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Biosocial Pathways of Reproductive Outcomes in the United States

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Biosocial Pathways of Reproductive Outcomes in the United States

by

Alison Gemmill

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Committee in charge:

Professor Joshua Goldstein, Chair
Professor Jennifer Johnson-Hanks
Professor Ralph Catalano

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Abstract

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Demographers have long recognized that fertility patterns observed in populations are driven by both behavioral and biological determinants. Yet, most studies of contemporary fertility focus solely on the behavioral dimension, treating biology as a residual determinant, if mentioned at all. In this dissertation, I address this shortcoming by drawing from a biosocial framework that allows for the integration of biological measures into explanatory models of socio-demographic outcomes. In particular, I consider the interplay between reproductive biology and behavior in three empirical chapters on childlessness and subfecundity in the United States. In doing so, I demonstrate that biology can create a frame in which individuals make decisions across their reproductive life course.

In the first empirical chapter, I focus on the process of remaining childless as a case study for examining how women's reproductive choices and behaviors take place against the backdrop of changing social structures, competing preferences, and age-related declines in fecundity. Specifically, I focus on an understudied, yet revealing dimension of why individuals remain childless—stated fertility expectations over the life course. Using data from the National Longitudinal Survey of Youth-1979 cohort, I use sequence analysis and logistic regression models to identify and describe groups of permanently childless women who follow similar trajectories of stated fertility expectations. Results indicate that three dimensions of fertility expectation patterns—the emergence of a childless expectation, the consistency of childless expectations, and the types of patterns that precede a childless expectation—provide a more nuanced description of the composition of permanently childless women than the standard voluntary/involuntary framework. The results, moreover, reflect how women reevaluate expectations for the future when they encounter critical junctures in their life courses.

The second empirical chapter considers how women internalize personal subjective risks about their fecundity, or their biological capacity to reproduce. First, I propose a conceptual model of perceived fecundity that emphasizes the evaluation of perceptions as a process drawn from understudied contextual and individual-level influences. Second, I use data from the National Longitudinal Survey of Youth (NLSY) 1997 cohort to provide new, nationally representative estimates of perceived fecundity among young adult women aged 25-30. Finally, I draw from the proposed conceptual framework to examine predictors of and variation in perceived fecundity. Results show striking variation across a range of demographic, contextual, situational, and experiential factors and highlight the need for improved measures of fecundity perceptions and a deeper understanding of how women evaluate their reproductive potential.

The third empirical chapter focuses on an understudied process by which reproductive biology can influence behavior. Prior research suggests that one reason women do not use contraception is because they perceive themselves to be infertile or have difficulty becoming pregnant (i.e. subfecund) and thus, at low risk of pregnancy. These beliefs, however, may provide a false sense of protection from unintended pregnancy if they are not medically accurate. Using data from the National Longitudinal Survey of Youth-1997 cohort, a large, nationally representative survey of young adults, I demonstrate that women with low perceived fecundity have higher odds of non-use of contraception. Further, these results persist after controlling for either a medical diagnosis of infertility or absence of pregnancy following at least 6 months of unprotected sex, suggesting that fecundity risk perceptions often operate independently of experienced subfecundity.

To my mother, Robin Louise Gemmill,
and my daughter, Arden Lovisa von Walter.

"Here's to strong women. May we know them.
May we be them. May we raise them."

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Acknowledgments

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Chapter 1

Introduction

Demographers have long recognized that fertility patterns observed in populations are driven by both behavioral and biological determinants. Yet, most studies of contemporary fertility focus solely on the behavioral dimension, treating biology as a residual determinant, if mentioned at all. In this dissertation, I address this shortcoming by drawing from a biosocial framework that allows for the integration of biological measures into explanatory models of socio-demographic outcomes. In particular, I consider the interplay between reproductive biology and behavior in three empirical chapters on childlessness and subfecundity in the United States.

In the first empirical chapter, I focus on the process of remaining childless as a case study for examining how women's reproductive choices and behaviors take place against the backdrop of changing social structures, competing preferences, and age-related declines in fecundity. Specifically, I focus on an understudied, yet revealing dimension of why individuals remain childless—stated fertility expectations over the life course. Using data from the National Longitudinal Survey of Youth-1979 cohort, I use sequence analysis and logistic regression models to identify and describe groups of permanently childless women who follow similar trajectories of stated fertility expectations.

In the following two chapters, I argue that the most paramount of proximate determinants for reproduction—fecundity, or the biological capacity to give birth—wields much greater influence over fertility behavior than previously considered. This is because women's experiences and perceptions of fecundity create a frame in which women make decisions across their reproductive life course—an important consideration as larger numbers of women delay childbearing and conversations around reproductive technologies become more commonplace.

While the link between experienced fecundity and realized fertility is relatively straightforward, the role of perceived fecundity is less so. Indeed, demographers

have given little attention to women's perceptions of their fecundity, even though they may have profound demographic implications. For example, they may drive partnership formation and timing of childbirth (Schmidt 2008), alter women's contraceptive use or other sexual behaviors (Polis and Zabin 2012), or influence other life course domains such as career or education plans. To date, however, few of these proposed relationships have been empirically tested.

This is surprising given that a larger than expected proportion of women consider themselves to be infertile. For example, in a nationally representative study of unmarried adults aged 18-29, 19% of women stated they were "very likely" to be infertile, while an additional 41% considered themselves "slightly likely" (Polis and Zabin 2012). However, data on infertility from the National Survey of Family Growth suggests that the actual proportion of women experiencing infertility is much smaller; only 6% of women aged 15-24 and 14% of women aged 25-29 are estimated to have impaired fecundity (Chandra et al. 2013). The reasons for these observed discrepancies are far from clear cut and highlight the importance of studying fecundity perceptions in their own right.

Moreover, although perceived fecundity emerges as a key determinant of contraceptive use and unintended pregnancy in qualitative work, few studies have investigated linkages between perceived fecundity and contraceptive use in nationally representative samples. Polis and Zabin (2012), in the sample of unmarried young adult women described above, find no relationship between perceived infertility and contraceptive use behavior, although they suggest this may be due to sample size limitations. Accordingly, they note: "our nonsignificant findings merit additional study with larger samples."

To address these gaps in the literature, the next two empirical chapters use data from a large, nationally representative cohort to provide an in-depth investigation of fecundity perceptions that has not been conducted elsewhere. In the second empirical chapter, I consider how women internalize personal subjective risks about their fecundity. I first propose a conceptual model of perceived fecundity that emphasizes the evaluation of perceptions as a process drawn from understudied contextual and individual-level influences. I then use data from the National Longitudinal Survey of Youth (NLSY) 1997 cohort to provide new, nationally representative estimates of perceived fecundity among young adult women aged 25-30. I also draw from the proposed conceptual framework to examine predictors of and variation in perceived fecundity.

The last empirical chapter investigates the relationship between perceived fecundity and contraceptive use in the same sample. My analysis employs a novel assessment of perceived fecundity that differs from measures used in prior research. My analysis, moreover, attempts to disentangle the roles of experienced subfecundity

and erroneous thinking in the perceived subfecundity-contraceptive use relationship. Doing so may reveal areas for potential interventions, such as addressing misinformation about objective, biological risks of pregnancy.

Chapter 2

From some to none? Fertility expectation dynamics of permanently childless women

Permanent childlessness is increasingly acknowledged as an outcome of a dynamic, context-dependent process, but few studies have integrated a life course framework to investigate the complex pathways leading to childlessness. This paper focuses on an understudied, yet revealing dimension of why individuals remain childless—stated fertility expectations over the life course. Using data from the National Longitudinal Survey of Youth 1979 cohort, I use sequence analysis and logistic regression models to identify and describe groups of permanently childless women who follow similar trajectories of stated fertility expectations. Results indicate that three dimensions of fertility expectation patterns—the emergence of a childless expectation, the consistency of childless expectations, and the types of patterns that precede a childless expectation—provide a more nuanced description of the composition of permanently childless women than the standard voluntary/involuntary framework. The results, moreover, provide support for process-based explanations of eventual childlessness that are often difficult to operationalize in cross-sectional data.

2.1 Introduction

Over the last 50 years, permanent childlessness (hereafter called childlessness) has become an important demographic phenomenon in the United States. Since the mid-1970s, when information on lifetime childlessness were first made available, the share of women aged 40-44 who never gave birth to a biological child doubled from

10% in 1976 to 20% in 2005 (Pew Research Center 2015). While recent evidence indicates that childlessness may be declining (Pew Research Center 2015), its relation to broader sociodemographic trends, such as delayed childbearing and increased opportunities for women outside the home, suggests that it will likely remain an important driver of US fertility in the coming years.

Because childlessness has important implications at both the population- and individual-level, researchers have focused on identifying its causes and determinants. The most common narrative in the demographic literature is that women end up childless by choice (i.e. voluntary childless) or as a consequence of biologic or other constraints (i.e. involuntary childless) (Bloom and Pebley 1982). However, there is growing recognition that the dichotomous voluntary/involuntary classification does not adequately reflect the dynamic, context-dependent processes leading to eventual childlessness (Letherby 2002). Indeed, as women move across their life courses, the choices they make and the behaviors they engage in take place against the backdrop of changing social structures, competing preferences, and age-related declines in fecundity.

Given limitations with the standard classification, there has been interest in providing a more nuanced picture of permanently childless women in the demographic literature, with an emphasis on life course approaches (Hagestad and Call 2007; Keizer et al. 2008; Mynarska et al. 2015). Research focusing on the diversity of pathways to eventual childlessness reveals complexities with respect to common life course measures, such as partnership experiences, educational attainment, and labor force participation (Keizer et al. 2008; Mynarska et al. 2015). One dimension that has not been adequately explored, however, is stated fertility expectations over the life course. This is surprising given that the vast majority of permanently childless women desired a child at some point in their lives, as we shall see in this analysis. Investigating fertility expectation dynamics offers additional insights into the processes of remaining childless since we are able to observe when a childless expectation first emerges, when it becomes permanent, and the types of sequences that precede or follow it. Such dynamics likely capture various influences on women's fertility decision-making and may reflect how women reevaluate expectations for the future when they encounter critical junctures in their life courses.

This paper provides new perspectives on the diversity of childless women by investigating the types of fertility expectation pathways that childless women report over the life course. Using a combination of sequence analysis, data-driven clustering techniques, and multinomial logistic regression models, fertility expectation data from the National Longitudinal Survey of Youth 1979 cohort are analyzed to identify and describe groups of women who share similar stated expectation trajectories. Using a sequential approach provides not only a more nuanced description of the

composition of permanently childless women, but also new insight into the various constraints or choices women make over the life course. As such, the analysis sheds light on considerations for future research related to childlessness determinants.

2.2 Background

2.2.1 Variation in childlessness: Time to move beyond the voluntary/involuntary classification?

The main theoretical distinction between voluntary and involuntary childlessness is primarily a function of volition; women either make a conscious decision to remain childless or they do not. While this dichotomy has proved useful in describing the patterns of childlessness that emerged in the last half of the 20th century (Abma and Martinez 2006; Tanturri and Mencarini 2008; Waren and Pals 2013), the classification is subject to several shortcomings.

First, there is no agreed-upon definition or method for distinguishing between voluntary and involuntary childless women. A main source of confusion, for example, stems from how to define involuntary childlessness. At its most basic level, involuntary childlessness may be solely determined by biological reasons, such as experiencing infertility or undergoing a hysterectomy before having children. This is the general approach of the National Survey of Family Growth (NSFG), which produces nationally representative estimates of reproductive behavior in the United States; women who ever experienced fecundity impairment are considered involuntary childless, while the remaining women are classified as voluntary (Martinez et al. 2012).[1] However, as early work on childlessness concedes, women may be unintentionally childless for non-biological reasons as well. For example, Bloom and Pebley (1982) considered involuntary childlessness to extend to women who may not be able to bear the high costs of childbearing, such as those experiencing financial hardship or unable to find a suitable partner. Likewise, Bongaarts (2001), in his description of "involuntary infertility" in post-transitional societies, included similar non-biological determinants. Despite this broader conceptualization of involuntary childlessness in the literature, few studies have operationalized it, relying instead on the biological definition.

