. women between 1973 and 1995, found that parental separation during early childhood (before age five years) was associated with earlier menarche, first sex, and first pregnancy, while parental separation during adolescence was associated with higher numbers of sex partners among female children. Another study found that father absence before age seven was associated with younger age at reproduction while father absence occurring during adolescence was associated with delayed voice-breaking among British males (Sheppard and Sear 2012). Alternatively, it may be that context affects these relationships, and our data are derived from a historical context (early-mid 20th century U.S.) compared to most studies which have demonstrated that early disruption accelerates life history strategies.

5.5.1 Limitations and Future Directions

A primary limitation of our study is our lack of information on potential confounding factors associated with being in different types of fostering situations. We are not able to eliminate the possibility that our results are due to the systematic differences in the characteristics of kin and non-kin foster parents and fostered children. In recent years, the characteristics of kin fosterers appear to be less favorable than non-kin fosterers, which would not necessarily help to explain our results. Fostering by kin is associated with lower levels of acceptance by foster children's genetically related parents, which is in turn related to poor adjustment to fostering by children (Vanschoonlandt et al. 2012). Kin fosterers tend to be older, less educated, and more likely to be single compared to non-kin fosterers (Vanschoonlandt et al. 2012). Additionally, kin fosterers tend to receive more government financial support (interpreted as greater financial need), less parental training, and fewer opportunities for formal parenting support than non-kin foster parents (Cuddeback 2004; Sakai, Lin, and Flores 2011).

Alternatively, informal kin fostering may be the result of a strategic choice by a genetic parent (see Judge and Sanders 2013 for an example from a low-income context). Until the 1980s the U.S. government favored formal foster placements with non-kin (Daly and Perry 2011) because in the early part of the century foster children's families of origin were believed to transmit "bad blood" to the child through continued contact or at least a bad environment and, later in the century, for fear of transmitting abusive or harmful behaviors between generations (Daly and Perry 2011). The kin placements in our sample, collected from 1938 to 1963, are therefore likely to be *informal* arrangements although the cause of placements (and potential differences in causes of kin and non-kin placements) are unknown for this time period. In the case of informal kin placements, it is reasonable to assume that genetic parents may not only have consented to the fostering, but sought it out as a strategic choice. Genetically related parental

consent in fostering situations is key in shaping children's acceptance of fostering and thus an important correlate with children's outcomes (Vanschoonlandt et al. 2012). In this case, a handpicked kin fosterer may actually present a better living situation for a child than the one offered by their genetic parents. In contrast, this could also mean that children fostered by non-kin in our historical sample may have been experiencing an all-over worse environmental quality than children fostered informally by kin at least partially because the non-kin placements were unlikely to be voluntary (i.e. parents were not likely placing their children strategically with non-kin carers).

Kin-fostered children themselves may also represent a unique set of children compared to non-kin fostered individuals, with at least some recent evidence suggesting that kin-fostered children may be more similar to children from intact families than non-kin fostered children. Sakai et al. (2011) found that lower proportions of children in kin fostering have behavioral problems or have experienced physical abuse than children in non-kin fostering situations. Children fostered by kin are more likely to enter the foster situation due to parental substance abuse than non-kin fostered children who most often are placed in care due to parental mental health problems (Cuddeback 2004).

Another limitation of our study is that we are unable to control for the degree of genetic relatedness between kin fostered children and their carers. For example, it is expected that more closely and more certainly related kin would behave more like genetic parents than less closely or certainly related kin (Euler and Weitzel 1996). Along with relatedness to carers, the number of other dependents in a household is likely to affect the quality of care provided by parents (genetic or otherwise) (Lawson and Mace 2011). With more children in a household, parental investments are expected to decrease. While we are able to control for respondents'

number of siblings (genetic and co-resident surrogates), we do not have information on co-residence with the genetic siblings.

Due to these limitations and confounders we remain cautious about interpretation of such findings in terms of positive or negative child outcomes. The consequence of controlling for some of these confounding influences, were we to have the data, is not clearly positive or negative. For example, kin foster parents may be more disadvantaged financially and educationally than non-kin carers, but these placements may offer more stability for children and garner greater acceptance of genetic parents. These conflicting characteristics of kin care may either strengthen or weaken the effects we find here.