Secondly, the voluntary/involuntary dichotomy is subject to misclassification bias. Due to data limitations, demographers resort to using various self-reported

[1] In the NSFG, childless women can also be classified as temporary childless, meaning that they desire a child/children in the future. However, because the focus of this paper is on women who are permanently childless, I do not focus on this typology here.

measures to indirectly assign women's reasons for ending up childless. It is not clear, for example, how some women, such as those who are childless by default, fit within the existing framework. Moreover, the boundary between voluntary and involuntary childlessness is far from clear cut. Voluntary childlessness, in particular, may be difficult to disentangle from shared demographic processes such as delayed marriage and childbearing.

A third shortcoming, and central to this paper's thesis, is that the classification oversimplifies the complex ways women end up childless. In the NSFG example cited above, voluntary childlessness is treated as a residual category, such that all women without a biological indication comprise a singular group. Yet, this fails to capture the full range of deterministic and context-dependent processes suggested in the literature. For one, Houseknecht (1979) and Veveers (1973), early scholars of childlessness in the US, emphasize differences between women who articulate a desire for childlessness early in the life course and those who decide to be childless at later ages. Second, work by McAllister (1998) argues that the choice to become childless falls on a continuum that ranges from absolute certainty to prolonged ambivalence. Third, Berrington (2004) has shown that many women end up childless after a series of "perpetual postponements" of childbearing. Postponement itself is a process linked with complex mechanisms—for instance, some women may alter their childbearing preferences as they become accustomed to a childless lifestyle (Carmichael and Whittaker 2007), while others may eventually view children as incompatible with employment or other life domains (Barber 2001). Finally, there is an "interdependency" between life course pathways that is not fully captured in a terminal voluntary/involuntary designation (Willekens 1991). Partnership, education, and career trajectories offer three important examples of how events in these domains may interact with childbearing attitudes and preferences (Keizer et al. 2008; Mynarska et al. 2015).

Given the limitations discussed above, there has been increased interest in providing a more nuanced picture of childless women in the demographic literature. This paper offers one such perspective by focusing on fertility intentions.

2.2.2 Investigating fertility expectation dynamics to reveal variation in childless women

Fertility intentions and expectations[2] have received much attention in the demographic literature because they are a key determinant of achieved fertility at the population- and individual-level (e.g. Quesnel-Vallée and Morgan 2003; Schoen et al. 1999). However, the extent to how well intentions predict later outcomes and

reasons for observed discrepancies between intended and realized fertility remain important topics of inquiry. Childlessness poses an interesting case study in this regard: many permanently childless women express an expectation for a child at some point in their lives, yet it would be misleading to claim that they all "miss the target." Instead, looking more holistically at stated fertility expectations over the life course offers opportunities to understand this paradox, as well as provide insights into how women end up childless. In particular, there are three dimensions of fertility expectation patterns that should reflect variation in these processes: 1) the emergence of a childless expectation; 2) the consistency of childless expectations; and 3) the types of patterns that precede a childless expectation.

As a starting point, the age when a childless expectation first emerges serves as a useful anchor for thinking about different sources of influence in remaining childless. For example, childless expectations expressed at an early age, before individuals fully transition to adulthood, may signify ingrained disinterest in childbearing or a predilection for careers and lifestyles that are incompatible with children (Hakim 2002). In contrast, childless expectations expressed later in the life course likely reflect contextual or exogenous influences. Indeed, most theories of fertility intentions, such as Ajzen and Klobas' (2013) application of the theory of planned behavior or Bachrach and Morgan's (2013) cognitive-social model, employ a context-dependent framework, arguing that individuals update their preferences as they encounter critical life course junctures, such as partnership formation, or acquire new information, such as an infertility diagnosis.

The emergence of a childless expectation may also be influenced by the social construction of motherhood. We might expect, for example, few statements of childlessness at early ages, when women are more susceptible to the societal pressures of "mandatory motherhood" (Russo 1976). In contrast, women at older ages may be more influenced by social age deadlines, in which late childbearing is widely discouraged (Billari et al. 2011). Accordingly, women who are not partnered or who have not had children by a certain age may abandon their previous desires and accept childlessness.

The consistency of a stated childless expectation offers yet another way to consider variation in childless expectation dynamics. While fertility expectations are often considered a "moving target," constantly shaped and revised by lived experience (Hayford 2009; Quesnel-Vallée and Morgan 2003), the sources and interpretation of observed fluctuations warrant special consideration among childless individuals. As with women who intend childbearing, fertility intentions measured prior to critical

[2]In this section I use the terms expectations and intentions interchangeably. As Hayford (2009) notes, while the two are conceptually different, they appear to operate similarly in empirical studies.

life course junctures, such as marriage or completion of education, may be imbued with ambivalence. Indeed, the cognitive-social model of fertility intentions posits that intentions do not become concrete until individuals move into situations that demand the formation of an actionable intention (Bachrach and Morgan 2013). However, compared to women who eventually become mothers, childless women may be less likely to encounter circumstances—most notably partnership—that may lead to the formation of an actual intention. Furthermore, it is not clear if an expectation of childlessness is synonymous with an intention to remain childless, as the latter calls for a distinct set of actions (e.g. effective use of contraception) to be carried out throughout the reproductive life course. As such, instability of childless expectations may signify general uncertainty about one's reproductive future.

In contrast, a *consistent* childless expectation over the life course may represent an important signal of one's commitment to a life without children. Prior research finds that commitment and certainty provide important distinctions among women classified as voluntary childless (Houseknecht 1979; Settle and Brumley 2014). Women with stable childless preferences, moreover, counter the notion that attitudes and perceptions adapt with changing circumstances. Thus, where women fall on the dimension of consistency likely reveals information about the tension between orientation and context in influencing the reproductive life course.

A final source of variation in fertility expectation trajectories relates to the types of sequences that precede a childless expectation. Did the switch to a childless expectation occur gradually over time? Or was it preceded by a long-term commitment to a 2-child family? These patterns may provide some indication of the life course processes leading to childlessness. For example, a gradual decline in stated fertility expectations might signify growing disinterest in childbearing, whereas a consistent expectation for children that persists into the late 30s and early 40s likely indicates the presence of a constraint.

To date, little research has investigated these three fertility expectation dimensions among childless women; however select studies provide evidence that statements of expected childlessness are far from static. Using data from the National Survey of Families and Households, Heaton and colleagues investigated the persistence or change in childless expectations between two survey waves spanning a 6-year period (Heaton et al. 1999). Of those who intended childlessness at Wave 1, more than half (62%) switched to either intending children at Wave 2 or had a child between waves; the remaining 38% maintained a childless expectation. In contrast, among childless individuals intending children at Wave 1, 16% switched to intending childlessness by Wave 2. Work from Iacovou and Tavares (2011), using data from the UK, find even greater stability in childless expectations, with 86% of women consistently expecting no children over a five- or six-year period.

Other studies have shed light on how expectations change over the life course more broadly. Hayford (2009), using the same data analyzed here, employs latent class growth models to identify common fertility expectation trajectories among all women. Of the 4 distinct groups that emerge in her analysis, the smallest group, made up of only 4% of women, follows a trajectory that includes childless expectations. This pattern is characterized by statements of low fertility earlier in the life course, followed by a gradual decline to expecting no children by the early 30s. While Hayford expands her test to potentially uncover other types of childless groups, she finds no support for a distinct "consistent childless" trajectory. However, the inclusion of mothers in the sample likely obscures granularity within the small group of childless women. Moreover, trajectories in her analysis are modeled monotonically and do not allow for the inclusion of non-numeric responses, such as "dont know", which may be more common among women who end up childless. The analysis presented in this paper digs deeper into the unique experiences of these childless women.

2.3 Hypotheses

In keeping with the traditional voluntary/involuntary classification of permanent childlessness, I expect to see at least two general patterns emerge in the analysis: women choosing childlessness early in life course and women becoming unintentionally childless at the end of their reproductive careers. However, at least in the case of voluntary childlessness, the theories and empirical evidence cited above suggest that not all childless women navigate their reproductive life courses in such deterministic ways. I predict, therefore, that the analysis will uncover different times in the life course, likely reflecting critical junctures, when some groups of women transition to a continuous childless expectation. I remain agnostic, however, about when these changes might occur. I also expect that some trajectories will be more likely to contain switches between expecting children and not, whereas others will be more consistent.

While previous studies have focused mostly on the determinants of ultimate childlessness—usually by comparing childless women with mothers—much less research has investigated differences in pathways among those who end up childless. The following two sections offer additional hypotheses in this regard.

2.3.1 Demographic and background factors

Across multiple dimensions of fertility, race/ethnicity, and foreign-born status are highly predictive of outcomes. The extent to how these factors are differentiated in pathways to childlessness remains less well-explored. Prior research finds that White women are more likely to be voluntary childless (Abma and Martinez 2006), but few differences are found by race/ethnicity for involuntary (i.e. biological) childlessness. However, Black, Hispanic, and foreign-born women have higher fertility than their White and native counterparts (; Ford 1990; Sandefur et al. 2001), suggesting that among those who end up childless, the former may be more likely to experience childbearing constraints. Thus, I hypothesize that the emergence of a childless expectation occurs later in the life course for Black, Hispanic, and foreign-born women.

Background and contextual characteristics such as family structure, religious upbringing, and urban/rural residence may be associated with normative differences in fertility expectations, especially earlier in the life course. Trent (1994), using the same data analyzed here, finds that those living with both biological parents at age 14 held more traditional fertility expectations in late adolescence compared to other family types, while those raised without mothers were most likely to expect childlessness. Similarly, sibship size and Catholicism were associated with expecting larger family sizes. One question that emerges from Trent's analysis, however, is if these determinants set into motion distinct pathways that persist throughout the life course. Hayford (2009), discussed above, finds little support for this notion. I tentatively hypothesize that family structure, religious, and contextual characteristics wield the strongest influence earlier in the life course.

Background factors linked with women's sex role orientation should have a more persistent effect on women's trajectories. Maternal characteristics may be particularly salient, as mothers likely serve as important models for their daughters. Mothers who attended college, for example, may influence their daughters to adopt an "achievement" orientation (Houseknecht 1979), which predisposes women to pursue successes outside the home. Furthermore, mothers who work while raising children not only provide an alternative to the traditional male breadwinner model, but also display challenges of combining work and family. Thus, I expect that women raised with less traditional maternal role models will be more likely to expect childlessness from a young age. In addition, I hypothesize that sex role attitudes and aspirations measured in adolescence will be highly predictive of fertility expectation pathways, with those holding more traditional orientations less likely to intend childlessness earlier in the life course.

2.3.2 Life course processes

Life course processes can interact with fertility expectation pathways in many ways. Marital history may be particularly salient, as many women consider a stable partnership a necessary precondition for childbearing. Furthermore, women experiencing marital disruption may abandon prior expectations for children, especially later in the life course. Previous research finds that women classified as voluntary childless are less likely to ever marry compared to involuntary childless women (Abma and Martinez 2006). However, it is difficult to discern if this relationship is a result of never finding a suitable partner or if women remain unmarried because they expect no children. I predict that women experiencing marital dissolution will expect children later in the life course, but I have no explicit predictions for women who remain unmarried.

Education often emerges as a key predictor of childlessness. In particular, pursuit of higher education has been linked with delayed childbearing (Ní Bhrolcháin and Beaujouan 2012), stronger attachment to the labor market (Juhn and Potter 2006), and changes in attitudes (Cunningham 2008), all of which may lead to eventual childlessness. Because these processes are so diverse, however, it is unclear if women who pursue higher education share similar fertility expectation pathways. Moreover, not all eventual childless women are highly educated; in 2006-2008, a little more than a third (34%) of childless women never attended college. Women with lower education may experience different life course pathways leading to childlessness. Baudin et al. (2015), for example, find that poorly educated women are more likely to be "socially sterile" due to lack of resources needed to bear children. I expect that women with less than a high school degree will be more likely to express a childless expectation later in the life course as a function of economic or partnership constraints, but I have no strong prediction for highly educated women.

Women's attachment to the labor force in early adulthood may also differentiate fertility expectation pathways. Women who opt out of career pursuits in favor of traditional gender roles may be more likely to maintain an expectation for children throughout much of the life course compared to women engaged in full-time work. Thus, I predict that women who are not in the labor force will be more likely to expect childlessness later in the life course. Relatedly, higher earning women may hold professional or managerial jobs that place childbearing in conflict with career advancement. However, it is unclear when in the life course these women would expect childlessness; some women's career and childbearing aspirations may be formed early in the life course, while others may be more influenced by increased opportunity costs incurred at later ages. As such, I have no strong predictions concerning the relationship between income and expectation patterns.

The relationship between fecundity impairment and eventual childlessness is well-known, but much less research has fully considered reproductive risk over the life course. Namely, in order to remain childless, women exposed to the risk of pregnancy must either mitigate that risk by using contraception or obtain abortions when unwanted pregnancies occur. I expect that women with a persistent commitment to childlessness will be more likely to use these strategies—particularly sterilization—than other childless women.

Lastly, the presence of step- or adopted children in a household may serve as a substitute for biological motherhood (Park and Hill 2014; Stewart 2002). Because adoption is common among those experiencing infertility (Jones 2008), fertility expectation pathways for women who adopt should largely mirror those of women with a biological constraint. Similarly, fertility expectation pathways for women with step-children will likely be characterized by a downward revision in childbearing expectations later in the life course.

2.4 Approach

The current study has two aims. The first is to characterize the fertility expectation pathways of permanently childless women from the National Longitudinal Survey of Youth 1979 cohort and identify groups of women who share similar trajectories. To accomplish this task, I use sequence and cluster analyses, techniques that are increasingly used in the social sciences to enable synthesis of a large number of possible trajectories (Abbott 1995; Billari 2001). These methods not only allow the investigator to look holistically at the sequential characteristics of individual lives, but also to distill individual-level variation into meaningful, shared life course patterns that capture the complex dimensions highlighted above.

The second aim is to predict group membership using binary and multinomial logistic regression models. The predictors I use fall into two groups: time-invariant background characteristics and measures related to life course processes. Prior studies predicting group membership usually limit analyses to the former group to avoid methodological concerns related to temporal ordering of events. However, the exclusion of life course measures throws out meaningful information that can be used to distinguish between clusters. Thus, while I acknowledge that using time-varying factors precludes making causal claims, I include them here to provide new perspectives on life course pathway interdependency and directions for future research.

2.5 Data and Methods

Data for this study are from the National Longitudinal Survey of Youth 1979, a panel survey of 12,686 males and females in the United States. Initial interviews were conducted in 1979, when participants were aged 14 to 22; subsequent interviews were conducted annually until 1994, and biennially thereafter. At the last available wave (i.e. 2012), almost all participants completed childbearing (age range: 48 to 56).

Fertility expectations were measured at 19 unique time points across the survey, starting with the first wave in 1979, yearly from 1982 to 1986, and then biennially from 1988 to 2012. Respondents were asked, "Altogether, how many (more) children do you expect to have?" and could provide both numeric and non-numeric responses. At each wave, responses were recoded into a categorical variable with 6 possible states: 0, 1, 2, 3 or more, "don't know," and missing. The last category, missing, is treated as a unique status that corresponds to refusals and survey non-response. Expectation states are assigned to two-year age groups (e.g. 21-22-year-olds) based on the age of the respondent at the time of the survey.

Each woman's sequence begins at age 21, when almost all women in the sample provided at least one fertility expectation measurement.[3] All sequences end at age 45. Thus, each woman has an equal sequence length of 18, in which each position in the sequence is one of 6 possible states.

To limit my study population to permanently childless women, I identify women in the sample who were last observed at age 45 or older and who never reported a live birth (n=657). Of these women, 21% are missing at least one fertility expectation state, which is coded as missing as described above. Those who are missing responses for more than half of the 8 waves spanning ages 25 to 39, a key observation period, are excluded (n=12), resulting in a final sample size of 645 childless women.

2.5.1 Sequence analysis

Sequence analysis is used to 1) provide an aggregate description of fertility expectation pathways, 2) measure the complexity of sequences, and 3) identify groups that share similar sequence patterns. Briefly, the procedure to accomplish these aims is as follows.

First, I define a 18-element sequence of fertility expectations for each woman in the sample.

[3]Just over 10% of the sample have a missing state at this age because they entered the study after 21.

Second, I calculate within sequence turbulence as a measure of sequence complexity. Sequence turbulence, developed by Elzinga and Liefbroer (2007), is an indicator of the variability of sequences based on both the number of distinct subsequences within each sequence and the variance of the consecutive time spent in each state. Higher turbulence values indicate more switches between states.

Third, using the Hamming Distance matching algorithm, I construct a dissimilarity matrix that quantifies the distance between each pair of sequences. A dissimilarity matrix is made up of pairwise distances or "costs" that provide an indication of the types of operations that are needed to convert one sequence into another, with higher values indicating more dissimilarity or distance between pairs. These operations include substitutions (i.e. substituting one state for another at the same position within a sequence) and insertions or deletions (i.e. inserting or deleting states or subsequences to align sequences with one another). In contrast to other matching algorithms, the Hamming Distance algorithm only uses substitutions. As a result, the Hamming Distance calculation is preferred for preserving contemporaneous relationships, since insertions and deletions may "warp" time (Lesnard 2010).

Before generating the dissimilarity matrix, I create a substitution cost matrix that defines costs associated with substituting one state for another. The three most common ways to set costs are 1) implementing a uniform cost for all substitutions, 2) using transition-rate based costs (i.e. data driven), and 3) generating theory-derived costs. I use a uniform cost matrix rather than a theory-derived matrix to avoid the assumption that some fertility expectation statuses are more similar than others. I do, however, conduct a sensitivity analysis using transition-rate based costs. Results are largely similar across cross-setting schemes.

In the last step, I apply a k-medoid clustering algorithm to the dissimilarity matrix to identify homogenous groups of women who follow similar patterns. The algorithm iteratively searches for k representative sequences from the sample, or medoids, and seeks to minimize the total distance to other objects in the cluster. The k-medoid clustering algorithm was chosen over a hierarchical clustering algorithm such as Ward's because it performed better across cluster quality metrics (see Appendix Figure A.1). I select the number of clusters by using a combination of data-based quality measures and by considering the construct validity of each cluster. Based on these criteria, I obtain a five-cluster solution. (More details of cluster selection, including a description of quality statistics of cluster solutions, can be found in the appendix.)

I conduct all analyses using the TraMineR and WeightedCluster packages in R (Gabadinho et al. 2011; Studer 2013); the latter accounts for complex sampling design of the survey.

2.5.2 Binary and multinomial logistic regression models

Once clusters are determined, I predict cluster membership using binary and multinomial logistic models encompassing several demographic, background, and life course determinants. Demographic measures include race/ethnicity (White, Black, Hispanic), an indicator for foreign-born status, and an indicator for rural residence when the respondent was 14 years old. Background measures include family structure at age 14 (lived with both parents, lived with mother only, other family types), a continuous measure of number of siblings, and childhood religious affiliation (Protestant, Fundamentalist Christian, Catholic, Other).

To capture influences on sex role orientation, I include measures of mother's education (less than high school, high school, some college, BA/BS or higher) and whether the respondent's mother worked when the respondent was 14 years old. Two measures are used to reflect gender attitudes or orientations formed in adolescence. The first is a binary indicator corresponding to whether the respondent reported that she expected to work at age 35 at the baseline interview. The second is a three-part categorical variable that was generated using 5 Likert-scale items measuring gender attitudes at the baseline interview. I follow the coding scheme used in Greenstein's (1995) analysis of gender ideology in the same sample analyzed here: Traditional, Moderate, and Non-traditional.

Life course measures include the respondent's highest grade completed (less than high school, high school degree, some college, BA/BS, Graduate degree), employment status (employed, unemployed, not in the labor force), and family income quartile,[4] all measured at age 30. I select age 30 to ensure that most of the sample has completed education and to capture determinants that may affect future family formation.

Partnership dynamics are captured using two variables. The first describes if the respondent was ever married, and if so, at what age the marriage occurred, since late marriage, in particular, may serve as a possible proxy for higher risk of subfecundity. The resulting measure is a three-part categorical variable: married at or before age 30, married after age 30, and never married. The second measure is an indicator for ever experiencing divorce or widowhood.

The last set of life course measures comprise a set of indicator variables denoting if respondents ever experienced the following events: lived with step-children, adopted a child, reported miscarriage, underwent sterilization, or reported an induced abortion.[5]

[4]Family income quartile cut-points were determined from the distribution of all women, not just eventually childless women.

[5]While underreporting of miscarriage and abortion is widespread, the mere reporting of these

In the final sample, 31% of women (n=205) are missing information on at least one covariate, with most of these women missing information on family income (n=139). Because the patterns of missingness meet the missing at random assumption, I use multiple imputation by chained equations to impute missing values (Royston and White 2011). All models use survey weights to account for complex sampling design.

2.6 Results and Discussion

2.6.1 Sequence analysis

Figure 1 displays the frequency distribution of stated fertility expectations for each 2-year age group, starting with age 21 and ending at age 45. To facilitate interpretation, missing states are excluded. Most (85%) women stated that they expected at least one child at age 21. In contrast, 15% of women state a childless expectation, and only 2 women (<1%) provided a "don't know" response. Of those expecting at least one child at age 21, the majority (55%) expect 2 children, followed by 32% expecting 3 or more children, and the smallest group (13%) expecting 1 child.

At the aggregate level, the two-child expectation norm is pervasive throughout the early reproductive life course but begins to decline by the late 20s and early 30s. The preference for 3 or more children, however, declines substantially over the 20s, falling from 27% at age 21 to 7% by age 31. The expectation for one child remains relatively stable across reproductive ages. Expectations of childlessness show a gradual upward shift across age, with the largest relative increase occurring between 27 and 29. By age 33, the majority of permanently childless women state a childless expectation. Interestingly, however, at age 45, a non-trivial minority either express a desire for at least one child (8%) or provide a "don't know" response (2%).

To more fully describe unobserved variation in the aggregate pattern, I now present results from the sequence and cluster analysis. Figure 2 displays the medoids and weighted proportions for each of the five clusters identified. Each medoid can be thought of as the most representative sequence of a given cluster. The most common cluster, the "Early Switchers," make up 32% of the sample. Women belonging to this cluster tend to state an expectation for children early in the life course (most commonly 2 children), but switch to a childless expectation in the mid-to-late-20s. In contrast, women belonging to the second largest group (24%), the "Consistent Childless," maintain a persistent childless expectation during the entire observation period. Taken together, a little more than half of eventually childless women (56%) fall into a cluster where childlessness is expected before age 30.

events may differentiate pathways among childless women.