5.6 CONCLUSION

While policy makers' and non-evolutionary social scientists' assumptions regarding the benefits of kinship care are not inconsistent with evolutionary theory, they present only proximate explanations for the predicted patterns of investments. As Daly and Perry (2011) nicely state, their assumptions are based on "an intuition that the non-relative is providing a service to someone else, whereas the kin caretaker is somehow serving her own interests" (p 364). Evolutionary theory validates this intuition and unifies broad assumptions of policy makers by providing an ultimate level explanation for expected patterns of care. Our results support evolutionary predictions regarding the influence of kin on the development of reproductive strategies in high-income countries. We find that independent of childhood instability due to parental death or divorce, the presence of kin in early life results in sexual and reproductive behavioral trajectories more similar to those raised by genetic parents than by non-kin carers when considering progressions to first sex and marriage. Our study has improved upon some of the methodological weaknesses of previous studies, and demonstrated the intellectual benefit

of an overarching theoretical framework within which to understand humans' behavioral responses to their environment.

5.7 ACKNOWLEDGEMENTS

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6 DISCUSSION

6.1 SUMMARY OF RESULTS

The main goals of this research were to (1) expand the cooperative breeding literature in HILF contexts on associations between intergenerational support and women's fertility, (2) deepen our understanding of how support relates to women's fertility by testing associations with many types of support, and (3) to identify contextual factors, particularly SEP, which may modify relationships between support and fertility. The classification of humans as cooperative breeders leads to the hypothesis that support is necessary for women's successful reproduction. However, with considerable variation in environments, and consequently reproductive strategies, and the availability of support in HILF countries, it is not always clear how individual women will respond to support in their reproduction. The primary finding of this research is a confirmation that families matter in women's reproductive decision-making in HILF countries. However, I demonstrate that all support is not equal: different types of support have different associations with women's fertility (Chapters 2 through 4); timing of family support/presence may also matter – in childhood or during adulthood (Chapter 5); and support from parents, other kin, and non-kin sometimes have distinct associations with reproductive behavior (Chapters 3 and 5). When considering early life family structures, kin carers more closely represent genetic parents' adaptive interests than non-kin carers in their influence on later sexual and reproductive behavior. For support in adulthood, I broadly find that practical or material support – like childcare, financial support, or sometimes, co-residence with families – relate to *reduced* fertility, while measures of non-practical/material support – like contact with friends, relationship quality, and sometimes, contact with kin – more often associate with *increased* fertility. This leads to the second main finding, which is that SEP environments may

modify patterns of support, levels of kin cooperation, and associations between support and fertility (Chapters 2 and 3). More specific results are highlighted in Table 6.1.

In the following sections I highlight and discuss support and substitution of support surrounding reproduction generally. This will be followed by a more detailed discussion integrating my dissertation findings into our current knowledge of the role of support in reproductive decision-making in HILF countries, highlighting the role of SEP. I will then address issues arising from this research, and discuss a few unmeasured confounders. Finally, I lay out several pathways for future research before a short concluding statement.

Table 6.1: Summary of findings

Chapter	Population/Data	Independent Support Variables	Outcomes	General Associations with Outcome	Moderating Factors
2	Europe/Generations and Gender Survey	Parents: -Survival Status -Co-residence	-Timing of first birth -Total fertility -Life-time childlessness	-Pro-natal effects of mother's survival -Anti-natal associations with co-residence	-Negative associations of co-residence with parents stronger for poor women
3	United Kingdom/Millennium cohort Study	Support from: -Parents -Partners -Non-kin Support including: -Practical -Emotional -Contact	-2nd birth	Generally: -Emotional support had positive effects on having 2nd birth -Practical support negatively related to having a 2nd birth	-Poorer women receive less support -Partner and other support sometimes substituted -SEP modifies associations between kin childcare and fertility -SEP relates to importance of support
4	United Kingdom/Millennium cohort Study	Parents and Parents-in-law: -Financial support -Childcare -Contact	-2nd birth	-Anti-natal association with financial support	-Associations similar regardless of fertility intentions
5	United States of America/original Kinsey survey	Early childhood family structure: -Fostered by kin -Fostered by non-kin -Genetic parents	Timing of: -First sex -Marriage	-Genetic parents delay sex and marriage -Kin fosterers more similar to genetic parents than non-kin	None

6.2 IMPLICATIONS

Until the past five years, very little research had been done on associations between kin and female fertility in European, HILF countries (Del Boca 2002; Hank and Kreyenfeld 2003; Rindfuss et al. 2007). Of those prior works, few specifically measured the roles of support from families, but rather relied on more ambiguous proxies for support such as proximity to kin (Hank and Kreyenfeld 2003; Rindfuss et al. 2007) or intergenerational transmission of fertility behavior (Pullum and Wolf 1991; Gee 1992; Murphy 1999; Murphy and Wang 2001; Murphy and Knudsen 2002; Wu and Schimmele 2003; Bernardi and White 2009). This dissertation research contributes to a growing field testing evolutionarily-grounded hypotheses surrounding family support and women's fertility in HILF countries that has blossomed in the past five years (Kaptijn et al. 2010; Waynforth 2012; Mathews and Sear 2013a; Thomese and Liefbroer 2013; Mathews and Sear 2013b; Tanskanen et al. 2014).

Beyond adding further studies to the field, this dissertation research extends previous research in novel directions. Firstly, I demonstrate that all support does not promote similar fertility outcomes. This is methodologically important because different forms of kin support or availability are used as proxies for one another (Rindfuss et al. 2007; Schaffnit and Sear 2014; Tanskanen et al. 2014), often out of necessity due to the unavailability of more precise measures. Different forms of support may actually provide contrasting cues for reproductive women - the availability of a safety net versus resource stress/need, for example – thus eliciting various responses in fertility to different measures of support. When possible, support types should be assessed separately and interpretations should remain conservative when direct measures are not used.

Secondly, while the availability of large, longitudinal, nationally-representative data sets is a major benefit of conducting quantitative research in HILF countries, their heterogeneity (in terms of SEP, for example) means that they may include a range of different reproductive decision- making ecologies, which may modify associations between support and fertility. For these reasons previous research has tested for modification of associations due to family structure (Aassve, Meroni, and Pronzato 2012) and women's employment status (Kaptijn et al. 2010; Fiori 2011). Chapters 2 and 3 demonstrate that SEP, a known correlate with reproductive schedules and (allo)parental investment strategies (Nettle 2010), can modify associations between support and fertility. Variation in more local contexts and associated reproductive strategies then must be accounted for even when using large, demographic data sets not collected for that reason.

6.2.1 Reproductive support in humans

Despite claims of the "breakdown of extended kinship networks" (Turke 1989; p. 64), it is evident that families provide key allomaternal support even in HILF countries, though other supporters are also important. The diversity of support available to women in these contexts is unprecedented. Traditional allomothers like families and partners are still common, but women also may seek or receive support from paid childcare sources, friends, institutions, care and support professionals or even virtual support through internet groups (for example, mumsnet.com).

Not all forms of support are equally available to, offered to, or sought by reproductive women. On a population level, provision of support by families is negatively correlated with care provided by state institutions (Hank and Buber 2009; Sear and Coall 2011), suggesting that family support may be more heavily utilized when other options are unavailable (or vice versa).

Unlike in natural fertility settings, it remains to be seen how these forms of support are strategically received or traded-off by reproductive women on an individual level. Thomese & Liefbroer (2013) found no substitution between childcare from families and formal care in the Netherlands. I found some evidence that paid and family childcare were inversely correlated, particularly for wealthier women using UK data. Further, I found evidence of substitution of support between partners and others, both families and formal support (Chapter 3). In both cases (Thomese & Liefbroer, 2013; Chapter 3) substitution between *types of support* were the unit of analysis regarding substitution. In natural fertility settings researchers often use time-allocation studies to more directly look at trade-offs or substitutions of investments (Ivey 2000; Marlowe 2003; Kramer 2009). To my knowledge these types of studies have not been done in HILF settings. Doing so may be a useful way to more intimately understand the currencies of contributions by allomothers, and how time, energy, or money gained by the availability of allomaternal support is used by women.