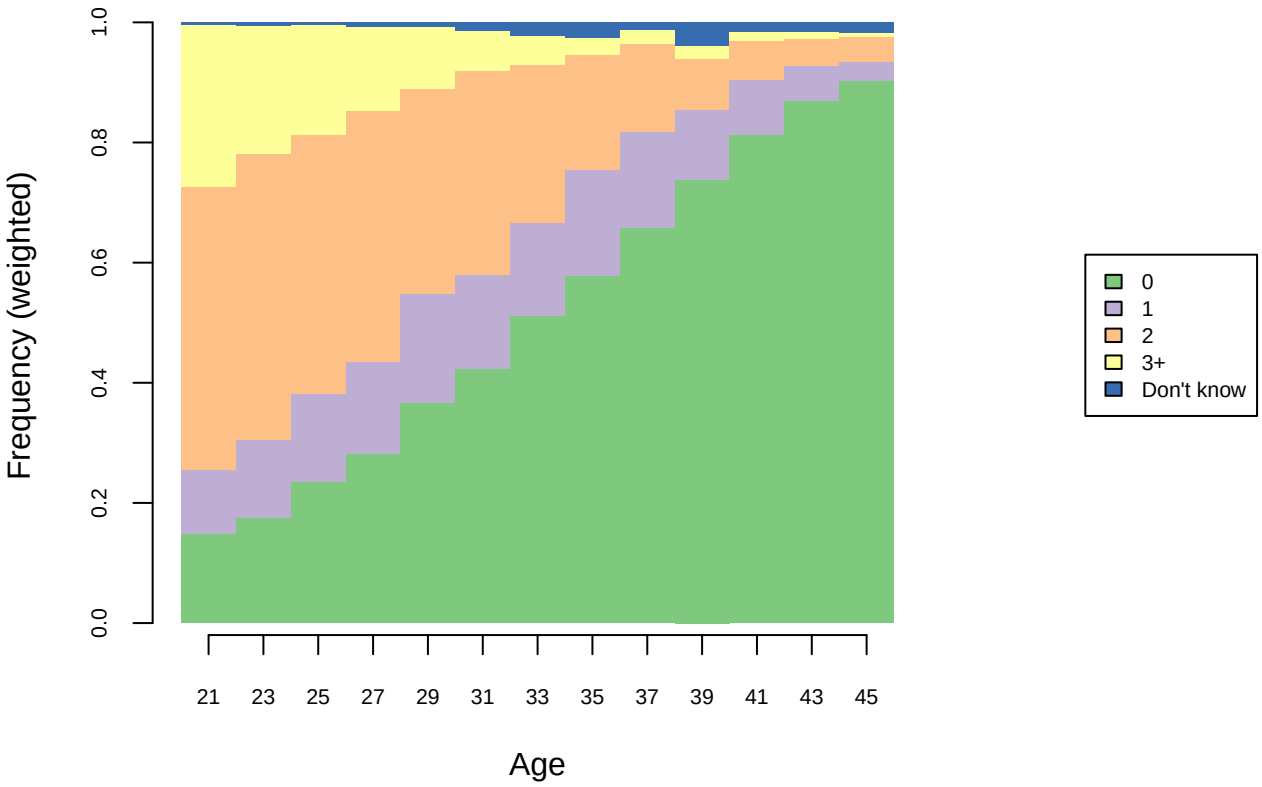

Figure 2.1: State distribution of fertility expectations over the reproductive life course for permanently childless women, n=645.

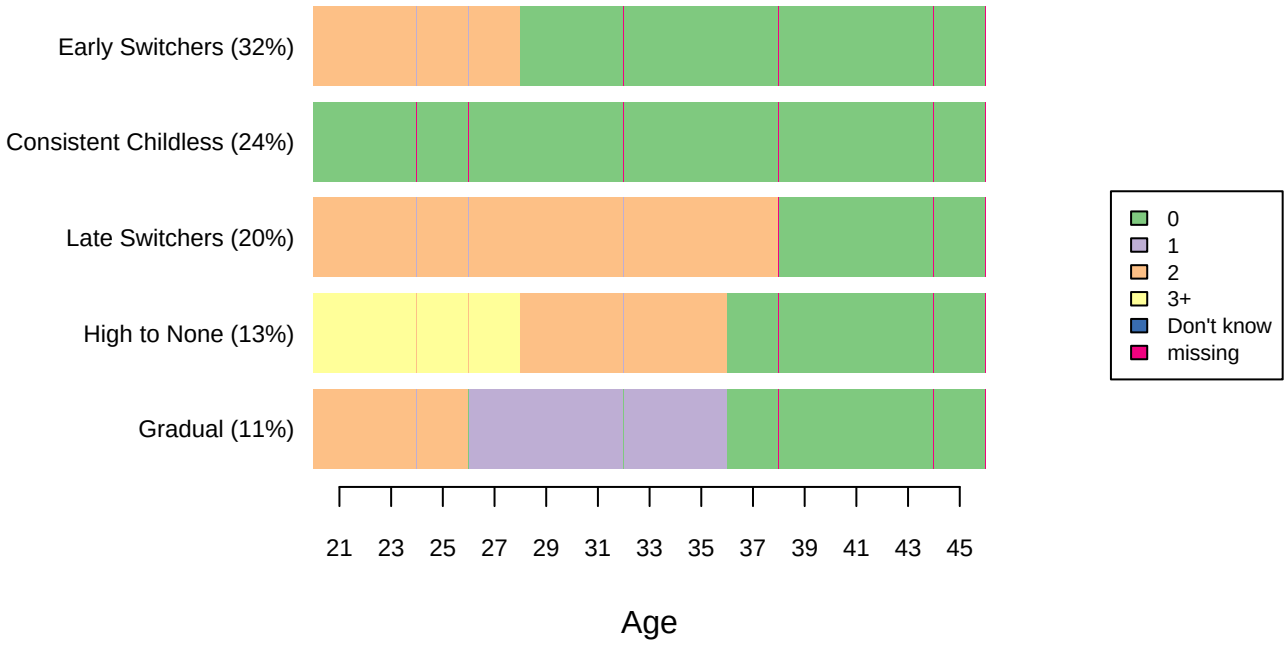

Figure 2.2: Medoids and weighted proportions for the 5 clusters identified in analysis, n=645.

Trajectories in the third largest cluster (20%), the "Late Switchers," are characterized by a stable 2-child expectation throughout the 20s and early 30s, followed by a switch to expecting childlessness in the late 30s. The remaining two clusters, "High to none" (13%) and "Gradual" (11%) are marked by patterns of decline prior to the emergence of a childless expectation. Women in the High to None group typically start off desiring large families, then revise their expectations downward in the late 20s and again in the mid-30s. As shown in the medoid, however, the downward pattern of the High to None group does not include a one-child expectation. Conversely, trajectories in the Gradual cluster typically include a persistent one-child expectation that emerges in the mid-20s, followed by a switch to expecting childlessness in the mid-30s. Thus, while the remaining three clusters share similarities in when individuals transition to expecting childlessness, they are differentiated by the types of trajectories that precede the emergence of a childless expectation.

The medoids shown in Figure 2 also reveal how downward revisions in fertility

expectation pathways occur at roughly the same periods in the life course. For three groups—Early Switchers, High to None, and Gradual—women revise their fertility expectations in the mid-to-late 20s, suggesting that life course junctures that occur in early adulthood, such as partnership or transitioning to the labor market may be linked to this revision. The second transition reflected in the medoids occurs later in the life course. Here we see that the Late Switchers, High to None, and Gradual groups all transition to expecting childless after age 35, with the Late Switchers expecting childlessness later than the other two groups. While the analyses preclude any type of causal claim for these transitions, their existence lends support for numerous hypotheses, including the presence of biological or partnership constraints, social age deadlines, or adaptation to childless lifestyles.

Figure 3 plots full sequences for the entire sample by cluster membership. Here, we are not only able to see support for the medoids described in Figure 2, but also additional variation in expectation trajectories within each grouping. In the Late Switchers and High to None groups, for example, some women maintain an expectation for children well into the early 40s. Likewise, some women Consistent Childless group express an expectation for a child at some point in their lives, especially earlier in the life course.

Plotting all sequences also sheds light on the commonality of a "don't know" response, which was not present in any of the medoids. While statements of "don't know" (in blue) are generally rare in this sample, there are differences between clusters. Further analysis indicates that women in the High to None group are the most likely to report an ambivalent expectation, with just over a quarter of women (26%) stating "don't know" at least once. Conversely, women in the Consistent Childless cluster were least likely to outwardly express any ambivalence (6%). These results support Morgan's (1982) assertion that "don't know" responses should be considered distinct from numeric responses.

Finally, as a way to assess the consistency of stated expectations, Figure 4 presents a boxplot of sequence turbulences by cluster. A higher turbulence indicates greater movement between states within a sequence. Not surprisingly, sequences of women in the consistent childless group have the lowest mean turbulence. Sequences in the High to None and Gradual clusters are more likely to have high turbulence scores, although no singular group emerges as being characterized by high levels of turbulence.

2.6.2 Binary and multinomial logistic regression models

The previous section provided an indication of the types of variation among childless women and the composition of childless women, but does not allow for any further

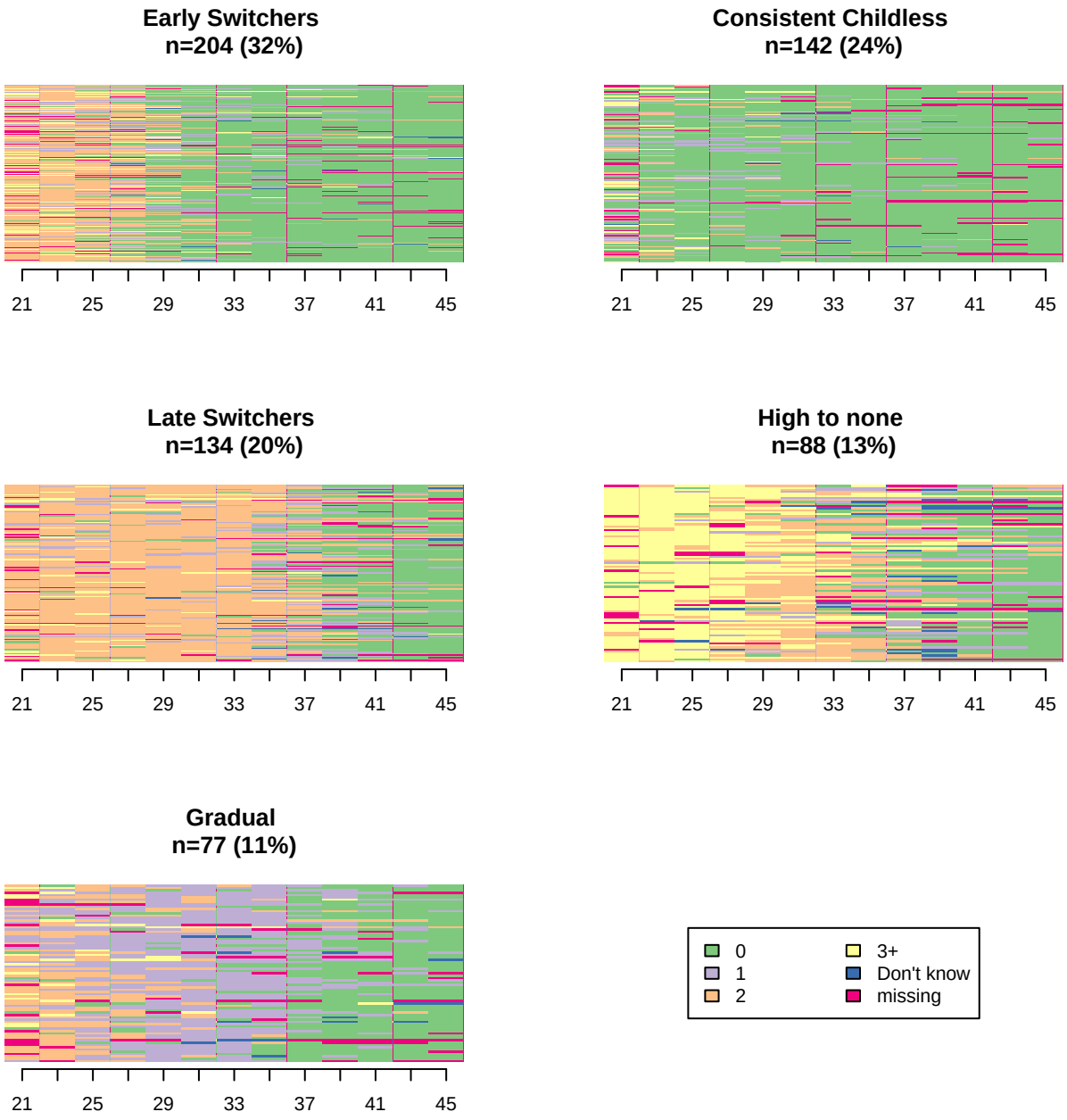

Figure 2.3: All sequences, by cluster, n=645.