6.2.2 Associations between support and fertility

While support is universal for reproductive women, associations with fertility are not. Cooperative breeding as a framework does not actually make clear predictions about individual level fertility, but rather species or group level reproductive patterns. This research and previous works have demonstrated the highly variable associations between support from families and others and individual women's fertility choices. In the introduction I suggested two reasons why this may be: (1) different types of support may evoke different responses from women in terms of their fertility and (2) contextual factors like SEP may modify these associations. Below I discuss each of these.

6.2.2.1 Timing and types of support may alter associations with fertility

Family support and presence could theoretically influence women's fertility through several competing mechanisms. For example, families may be a source of direct help (Hrdy 2009a), cultural information (Newson et al. 2005), or a cue to the environment (Draper and Harpending 1982; Belsky, Steinberg, and Draper 1991). Each mechanism does not necessarily predict similar fertility outcomes. Direct support may reduce costs of childrearing thus increasing women's fertility. In contrast, the support or presence of family may denote a stable environment in which delayed reproduction may be a viable fitness enhancing strategy (as opposed to a harsh environment where early reproduction is optimal). Finally, cultural information gained through contact, communication, or support from families could have any effect on fertility depending upon the information transmitted (for example, status or fitness enhancing messages). The mechanism associating families and women's fertility may be different depending up the timing of the support/presence and/or the type of support/presence measured.

Considering timing, early life family support from parents or other kin may be a good indicator of future environmental stability (mortality risks, relationship stability, etc.). In this way support in childhood may set the stage for a slower life history strategy characterized by delayed reproduction (Chapter 5) as demonstrated in a sizable amount of previous research (Ellis et al. 2003b; Lenciauskiene and Zaborskis 2008). Another mechanism through which families may delay their children's reproduction is through intergenerational conflicts over reproduction. Mothers and fathers may wish to delay their children's first births if they themselves are still able to reproduce because a child would be more related to the mother and father than a grandchild. This is unlikely to explain our results in Chapter 5 for two reasons: (1) most parents end reproduction in high-income countries well before their biological limit thus reducing

potential intergenerational reproductive competition; and (2) if this were the case, non-kin carers may wish to delay their foster children's first births longer that kin as the children of the foster children would have no relationship to the foster parents. I also demonstrate in Chapter 5 that the sources of early life support matters: kin carers in childhood, as opposed to non-kin carers, have different associations with sexual and reproductive behavior. Early reproduction, a sometimes rational life history strategy in unstable or harsh environments, can also be conceptualized as a risky behavior. In this case, families are expected to buffer children from risky behaviors which may reduce their fitness. I find that kin care more closely follows the patterns of parents in delaying this behavior than non-kin as expected.

In seeming contradiction to the predictions of Chapter 5, in the remainder of the thesis I predict opposite associations between kin support and women's fertility: in contrast to early life measures of support, direct support to reproductively aged women may serve as means of lowering the real or perceived costs of initiating or continuing reproduction, thereby increasing fertility. In this way, early versus late support from families may invoke different mechanisms through which kin influence fertility. It logically follows that there is some turning point within women's lives at which family support will shift from delaying reproduction (then seen as a risky behavior or a means of curtailing the acquisition of embodied capital) to encouraging or allowing for reproduction. The turning point (when families stop delaying and start promoting fertility) could vary between socioecological contexts. This could be empirically tested using cross-cultural, time-varying information on parental survival (or another crude measure of kin presence) and interactions with age in an event history analysis or similar method.