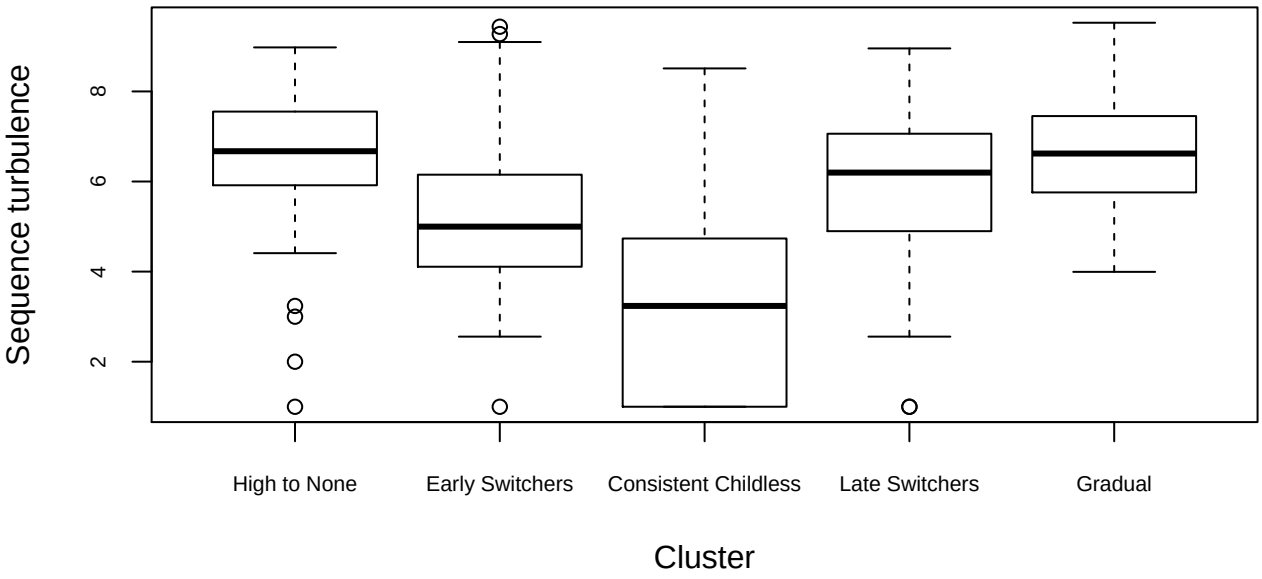

Figure 2.4: Boxplot of the within sequence turbulence, by cluster.

description by characteristics. Table 1 provides the Ns and weighted descriptive statistics for the full sample, as well as for each of the 5 clusters. Chi-square and ANOVA tests are used to assess significant differences between clusters for each characteristic. At the bivariate level, only three background measures—race/ethnicity, rural status, and religious upbringing—are significantly different between clusters. Among life course measures, women's educational attainment, employment status, and adoption are significant predictors, while family income and marital history are marginally significant.

We turn now to the results of the multinomial analysis to build on the relationships observed in Table 1.

Demographic and background factors Table 2 focuses on the role of background factors in two separate models. The first, limited to groups expecting childlessness early in the life course, determines which, if any, background factors distinguish between women consistently expecting childlessness over the observation period

(i.e. Consistent Childless) and women who switch to expecting childless in their 20s (Early Switchers). Results indicate that women raised by single mothers, as well as those raised in Fundamentalist Christian or other religious traditions have higher odds of belonging to the Consistent Childless group compared to the Early Switchers cluster, suggesting that family structure and background provide an important distinction for women expecting childlessness early in the life course. Results also show little support for the argument that both groups draw from the same latent pathway of expecting no children, as women in the Early Switchers cluster have higher odds of holding either traditional or moderate gender attitudes at baseline, while women in the Consistent Childless cluster hold less traditional attitudes.

The second model presented in Table 2, also focused on background factors, compares membership in clusters characterized by expecting childlessness later in the life course vs. earlier in the life course. As with model 1, religious background emerges as a significant predictor—compared to those raised in protestant households, women who are raised Catholic or in other traditions (or no tradition) have higher odds of expecting childlessness later in the life course. Other family background characteristics and gender attitudes measured at baseline are not significant predictors. However, women raised in rural areas have higher odds of expecting childlessness early in the life course, a counterintuitive result given stronger childbearing norms in rural America.

Although maternal factors do not predict differences between the Early Switchers and Consistent Childless clusters, they do predict when in the life course daughters expect childlessness. Contrary to my hypothesis, women with higher levels of maternal education have higher odds of expecting childlessness later in the life course, not earlier. However, it is possible that the pathways invoked between maternal education and childlessness, namely that highly educated mothers influence their daughters to pursue success outside the home, still hold.

Both models presented in Table 2 also demonstrate the importance of race as a marker of cluster membership among permanently childless women. Black women, in particular, have lower odds of belonging to the Consistent Childless group and higher odds of expecting childlessness later in the life course, compared to their white counterparts. However, counter to my hypothesis, there were no significant relationships for Hispanic and foreign-born women.

Life course factors Because remaining childless is a life course process, I also explore potential relationships between cluster membership and life course characteristics. Model 3, presented in Table 3, investigates how these life course characteristics distinguish between groups expecting childlessness later in the life course and groups

expecting childlessness earlier. Consistent with the traditional voluntary/involuntary childless dichotomy, two proxy measures of subfecundity—ever adopting and ever reporting miscarriage—are important predictors of expecting childless at later ages. Life course measures related to labor force participation also differ between the two groups. Compared to women who are employed at age 30, women who are not in the labor force have lower odds of expecting childlessness at later ages. Differences in education are less clear, although there is some suggestion that women holding a bachelor's degree have marginally higher odds of expecting childlessness later compared to women with a high school education. Having less than a high school education, however, was not significant in any of the models.

Results from the last set of models, shown in Table 4, shed light on how life course factors may influence pathways among the three clusters characterized by expecting childlessness later in the life course. In model 4, multinomial regression is used to predict membership in either the High to None group or Gradual group, compared to belonging to the Late Switchers group. Model 5 presents the same multinomial model, but changes the reference group to Gradual, thereby ensuring that relationships are shown for each unique combination of clusters.

Across Models 4 and 5, we see that the two most common predictors of eventual childlessness—marriage and education—also distinguish between fertility expectation pathways of those expecting childlessness at later ages. In the case of marital history, for example, women belonging to the High to None and Gradual clusters had significantly higher odds of never marrying compared to women in the Late Switchers group. Marital dissolution was also more common among the Gradual cluster than the Late Switchers cluster. Education, on the other hand, was a significant predictor of belonging to the High to None group.

Among the three groups, the High to None cluster stands out with a distinctive profile; compared to women belonging to the Late Switchers and Gradual clusters, women in the High to None group are more likely to hold graduate degrees (vs. high school education), more likely to undergo sterilization, and less likely to report any abortion. Looking at the other groups, there were notable differences between the Gradual and Late Switchers cluster related to labor force status and the presence of step-children in the home, but these differences did not emerge in comparing the Gradual and High to None groups.

Lastly, although experiences of impaired fecundity appear to distinguish between earlier and later patterns of when women expect childlessness, they do not differentiate between pathways characterized by later emergence of a childless expectation. In other words, these results do not show that there is a cluster or set of clusters that are strongly marked by women's experience of subfecundity, after controlling for other factors. This discrepancy suggests that either women belonging to the

three "late childless expectation" clusters experienced similar levels of subfecundity or that women's reactions to experienced infertility mirror those of competing explanations in relation to childlessness expectation patterns. Despite this limitation, results indeed show that a variety of factors—not just biology—contribute to different pathways among women expecting childlessness later in the life course.

2.7 Conclusion

In this paper, I find that three dimensions of fertility expectation patterns—the emergence of a childless expectation, the consistency of childless expectations, and the types of patterns that precede a childless expectation—provide a more nuanced description of the composition of childless women than the standard voluntary/involuntary framework. Taken together, the results provide support for process-based explanations of eventual childlessness that are often difficult to operationalize in cross-sectional data, including the presence of biological or partnership constraints, social age deadlines, and gradual disinterest in childbearing.

This paper provides four important contributions to the literature on childlessness. First, outside of the voluntary/involuntary dichotomy, there are few typologies of childless individuals in contemporary society. Here, I identify five different groups of permanently childless women. Two of these groups, comprising 56% of the sample, expect childlessness earlier in the life course, while the remainder expect childlessness later in the life course. While biology has served as a central marker for the voluntary/involuntary delineation of permanently childless women, my results demonstrate that women experiencing subfecundity (proxied by reports of miscarriage and adoption) do not necessarily share similar fertility expectation pathways, suggesting that the way women evaluate their future life courses is contingent on other factors. Indeed, this has been echoed by previous research investigating which life course domains influence eventual childlessness (Mynarska et al. 2015). Future work should more fully integrate the interdependencies between life course domains and fertility intentions in a unified conceptual framework on childlessness.

Second, this paper identifies important considerations for studying childless determinants. First, if we are interested in understanding the causes and consequences of childlessness, using a dichotomous voluntary/involuntary framework may mask important heterogeneity in the life course processes related to eventual childlessness. Second, results suggest that using mothers as a single counterfactual group may not fully capture the multiple selection processes at play across women's lives. For example, do women expecting children remain childless because they have different preconditions for childbearing than eventual mothers or are preconditions never met?

Table 2.1: Descriptive statistics for the full sample and 5 clusters

	Full sample	Early Switchers	Consistent Childless	Late Switchers	High to None	Gradual
Population share (%)	100	32	24	20	13	11
Number of cases	645	204	142	134	88	77
Race/ethnicity*						
White	0.83	0.83	0.89	0.82	0.80	0.75
Black	0.13	0.13	0.08	0.14	0.15	0.21
Hispanic	0.04	0.05	0.03	0.05	0.05	0.04
Migrant	0.04	0.03	0.01	0.07	0.05	0.04
Rural*	0.23	0.29	0.26	0.13	0.13	0.26
Family structure at age 14						
Lived with both parents	0.80	0.83	0.74	0.81	0.85	0.74
Lived with mother only	0.11	0.08	0.16	0.08	0.10	0.14
Other family type	0.09	0.09	0.10	0.10	0.06	0.12
Number of siblings	2.87 (0.08)	2.95 (0.13)	2.79 (0.16)	2.67 (0.16)	3.19 (0.33)	2.80 (0.24)
Mother's education						
Less than high school	0.25	0.26	0.26	0.24	0.15	0.36
High School	0.45	0.50	0.48	0.42	0.40	0.36
Some college	0.13	0.11	0.12	0.12	0.20	0.17
BA/BS and higher	0.16	0.14	0.13	0.22	0.25	0.11
Mother worked when R was 14	0.55	0.52	0.54	0.61	0.57	0.57
Religion raised**						
Protestant	0.34	0.43	0.32	0.30	0.28	0.26
Fundamentalist Protestant	0.20	0.18	0.26	0.19	0.08	0.34
Catholic	0.26	0.25	0.22	0.26	0.39	0.23
Other	0.19	0.14	0.19	0.25	0.25	0.17
Church attendance						
None	0.23	0.27	0.29	0.14	0.19	0.20
Few times a year	0.35	0.34	0.35	0.41	0.29	0.35
Monthly	0.16	0.16	0.12	0.17	0.18	0.24
Weekly	0.16	0.17	0.11	0.22	0.22	0.09
More than weekly	0.09	0.06	0.12	0.07	0.12	0.12
Gender attitudes in 1979						
Traditional	0.18	0.19	0.13	0.29	0.26	0.13
Moderate	0.36	0.42	0.32	0.31	0.33	0.36
Non-traditional	0.47	0.39	0.56	0.49	0.41	0.51
R expected to work at age 35	0.80	0.78	0.86	0.81	0.76	0.74

Table continues on next page

	Full sample	Early Switchers	Consistent Childless	Late Switchers	High to None	Gradual
Highest grade completed at age 30*						
Less than high school	0.05	0.07	0.07	0.05	0.00	0.04
HS	0.31	0.37	0.32	0.25	0.17	0.35
Some College	0.28	0.26	0.32	0.30	0.23	0.28
BA	0.21	0.16	0.16	0.27	0.34	0.18
BA+	0.15	0.14	0.12	0.13	0.27	0.14
Employment status at age 30*						
Employed	0.86	0.87	0.78	0.95	0.89	0.83
Unemployed	0.03	0.03	0.04	0.01	0.02	0.06
Not in labor force	0.10	0.10	0.18	0.03	0.09	0.10
Family Income quartile at age 30†						
1 (low)	0.22	0.23	0.34	0.16	0.16	0.09
2 (low middle)	0.32	0.28	0.35	0.30	0.30	0.37
3 (high middle)	0.23	0.25	0.16	0.23	0.23	0.30
4 (high)	0.23	0.24	0.16	0.31	0.31	0.24
Marital history						
Ever married-before age 30	0.42	0.42	0.42	0.48	0.25	0.52
Ever married 30+	0.26	0.24	0.28	0.29	0.30	0.21
Never married	0.31	0.34	0.30	0.24	0.45	0.27
Experienced marital disruption†	0.40	0.41	0.42	0.33	0.31	0.54
Ever reported step-children	0.16	0.15	0.18	0.11	0.15	0.25
Ever adopted*	0.06	0.05	0.02	0.11	0.06	0.11
Ever reported miscarriage	0.12	0.09	0.08	0.14	0.14	0.19
Ever sterilized	0.09	0.11	0.12	0.04	0.10	0.04
Ever reported induced abortion	0.17	0.17	0.19	0.18	0.06	0.23

Note: $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Standard deviations are in parentheses. Respondents with missing values are removed when calculating descriptive statistics.