Even in the case of current support (i.e. that received during a woman's reproductive years), the type of support received may evoke various mechanisms through which support influences

fertility. Chapter 3's results suggested that type of support rather than source (kin or non-kin; maternal versus paternal kin) may better explain patterns of associations. This could be a surprising result because previous research often highlights the idea that maternal and paternal kin sometimes have divergent interests when it comes to a given woman's fertility: maternal kin may wish to buffer women from high fertility and invest in child quality, while paternal kin, with less regard for the woman's well-being, may promote continued reproduction (Leonetti, Nath, and Hemam 2007; Borgerhoff Mulder 2009; Tanskanen et al. 2014). This argument is perhaps less relevant in low-fertility settings such as Europe. Firstly because fertility is low enough that the risks for women in terms of health of having children are very low. And secondly, the hypothesis assumes that female mates are readily available and replaceable for men, which in the context of long-term monogamous relationships is not necessarily true. In primarily monogamous contexts, particularly ones where paternal investments in children are both costly and have high returns, it becomes increasingly less likely that partners' fitness interests, and thus their kin's interests in the partners' reproduction, will diverge. This is not to say that paternal kin do not invest less than maternal kin in grandchildren *given the availability* of more certain investment avenues to the paternal kin (Danielsbacka et al. 2011) – indeed that seems to regularly be the case (Pollet, Nelissen, and Nettle 2009; Waynforth 2012; Snopkowski and Sear 2015) - but rather, I'm not convinced that we should expect a priori that one unit of support from a parent-in-law will have a different association with a woman's fertility than one unit of support from a parent in the given context.

Returning then to types of support, previously others have suggested that material or practical (financial and childcare) support may be less relevant to reproduction for women in HILF countries than perceptions of support (emotional support): "Objective measures [of support] may be less important in people's marriage and fertility choices than their perceived wealth

trajectory, perceived comparative wealth, or perceived social well-being" (Low, Simon, & Anderson, 2002; p. 164); "…one possibility is that humans respond to levels of extended family supportiveness in making reproductive decisions: actual amounts of financial assistance and direct childcare help may be less important than the understanding that extended family may be relied on when necessary" (Waynforth, 2012; p. 5). I agree with these sentiments, but in this dissertation research actually find that practical support *does* matter for women's reproduction, but often negatively. So it isn't just that actual help is irrelevant and feeling supported is important, but that practical or material help can have *detrimental* effects on fertility while feeling supported positively associates with fertility. Emotional support could be a means of reinforcing cultural norms surrounding reproduction, or as Waynforth (2012) notes, may indicate the presence of an untapped source of support which could be used in the future thus lowering perceived costs of reproduction. In contrast, practical support, often associated with need, may demonstrate that support resources have already been tapped thus associating with delaying or forgoing reproduction.

Notably both Waynforth's study and the two of my studies which most clearly suggest this pattern – positive associations between emotional/contact support and fertility and negative associations between practical support and fertility - use UK data. The UK and the Netherlands are two of the more commonly studied European countries for kin and fertility research and interestingly, they present mostly opposite results. In the Netherlands, childcare (Kaptijn et al. 2010; Thomese and Liefbroer 2013), and financial support (Thomese & Liefbroer, 2013 - non-statistically significant) has been linked positively to fertility, while emotional support linked negatively to fertility (Balbo & Mills). In the UK, my research and that of Waynforth (2012) note negative associations between childcare and births, and financial support and births. However, Mathews & Sear (2013b) find a positive association with childcare in their study using the UK

BHPS, and my research notes variations in associations by SEP. Emotional support, measured by contact (Waynforth 2012; Tanskanen et al. 2014) and closeness to parents (Waynforth 2012) have positive associations with births in the UK. These differences may come down to cultural or institutional factors such as the availability and cost of formal childcare or country-specific norms regarding family networks and childrearing. Both countries have excellent longitudinal data sources which, in conjunction with qualitative research, would allow for these differences to be explored further.

6.2.2.2 The modifying role of socioecological context

Inherent to the HBE framework is the understanding that local socioecological environments will likely modify behavior. Previous research in HILF countries on associations between kin and fertility have considered women's employment status (Kaptijn et al. 2010; Fiori 2011) and family composition (Aassve, Meroni, and Pronzato 2012) as factors which may alter these associations. In this dissertation the role of SEP was highlighted. SEP is influential in modifying several components of the reproductive decision-making process, not the least of which is how kin associate with one another. SEP represents resource stress and/or environmental harshness (mortality and morbidity rates) and is associated with variations in (allo)parental investment strategies (Kaplan, Lancaster, and Anderson 1998), patterns of alloparental support (Nettle 2008; Nettle 2010; Coall, Hilbrand, and Hertwig 2014), and the nature of family interactions (cooperative or competitive) (Hadley 2004). As a consequence of all of these factors, SEP may then modify how women respond to family presence or support in their fertility behavior.