Table 2.2: Results from multinomial regression predicting cluster membership.

	Model 1				Model 2	
	Ref: Consistent Childless				Ref: Late Switchers	
	Early Switchers	Late Switchers	High to None	Gradual	High to None	Gradual
Race/ethnicity						
Black	1.37**	1.18*	1.76***	1.26*	0.58	0.08
	(0.42)	(0.47)	(0.48)	(0.57)	(0.42)	(0.54)
Hispanic	0.67	1.18*	0.10	0.22	−0.20	−0.08
	(0.50)	(0.47)	(0.81)	(0.66)	(0.61)	(0.65)
Migrant	0.65	1.46*	0.82	1.17	−0.64	−0.28
	(0.84)	(0.71)	(0.81)	(1.06)	(0.70)	(0.89)
Rural	0.24	−1.12*	−0.72	−0.17	0.40	0.95†
	(0.31)	(0.46)	(0.47)	(0.45)	(0.57)	(0.53)
Family structure at age 14						
Mother only	−0.76*	−0.58	−0.14	0.05	0.44	0.63
	(0.39)	(0.52)	(0.58)	(0.57)	(0.63)	(0.61)
Other family type	−0.25	0.24	−0.19	0.24	−0.44	−0.00
	(0.43)	(0.54)	(0.60)	(0.61)	(0.63)	(0.61)
Number of siblings	0.03	−0.01	0.09	−0.08	0.10	−0.06
	(0.06)	(0.08)	(0.10)	(0.09)	(0.10)	(0.10)
Mother's education						
Less than high school	−0.16	0.14	−0.01	0.86	−0.15	0.73
	(0.38)	(0.47)	(0.51)	(0.57)	(0.50)	(0.55)
Some college	0.09	0.17	0.94†	0.66	0.77	0.48
	(0.40)	(0.49)	(0.52)	(0.55)	(0.57)	(0.59)
BA/BS or higher	0.21	0.63	0.81	0.22	0.19	−0.41
	(0.50)	(0.50)	(0.58)	(0.63)	(0.52)	(0.59)
Mother worked when R was 14	0.13	0.22	0.10	0.11	−0.11	−0.11
	(0.28)	(0.33)	(0.40)	(0.37)	(0.40)	(0.38)
Religion R raised with						
Fundamentalist Christian	−0.99***	−0.36	−1.02***	0.02	−0.66	0.38
	(0.37)	(0.47)	(0.49)	(0.58)	(0.49)	(0.58)
Catholic	−0.07	0.27	1.47***	0.40	1.21*	0.13
	(0.38)	(0.45)	(0.48)	(0.52)	(0.48)	(0.54)
Other	−0.62	0.41	0.78	−0.06	0.38	−0.46
	(0.43)	(0.47)	(0.51)	(0.55)	(0.50)	(0.56)
Religious attendance						
None	−0.20	−1.24*	−0.33	−0.22	0.90	1.01
	(0.45)	(0.56)	(0.62)	(0.66)	(0.65)	(0.68)
Few times a year	−0.21	−0.54	−0.51	0.21	0.03	0.75
	(0.43)	(0.50)	(0.54)	(0.63)	(0.52)	(0.62)
Monthly	−0.04	−0.26	0.09	1.01	0.35	1.27†
	(0.49)	(0.57)	(0.65)	(0.65)	(0.62)	(0.65)
More than once a week	−0.89†	−1.28*	−0.37	0.47	0.91	1.75*
	(0.52)	(0.63)	(0.68)	(0.74)	(0.69)	(0.74)
Gender attitudes in 1979						
Traditional	1.02*	0.76	1.40*	−0.16	0.64	−0.92
	(0.43)	(0.49)	(0.57)	(0.61)	(0.51)	(0.60)
Moderate	0.60†	−0.04	0.27	0.07	0.32	0.12
	(0.31)	(0.37)	(0.43)	(0.42)	(0.43)	(0.42)
R expected to work at age 35	−0.35	−0.43	−0.72	−1.06*	−0.29	−0.64
	(0.40)	(0.49)	(0.51)	(0.52)	(0.49)	(0.53)

Table continues on next page

	Model 1				Model 2	
	Ref: Consistent Childless				Ref: Late Switchers	
	Early Switchers	Late Switchers	High Fertility	Gradual	High Fertility	Gradual
Education at age 30						
Less than high school	−0.13	−0.28	−2.76*	1.54†	−2.48†	−1.27
	(0.59)	(0.83)	(1.27)	(0.85)	(1.28)	(0.99)
Some college	−0.60	−0.36	−0.40	−0.85†	−0.04	−0.49
	(0.37)	(0.46)	(0.55)	(0.48)	(0.56)	(0.49)
BA/BS	−0.37	−0.03	0.84	−0.32	0.86	−0.30
	(0.47)	(0.51)	(0.60)	(0.56)	(0.59)	0.53
Graduate	−0.20	0.08	1.30*	−0.11	1.22†	−0.19
	(0.48)	(0.58)	(0.61)	(0.62)	(0.62)	0.65
Employment status at age 30						
Unemployed	0.09	−1.21	−0.77	0.42	0.44	1.63†
	(0.63)	(0.79)	(0.89)	(0.79)	(1.03)	(0.89)
Not in the labor force	−0.91*	−2.27***	−0.95	−0.62	1.33†	1.65*
	(0.44)	(0.62)	(0.59)	(0.53)	(0.76)	(0.72)
Family income at age 30						
Quartile 1 (i.e. Lowest)	−0.89	−1.05†	−1.21†	−1.23†	−0.17	−0.18
	(0.51)	(0.56)	(0.66)	(0.71)	(0.67)	(0.72)
Quartile 2	−0.64	−0.43	−0.02	−0.56	0.41	−0.13
	(0.48)	(0.49)	(0.62)	(0.60)	(0.57)	(0.57)
Quartile 3	−0.00	−0.12	0.57	0.11	0.69	0.22
	(0.48)	(0.53)	(0.65)	(0.62)	(0.57)	(0.59)
Marital history						
Married after age 30	−0.03	−0.47	0.32	−0.09	0.78	0.38
	(0.38)	(0.51)	(0.57)	(0.49)	(0.57)	(0.54)
Never married	0.29	−0.92*	1.07†	0.64	1.98**	1.56**
	(0.41)	(0.49)	(0.63)	(0.59)	(0.60)	(0.60)
Experienced marital disruption	0.16	−0.73†	0.27	0.86†	1.00†	1.59**
	(0.34)	(0.42)	(0.53)	(0.46)	(0.52)	(0.46)
Ever had step-children	−0.17	−0.67	−0.16	0.71	0.51	1.38**
	(0.39)	(0.50)	(0.52)	(0.46)	(0.56)	(0.52)
Ever adopted	1.27	1.99**	1.07	2.08*	−0.92	0.09
	(0.84)	(0.84)	(1.07)	(0.91)	(0.81)	(0.64)
Ever reported miscarriage	0.12	0.47	1.22†	1.12*	0.75	0.65
	(0.44)	(0.46)	(0.64)	(0.50)	(0.60)	(0.49)
Ever sterilized	−0.13	−1.34†	0.43	−1.50*	1.77	−0.15
	(0.43)	(0.73)	(0.66)	(0.69)	(0.76)	(0.85)
Ever reported induced abortion	0.09	0.07	−1.40*	0.57	−1.47*	0.50
	(0.37)	(0.42)	(0.69)	(0.46)	(0.71)	(0.49)
Constant	0.75	1.48†	−2.55*	−1.85	−3.73**	−2.69*
	(0.71)	(0.81)	(1.09)	(1.16)	(1.09)	(1.13)

Note: $^{\dagger}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

And how do differences in women's responses to unintended pregnancies, which remain high in the US (Finer and Zolna 2016), contribute to eventual childlessness? Future research should consider multiple pathways into both childlessness and motherhood across the life course.

Third, I integrate several life course measures in my analysis that have not been fully considered in prior studies of childless women. The first of these includes the use of sterilization or abortion as means of mitigating reproductive vulnerability across the life course. I find that while these measures are not associated with *when* in the life course women expect childlessness, they do distinguish between women expecting childlessness later in the life course. In particular, women in the "High to None" cluster, who were more likely to hold Graduate degrees, were also more likely to become sterilized than the other two groups expecting childlessness at older ages. Further, I also consider how step- or adopted children may distinguish between or alter fertility expectation trajectories. While adoption may serve as a proxy for infertility, little research has investigated how childless women with step-children view their own biological childlessness. This is an important consideration given that 16% of childless women in my sample reported the presence of step-children in the household.

Fourth, this study adds to the growing body of literature examining the dynamic and uncertain nature of fertility intentions and expectations (Hayford 2009; Jones 2017). Few studies have used sequence analysis to demonstrate these complexities in detailed, visual displays. Furthermore, the analyses introduce a new measure of turbulence that captures wavering between expectations for children and expectations for childlessness. These turbulence values, displayed for each cluster in Figure 4, underscore the importance of ambivalence, context, or even measurement error in influencing expectation trajectories.

This study capitalizes on the recent completion of childbearing in the NLSY79 cohort to provide new perspectives on the diversity of childless women. While the fertility expectations of this cohort have been studied extensively, few have presented these expectations as sequences over the reproductive life span, and even fewer have considered how these trajectories might differ among permanently childless women. However, one central limitation of this study is that results may not be generalizable to other cohorts or contexts. Indeed, the shortcomings associated with cohort studies—namely, that they require long periods of observation to link life course processes with completed childbearing—appear unavoidable. Nevertheless, the study offers new insights and considerations for future research on childlessness in contemporary societies.

Chapter 3

Can I get pregnant? Understanding variation in women's perceived fecundity

Women's perceptions of their fecundity, or the reproductive capacity to reproduce, have received surprisingly little attention in scholarly literature. Given this lacuna, this chapter provides an in-depth investigation of perceived fecundity to reveal new insight into the correlates and potential drivers of subjective perceptions of personal risk. First, I propose a conceptual model of perceived fecundity that emphasizes the evaluation of perceptions as a process drawn from understudied contextual and individual-level influences. Second, I use data from the National Longitudinal Survey of Youth (NLSY) 1997 cohort to provide new, nationally representative estimates of perceived fecundity among young adult women aged 25-30. Finally, I draw from the proposed conceptual framework to examine predictors of and variation in perceived fecundity. Results show striking variation across a range of demographic, contextual, situational, and experiential factors and highlight the need for improved measures of perceptions and a deeper understanding of how women evaluate their reproductive potential.

3.1 Introduction

Demographers have long recognized that fertility patterns observed in populations are driven by both behavioral and biological determinants. Yet, most studies of contemporary fertility focus solely on the behavioral dimension, treating biology as a residual determinant, if mentioned at all.

However, there are several reasons to formally investigate the under-appreciated role that biology may play in population-level outcomes and individual-level decision-making. For one, larger numbers of women are delaying childbearing, placing many at the upper limits of biology. Secondly, there is emerging evidence that the uncertainty surrounding one's reproductive potential may influence life course pathways, such as the timing of marriage and childbearing (Schmidt 2008). And third, as conversations around reproductive technologies become more commonplace, individuals are increasingly exposed to messages about their biological clocks than they were decades ago. Despite this confluence of events, women's perceptions of their fecundity, or the reproductive capacity to reproduce, have received surprisingly little attention in scholarly literature.

This chapter provides an in-depth investigation of fecundity perceptions that has not been conducted elsewhere. First, I propose a conceptual model of perceived fecundity that emphasizes the evaluation of perceptions as a process drawn from understudied contextual and individual-level influences. Second, I use data from the National Longitudinal Survey of Youth (NLSY) 1997 cohort to provide new, nationally representative estimates of perceived fecundity among young adult women aged 25-30. Finally, I draw from the proposed conceptual framework to examine predictors of and variation in perceived fecundity. The paper concludes with a discussion of proposed directions for future research.

3.2 Theoretical Perspectives

To date, there is no unified conceptual framework describing women's perceptions of their biological capacity to reproduce. A close parallel, however, may be that of self-rated health, arguably the most common, standardized measure of subjective biological functioning (Idler and Benyamini 1997; Miilunpalo et al. 1997). In this section, I draw from Jylhä's (2009) widely-cited conceptual model of self-rated health to lay the foundation for investigating determinants of perceived infertility. In doing so, I develop a conceptual model of perceived fecundity that not only incorporates a health evaluation framework, but also accounts for inherent uncertainty of women's reproductive potential. As such, the model provides a deeper conceptualization of perceived fecundity that has not been fully described elsewhere.

Jylhä's (2009) model of self-rated health seeks to understand the biological, cultural, and social processes that "mediate information from the human organism to individual consciousness." While the central component of the model focuses on an individual-level evaluation of health status, the model importantly emphasizes the contextual frameworks in which the individual-level processes are embedded. The

adapted model of perceived fecundity, presented in Figure 3.1, echoes these multi-level influences. On the right-hand side, the individual-level evaluation is conceptualized as a flow across four steps or stages that largely mirror Jylhä's (2009) model. In the first step, for example, individuals may ask themselves: "What constitutes fecundity?" and "What are the relevant components of fecundity?" The second component of the model, represented by the horizontal arrows to the left of each step, displays how contextual factors feed into each stage. For example, there may be cultural differences in conceptions of fecundity or in how individuals evaluate the relative importance of fecundity indicators.

It should be noted here that while the model is conceptualized as a deliberate, multi-stage process, the actual elicitation of a perception in social surveys occurs over a very short time frame (usually a few seconds) and is likely to draw from much simpler tools or heuristics. Nevertheless, the model offers a broad overview of possible inputs that may influence perceptions. The following describes this evaluation process in more detail.

Step 1: What constitutes fecundity? In Jylhä's (2009) model of self-rated health, the first step of the evaluation process involves how individuals identify and assess components that constitute "health." While there is no universal definition of health, individuals are likely to draw from a shared set of indicators, such as medical diagnoses or bodily symptoms, that reflect commonly understood expressions or manifestations of well-being and impaired functioning.

Eliciting an evaluation of one's fecundity presents far more challenges in this regard. First, individual notions of fecundity may be complicated by confusing terminology or definitions. For example, the average person's grasp of the terms used to describe biological reproductive functioning is rudimentary, usually limited to an overarching term of "infertility." Even the definition of infertility, while codified in clinical or scholarly circles, varies across individuals and contexts (Greil et al. 2010). Moreover, the formal definition of fecundity itself—"the biological capacity to reproduce"—is a nuanced, abstract concept that can be conceptualized as on a continuum (i.e. high to low) or in absolute terms (i.e. fertile/infertile).

Second, fecundity remains largely unknown to individuals as they move across the reproductive life course. Outside of a live birth or recognized pregnancy, there are no measurable biomarkers akin to those often used in health assessments, such blood pressure or cholesterol levels. Instead, our best measure of fecundity, a live birth, tells us little about the underlying status that produced the outcome.

Although we have little knowledge of what fecundity components are considered by individuals (or even how these are considered), the first step in Figure 3.1 displays a list of possible indicators that individuals are likely to draw from. These indicators, drawn from prior studies and theory, include objective, experiential, or other

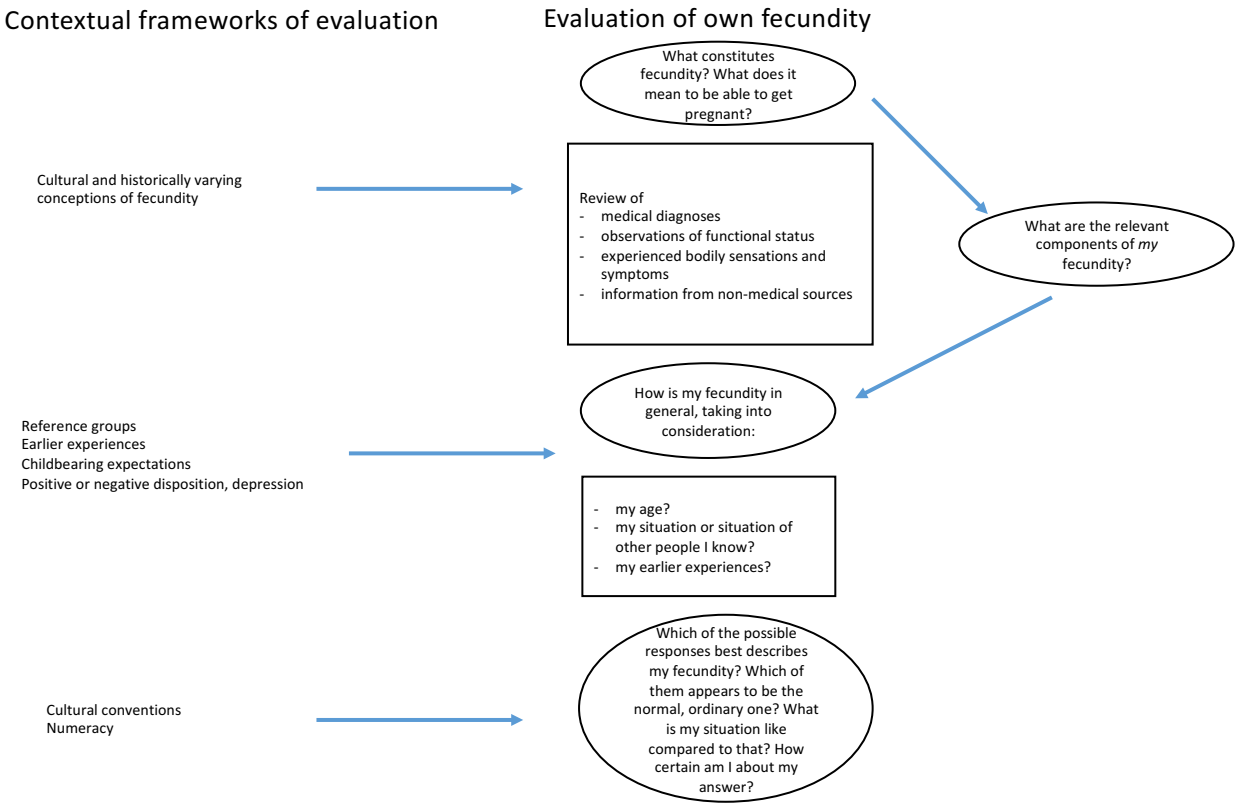

Figure 3.1: Conceptual model of perceived fecundity (adpated from Jylhä (2009)).

subjective measures. Objective measures include clinical diagnoses of infertility or sterility, or other diagnoses associated with impaired fecundity, such as polycystic ovary syndrome (PCOS), endometriosis, or amenorrhea. Experiential measures of fecundity may include the number of cycles it took to become pregnant or subjective assessments of long vs. short durations of pregnancy attempt. Women may also rely on personally observed indicators of reproductive functioning such as the regularity or severity of menstruation.

A woman's contextual framework (left side of Figure 3.1) should play a salient role in this first step of the evaluation process, since the sources of information women have been exposed to throughout the life course are strongly rooted in context. For example, women's identification of components may be influenced by their comfort with medical information, discussions of female biology within social networks, culturally varying conceptualizations of reproductive functioning, or even exposure to representations of fecundity portrayed in the popular press or media.

Step 2: Which components are relevant to me? After individuals have determined what constitutes their conceptualization of "fecundity," they consider how these components relate to their personal status (Step 2 of Figure 3.1). This in large part rests on an individual's personal recognition of fecundity indicators, some of which are conditional on reproductive behaviors. For example, fecundity may remain hidden or "silent" in women who use contraception, but may be "revealed" to women who actively try for pregnancy. Assessment of personal status might also be obscured by the degree to which fecundity has measurable effects on person's lives (White et al. 2006b). Whereas all individuals have personally experienced how health can impair basic functioning and everyday livelihood, fecundity primary impairs one outcome—reproduction. Furthermore, those who have no personal experiences from which to draw from may instead rely on inferential reasoning, such as using proxy indicators about a family member or peer's experience (Polis and Zabin 2012; Sandelowski et al. 1990).

Step 3: What is my fecundity in general? The next step of the model describes how individuals consider the components from the previous stages to develop a personal indicator based on their own situation or status. The processes underlying this stage are multi-dimensional and may draw upon an individuals reference groups, earlier experiences, expectations for the future, or personal disposition.

For example, one such process is how individuals "stack up" their experiences against the experiences of others. Thus, respondents must rely on their own individual yardstick and reference groups to conceptualize their status relative to other individuals or to some assumed objective truth.

Yet another process concerns women's current situations, including her age, partnership status, or intentions for children. Indeed, the cognitive-social model of fertil-

ity intentions posits that intentions do not become concrete until individuals move into situations that demand the formation of an actionable intentions (Bachrach and Morgan 2013). Thus, awareness or experiences of fecundity may have more salience for those schemas or identities more closely related to childbearing, such as marriage.

Lastly, this step also considers how interpersonal or psychosocial factors may influence the evaluation process. Perceptions of the future, positive or negative dispositions, optimism/pessimism, or fatalism may all exert influences in how women perceive their reproductive potential.

Step 4: Which possible responses best describes my fecundity? The final stage describes how the evaluation process must adapt to the researcher's measurement item(s). As such, this stage considers not only cultural conventions in responding to survey items, but also how the construction and content of questions may introduce bias. For example, previous studies assessing perceived fecundity have directly asked women if they believed they were "infertile" (Raine et al. 2003; Downs et al. 2004; Polis and Zabin 2012), but such assessments are likely influenced by highly contextual and varied lay interpretations of the term infertility, as alluded to above (Greil et al. 2011). Alternative measures, such as those asking women to focus on their underlying reproductive potential, might also suffer from measurement error, especially among women who have no desire to become pregnant.

Lastly, the type of measurement response (e.g. binary, ordinal, or ratio) may allow participants to account for a level of certainty in their assessment. For example, providing a "yes/no" response to a question measuring perceived fecundity is quite different than asking participants to rate their probability of conception on a scale.

3.3 Prior Research

Much of the prior literature on perceived fecundity can be categorized into two arms. The first concerns how women's perceptions relate to health-seeking behaviors for infertility services (e.g. White et al. 2006b), while the second examines how fecundity perceptions may influence contraceptive and other sexual behaviors (e.g. Polis and Zabin 2012).

There are few studies that have investigated the determinants of perceived fecundity in their own right. One exception comes from Polis and Zabin's (2012) work on perceived infertility among young unmarried women, which provides an initial description of why women may question their fecundity. In the survey instrument the authors use, women who stated they were at least slightly likely to be infertile were asked to provide up to three, non-mutually exclusive reasons for this belief: a doctor had informed them they were infertile or would have difficulty pregnant, they

had a female relative who was infertile, or they engaged in unprotected sex but had not become pregnant. The most common reason women gave was information from a doctor (41%), followed by not getting pregnant after unprotected sex (37%), and having an infertile relative (18%). Notably, one-third of the women chose none of these reasons. The authors also find that among those who cite information from a doctor as a reason, approximately 20% of them reported that they had never seen a medical provider for sexual health care, calling into question the validity of the measure.

In sum, few studies have provided a detailed examination of women's subjective perceptions of their biological capacity to reproduce. This paper begins to address this gap by using nationally representative data that include a perceived fecundity module.

3.4 Data and Methods

Data: Data are from the National Longitudinal Survey of Youth (NLSY) 1997 cohort, a panel survey of 8,984 males and females in the United States. Interviews were first conducted in 1997, when participants were aged 12 to 17; subsequent interviews were conducted annually until 2011, and then biennially thereafter.