In chapter 2, SEP was approximated by wealth and used as a measure of resource stress. I highlighted that in resource stressed situations family relations may sway towards competition

rather than cooperation. I then tested if, with greater resource stress, kin interactions become more competitive thus resulting in less positive associations between family presence and fertility in these contexts. Results indicated that co-residence with kin associates negatively with fertility but this association is stronger for poorer, i.e. more resource stressed, women. Family competition may explain some of this association, but it is important to recognize that co-residing with kin does demonstrate that some base level of cooperation is occurring. The interaction found may also indicate that co-residence with kin *means* something different to women depending upon their wealth. Wealthier women may remain living with parents as a way to garner more parental investment; in contrast, poorer women may co-reside with parents out of need. SEP then, may either (or both) modify the nature of kin interactions and/or the ways in which women perceive family support.

In Chapter 3, SEP is again approximated using wealth. In this case SEP is conceptualized as a broad measure of environmental harshness (which resource stress would feed in to). Competition between kin due to SEP differences did not factor into the framework of this chapter as much because the direct measures of support available in the data set, such as childcare of financial support, imply that cooperation is occurring, in contrast to more ambiguous presence measures like co-residence and parental survival. In this chapter, I first identified whether patterns of alloparental support varied by SEP and whether absence of fathers and SEP predicted support from other allocarers. I then tested for variation in associations between support and fertility by SEP, which helped to further the understanding of what various forms of support actually mean for different women. In only one case, that of childcare from kin, did wealth modify associations with fertility. In that case, it is suggested that childcare may present different opportunities to women depending upon their SEP: an opportunity to continue reproduction versus an opportunity to enhance SEP further. Taken

together, these two chapters highlight the ways in which SEP, as a socioecological environment, may alter the reproductive decision-making process, specifically the relationship between kin and fertility, on many levels.

6.2.2.3 What about women's *intentions?*

In addition to SEP, fertility intentions were identified as a factor which could modify associations between support and fertility (Chapter 4) based on findings in Chapters 2 and 3 and the previous literature. Fertility intentions are not a context in the way SEP is, but rather may represent alternate reproductive strategies. In this research it is not clear if family support is *causing* fertility intentions and thus helping women form these strategies because fertility intentions and allomaternal support were measured at the same time (wave one of data collection for the MCS). Despite this, associations between kin support and fertility intentions were noted in Chapter 4 and in previous literature. I found that some types of support, like contact with families and childcare, were related to higher probabilities of intending to have another child, while financial support had an opposite association. The most striking finding of this chapter to me, however, was that receiving support did not play out in the fulfillment of fertility intentions *despite sometimes positively relating to intentions*. This raises questions about what intentions mean and how family support associates with reproductive strategy formation. Do women adaptively respond to support in the formation of fertility intentions, but then other competing goals get in the way of achieving the intentions? The prominence of family support in intention formation, but not achieved fertility may speak to the mechanism through which families influence fertility. In this case, the role of families as providers of cultural information may take precedent over their role as helpers in reducing costs of reproduction. This is very speculative, however, and further research into how support conceptually plays into the relationship between fertility intentions and achieved fertility is

clearly needed. Data with time-varying information on both support and intentions will be key for this future research.

6.3 ISSUES ARISING AND FUTURE RESEARCH

Conducting evolutionary research in HILF countries comes with many complications. The primary one being that it is not clear what currency we are maximizing. As human behavioral ecologists we make the assumption that behavior is motivated by fitness-enhancing ideals. In current HILF environments, most children survive to adulthood and parents have shifted attention from child quantity to quality. In past environments, this strategy (of increased investment in quality when possible) may well have resulted in higher long-term fitness; however, available multi-generational data suggest that investments in embodied capital do not increase long-term fitness in HILF countries (Goodman, Koupil, and Lawson 2012). This complicates evolutionary studies of kin and fertility (as described here), as investments from families may be redirected to child quality rather than child quantity even at detriment to lifetime and long-term fitness. There is no *one* measure of child quality which can easily be quantified, which further complicates these studies. In natural fertility settings, child quality may be measured in a pretty straight forward way through health or survival. In HILF settings, as mentioned above, most children survive to adulthood with reasonable levels of health. Quality is then measured in variables such as education or skills, but even here we are presented with many novel measures which we may *perceive* to be important for child quality (or even one's own status) such as owning a large home or living in a nice neighborhood. Further, perceived "necessities" for raising high quality children may vary by ecologies such as SEP thus changing relevant currencies.

Another related complication is that women in HILF countries have many competing goals which may or may not include reproduction, as highlighted in Chapter 4. These goals may be in contrast to reproduction or seen as necessary pre-cursors to reproduction. Either way, pursuit of non-reproductive goals is often associated with delaying or forgoing births. Support received from families may serve as an opportunity for women to pursue these goals at detriment to their lifetime fertility. Although experimental evidence suggests families may provide pro-natal messages to women (Newson et al. 2007), they may also help women pursue non-reproductive goals. This may be particularly true, when the non-reproductive goals are status-seeking, because families are susceptible to prestige bias in their desires for their children and/or because investments in status-seeking would have resulted in higher fitness in previous environments. Either way, the diversity of options available to women in HILF complicates studies of family support and fertility.

More specifically to the study of kin and fertility, the large geographic distances between kin in HILF countries makes it difficult to identify and measure meaningful forms of family support. This is particularly relevant as I find that emotional support may more positively relate to fertility than other support (at least in the UK). Women may not live near or see her family often, but frequent contact by phone or email may mean that she feels or perceives having large amounts of (potential) support. Further, as highlighted in the discussion in Chapter 2, even when families do not live in close proximity to one another they may share financial resources easily. All of these factors complicate our understandings of the role of family support in women's fertility behavior.

6.3.1 Confounding factors

As in any study using observational data, there are a number of unobserved factors which may confound the noted associations between support and fertility in this research. A potential confounder is something which predicts both receiving support and women's fertility, but is not on the causal pathway linking support to fertility. One good example of this would be the demographic and socioeconomic characteristics of women's parents and parents-in-law. Due to data limitations these factors were not included in Chapters 3 and 4 (the MCS chapters), but were partially accounted for Chapter 2. Previous research has linked parental age, health, SEP and fertility to the types and amounts of allomaternal support given to their reproductively aged children (Coall et al. 2009; Hank and Buber 2009; Coall, Hilbrand, and Hertwig 2014). We can also expect that parental(-in-law) characteristics also relate to reproductive outcomes. For example, parental SEP plays a role in the development of life-history strategies early in life and may continue to do so in adulthood. Alternatively, poor parental health or old age could prompt women to reproduce quickly so their parent can meet their grandchild while simultaneously negatively predicting allomaternal support. In these ways parental characteristics could both associate with the types and amounts of support given to reproductive women and, independently, to her reproductive schedules.

The characteristics of a first child (or any previous children) also could be an important confounder in the association between support and women's fertility. Child characteristics could include sex (although Tanskanen et al. [2014] find no evidence that sex predicts timings of second or third births in the UK), personality, or disability. All of these things may modify levels of support. For example, particularly needy or difficult children may elicit more support. At the same time, these characteristics also may adjust women's decisions about whether or not to have another child. The MCS provides a large amount of information that could, in the

future, be used to investigate these relationships between support and child characteristics, and child characteristics and births.

Another potential confounder (again excluded from the two MCS chapters, but included in Chapter 2) is women's number of siblings. Presence of siblings both associates with allo(maternal) support received and women's fertility. Women with more siblings receive reduced support from parents probably because parents have more (grand)children over which they must distribute their support (Coall et al. 2009; Coall, Hilbrand, and Hertwig 2014). Simultaneously, having more siblings is often noted to positively predict women's fertility. This may be due to shared genes, environments, or shared norms (Murphy and Knudsen 2002) or because siblings may provide allomaternal support.

Finally, institutional or country-level support structures may also confound associations particularly between childcare from kin and fertility (Kaptijn et al. 2010; Sear and Coall 2011). Allomaternal care from women's parents and parents-in-law is positively associated with weak country-level family support systems in Europe (Hank and Buber 2009). There is also some evidence that country-level support structures relate to women's fertility: countries with weak family-friendly policies in Europe often have lower TFRs (Sear and Coall 2011); and area-level childcare support has been related to women's fertility in various ways (Del Boca 2002; Andersson, Duvander, and Hank 2004; Hank, Kreyenfeld, and Spiess 2004). In Chapter 2, I used GGS data to study associations between family and fertility across several European countries. Despite testing for variations between countries in the associations between family and fertility, none were found. This somewhat surprising result may be explained by the indicators of parental availability that were used – survival status and co-residence - rather than the provision of support, such as childcare of financial support, which may be particularly affected

by policy. The provision of support was not the focus of the chapter, because longitudinal data on direct allomaternal support such as childcare were not available at the time of analysis in this dataset. Now that further waves of the GGS have been released, a study accounting for both individual level family support with childcare and country or regional level family support systems could more readily be conducted.

6.3.2 Dissemination and future research

The research presented in this dissertation has been presented at numerous conferences over the past three years. These conferences included those focused on demography and those directed at researchers involved in evolutionary studies. The diversity of audiences was helpful in the development of my research and my overall understanding of the role of family support in the reproductive decision-making process.

Conducting this research has highlighted the need for more mixed methods studies on reproductive decision-making in HILF countries. With so many complex decisions and trade-offs going on throughout one's reproductive career, the use of secondary data can only go so far. Newson et al. (2007) have demonstrated the utility of experimental data in HILF countries. Along with colleagues in the LSHTM Evolutionary Demography Group, I intend to continue exploring reproductive decision-making by using economic experimental methods novel to HBE. Doing so would combine qualitative, experimental, and quantitative methods in a way which allows for a deeper understanding of the trade-offs (including the currencies of these trade-offs) women (and men) perceive and make in HILF countries during reproduction.

Another topic I would also be interested in pursuing would be to try to understand the opposite associations between support and fertility in the UK and Netherlands as highlighted in Section 6.2.2.1. Both countries benefit from excellent longitudinal data which could be used to compliment qualitative work, including time-allocation studies. With several potential

mechanisms through which families may influence women's fertility, it is possible that due to cultural, economic, or institutional contexts, support from families evokes different mechanisms in the two countries. For example, greater economic equality in the Netherlands may mean that practical support from families truly relates to lower perceived costs of reproduction and thus increased fertility. In the UK, greater economic *inequalities* may mean that the use of financial support highlights financial need and thus deters reproduction. In the studies presented in this dissertation financial status - one measure of financial need - was controlled for in statistical models, but it is possible that receiving financial support (and other forms of practical support) in the UK is indicative of other unmeasured needs.

6.4 CONCLUSIONS

The research in this dissertation has contributed to our growing knowledge of how women's families influence reproductive behavior in HILF countries. The work confirms the important role of families in providing support throughout women's lives, but also highlights the diversity of non-parental(-in-law) support women can receive: from partners, foster parents, friends, paid care givers, professional supporters, and others. In several chapters, distinguishing between type (Chapters 2 through 4), provider (Chapter 3 and 5), and timing (Chapter 5) of support proved important in demonstrating that all support is not equal for women when deciding when and if to have children. Further, SEP was identified as a key contextual factor which modifies several components of the associations between families and fertility including the nature of family interactions, (allo)parental investment strategies, patterns of allomaternal support, and women's reproductive schedules. Both points – that all support is not equal, and SEP context modifies kin and fertility associations – have important methodological implications for future research: proxies for support should be avoided when possible; and not accounting for local socioecological contexts may disguise some associations between families

and fertility when using large observational datasets. Finally, to me this research highlights need to pinpoint the mechanisms through which family support associates with women's fertility, and identify contexts in which similar forms of support may work through competing mechanisms. Doing so will necessitate the further integration of qualitative, experimental, and quantitative research.

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