Perceived fecundity: In 2009 (Round 13), the NLSY administered questions concerning women's experiences and perceptions of their biological capacity to reproduce. (Any respondents who were not interviewed in 2009 were asked these questions in 2010 or 2011.) Perceived fecundity was assessed via the following vignette: "The next [question is] about your biological ability to have a child. In answering [this question], please imagine that you wanted to have a child. Suppose you started to have unprotected intercourse today. What is the percent chance you would have a child within the next two years?" If a respondent stated that a child was not wanted within this time frame, the interviewer asked her to focus on her biological ability to have a child.

A brief discussion of this hypothetical measure is worth noting here. First, while women are not explicitly asked about their "fecundity," the measure incorporates the definition of fecundity in the vignette (i.e. their biological ability to have a child). Second, the objective probability of pregnancy after a year of unprotected intercourse is estimated to be 85%; thus, most women in the sample have a high biological likelihood of having a child within the two-year time frame. Lastly, by asking women to imagine that they wanted a child, the measure attempts to lessen potential non-biological influences in how women might answer the question.

Most participants provided numerical responses ranging from 0-100%, with higher values indicating higher perceived probability of having a child within two years; a small proportion of women (5%) provided a "don't know" response. I investigate perceived fecundity as both a continuous measure and a categorical one; in analyses involving the continuous measure, women stating "don't know" are dropped. I develop a three-part categorical measure of perceived fecundity based on (1) cut points derived from the probability distribution and (2) similar constructs used in prior literature (e.g. Polis and Zabin 2012). The resulting categories correspond to women perceiving themselves to be very likely to conceive (75-100% chance), somewhat likely (50-74% chance), and not as likely (<50% chance.)

Predictors. To best capture the constructs described in the proposed conceptual framework above, I draw upon a range of demographic, contextual, situational, experiential, health-related, and psychosocial measures that were collected in the survey. All covariates are measured in the same year as the measurement of fecundity perceptions unless noted otherwise.

Demographic and contextual factors. Demographic variables include age, race/ethnicity, and education. Although the age range of participants in my sample is narrow (i.e. 25-30), there could be important differences in fecundity perceptions by age, especially among those who are approaching 30. Age is coded as both a continuous and categorical variable, with categories corresponding to each year of age.

I also included measures of race/ethnicity and education. Race/ethnicity (measured in 1997) includes White, non-Hispanic Black, and Hispanic; the few respondents classified as mixed race were dropped from analysis (n=39). Education was coded as less than high school, high school degree, some college, and college degree or higher.

While both race/ethnicity and education serve as demographic predictors in the traditional sense, their complex relationships with a variety of health outcomes suggest that such measures also capture complex socio-cultural and structural influences that are not adequately measured in traditional surveys. For example, the relationship between education and perceived fecundity may be driven by not only differences in objective knowledge of biological functioning, but also by differences in how individual's perceive their futures or deal with uncertainty. Unfortunately, however, I am limited in my investigation of such pathways.

Contextual characteristics such as geographic location may be associated with normative differences in childbearing expectations and differential exposure to sex education content (Gold and Nash 2001), both of which may influence perceived fecundity. The contextual measures I use include urban/rural residence and region of residence (Northeast North Central, South, and West.) For the latter, measures

for smaller geographic areas, such as state or county, were not available for analysis.

Finally, I include two measures that capture economic and health-related resources. The first is a measure for household income poverty level, which measures respondents' household income ratio to the federal poverty line. For descriptive characteristics, I use a 5-part categorical variable (<100, 100-199, 200-299, 300-399, 400 or more) but in multivariate analyses use a continuous variables that is logged to reduce variation. The second measure, coded as a binary indicator variable, accounts for whether the respondent reported having any health insurance at the time of the survey (vs. none).

Situational factors. Women's perceptions of their fecundity may be influenced by their current relationships, sexual activity, childbearing history, and fertility intentions.

I use a combined measure of marital and cohabiting status to create four partnership categories: never married/not cohabiting, never married/cohabiting, currently married, and divorced/widowed/separated. Respondents were also asked if they engaged in any sexual intercourse in the past year; this is coded as a binary variable (any sex vs. no sex). I also use a categorical variable for parity (0, 1, 2, 3 or more biological children) because the relationship between parity and perceived fecundity may be nonlinear.

To account for differences in motivation for pregnancy, I include a direct measure of stated expectations for future children assessed via the following question: "Altogether, how many (more) children do you expect to have?" I code this as a binary variable indicating whether a respondent intends any children in the future or not. (Note: Throughout this paper, I use the terms expectations and intentions interchangeably. As Hayford (2009) notes, while the two are conceptually different, they appear to operate similarly in empirical studies.)

Experiential factors. Experienced subfecundity may influence the relationship between fecundity perceptions and contraceptive use. The NLSY-97 contains three measures of experienced subfecundity that I consider in analysis. The first, coded as a binary variable, indicates whether a respondent or her partner had received a doctor's diagnosis regarding fertility difficulties. The second measure is a binary variable indicating whether a respondent reported having multiple miscarriages or stillbirths. The third variable was derived from two questions asking if a respondent was unable to conceive a child after 6 or 12 months of unprotected intercourse in a row. I combine these measures into a three-part variable: no reported absence of conception after 6 or 12 months, absence of conception after 6 months of unprotected sex, but not 12 months, and absence of conception after 12 months of unprotected sex. Importantly, the last category, 12 or more months of unprotected intercourse in a row without conception, meets the criteria for a clinical diagnosis of infertility

(Zegers-Hochschild et al. 2009).

Health and psychosocial factors. Because the survey does not collect detailed information on reproductive disorders, such as polycystic ovary syndrome, I rely on a more general measure of self-rated health to account for a broad range health-related experiences that might influence perceived fecundity. Using self-rated health in my analysis also may account for other latent variables that influence subjective assessments of health outcomes.

I include a measure of psychological distress that was adapted from a 5-item version of the Mental Health Inventory (MHI-5; Berwick et al. 1991). The MHI-5 may correlate with other proposed, but unmeasured, predictors of perceived fecundity such as optimism and positive affect. Participants were asked to rate on a four-point scale how often they felt "nervous/calm and peaceful/down or blue/happy/depressed" over the previous month. Following Evans-Lacko et al. (2013) and Egan et al. (2016) I create a measure of distress from the summed score (Cronbach's α=0.75), classifying those above 1 standard deviation as experiencing high levels of distress.

I also use a measure of subjective well-being collected using the Cantril Self-Anchoring Scale (Cantril 1965). Participants are provided a picture of a ladder representing the "ladder of life," where the top rung represents the best possible life and the bottom rung represents the worst possible life. Participants were asked to provide which rung corresponds to their current life situation. The resulting variable is a continuous measure where higher values indicate higher life satisfaction.

Previous research has shown that risk preferences, assessed via hypothetical gambles of lifetime income, are associated with timing of marriage and fertility (Schmidt 2008). In particular, highly educated, risk tolerant women, are more likely to delay childbearing, perhaps because of fewer concerns of future infertility. The current analysis employs similar measures of risk aversion and tolerance as those used in the Panel Study of Income Dynamics (Schmidt 2008) and the Health and Retirement Study (Barsky et al. 1997). Women are coded in a four-part category ranging from least risk tolerant to most risk tolerant.

Poor numeracy. Finally, I employ a measure of financial literacy to control for numeracy, or the ability to understand and use numerical information. I do this to both control for the complexities of the perceived fecundity measure used as well as for potential difficulties with quantifying risk perceptions (Reyna et al. 2009). I use the first question in a set of financial literacy measures that were originally designed by Lusardi and Mitchell (2006, 2008) to measure knowledge of financial concepts in social surveys. The question is: "Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?" Possible responses include: more than $102, exactly $102, or less than $102. Those providing incorrect responses or

stating they do not know are coded as having lower numeracy.

Analytic sample: I limit my sample to women who provided either a numerical or "don't know" response to the perceived fecundity measure (n=3,901). Because sterilization alters women's underlying reproductive potential, women (or their partners) who are sterilized or become sterilized in the following year are excluded from analysis. I further exclude women who are currently pregnant to account for women's perceptions of potential subfecundity following birth, and exclude women who ever reported a same-sex partner, as homosexual women were assigned a value of "0%" during data collection. Lastly, women who are missing responses on any of the experienced subfecundity measures are also excluded. The final sample comprises 3,181 women.

Statistical analysis. I use ordinary least squares (OLS) models to predict how a one-unit change in a predictor variable is associated with a one-percentage point change in the state probability of having a child within two years.

Because heaping is evident in the dependent variable, I also investigate differences in who provides a response of 0%, 50%, or 100%. Responses of 0% or 100%, for example, may convey absolute certainty, while a response of 50% could convey absolute ambivalence. I create binary indicators for each (i.e. 0% vs. else) and use logistic regression models to predict the odds of stating 0, 50, or 100%. Because "don't know" responses offer yet another way for participants to convey uncertainty, I similarly predict the odds of a respondent stating "don't know" versus a numeric response.

I use multiple imputation by chained equations to impute missing values of control variables (Royston & White 2011), and all models use survey weights to account for complex sampling design.

3.5 Results

3.5.1 Descriptive results

Figure 3.1 displays the distribution of responses assessing the hypothetical probability of having a child within two years among the 3,022 members of the sample who provided a numeric value. Close to two-thirds of the sample (62%) provided a response of 75% or more, while 14% provided a probability ranging from 50 to 74%. Close to 1 in 5 women (18%) provided a probability less than 50%, while the remainder (5%) provided a don't know response. Heaping of numeric values is also evident in the figure; 12% say a 0% chance, another 12% say 50% and 43% say 100%.

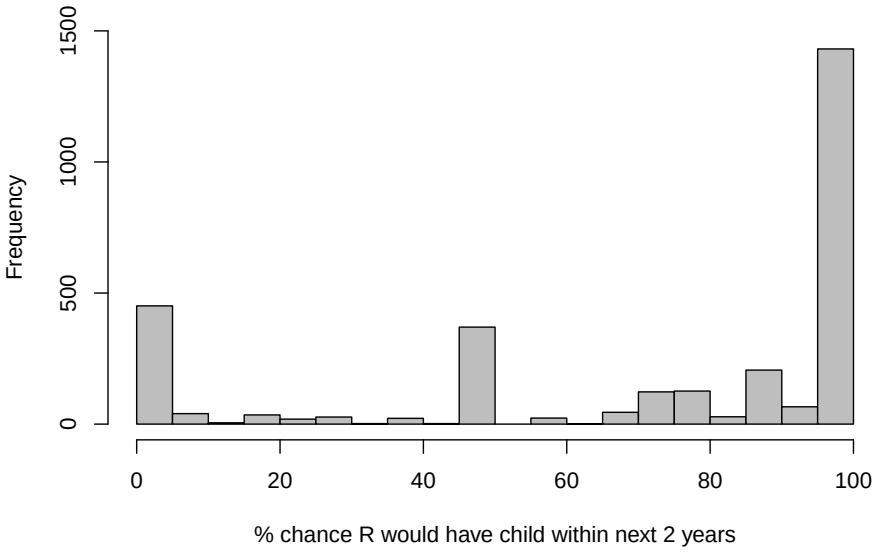

Figure 3.2: Distribution of responses, n=3,022.

Table 3.1 provides further description of the perceived fecundity measure for the entire sample and by respondent characteristics. The table presents means and standard deviations of perceived fecundity among those providing numerical responses, as well as the percent distribution across four categories of perceived fecundity (i.e. <50%, 50-74%, 75-100%, and "don't know") among the entire sample.

At the bivariate level, stark differences in perceived fecundity emerge. In addition to the descriptive statistics provided in Table 3.1, these differences are graphically displayed for a subset of characteristics. Figure 3.2 presents boxplots of the distribution of perceived fecundity, where higher values correspond to greater perceived likelihood of a hypothetical pregnancy.

Differences by race/ethnicity and education are displayed in the top two panels of the figure. The average probabilities provided by Black and Hispanic women were 15 and 8 percentage points lower than White women, respectively. This difference is further evidenced by the proportion of women in each group who rate their fecundity low: 27% of Black women and 22% of Hispanic women rate their probability of conception as not as likely (i.e. <50%) compared to only 13% among Whites.

There is also a strong educational gradient associated with perceived fecundity, such that the mean probability stated among college women is nearly 30 percentage

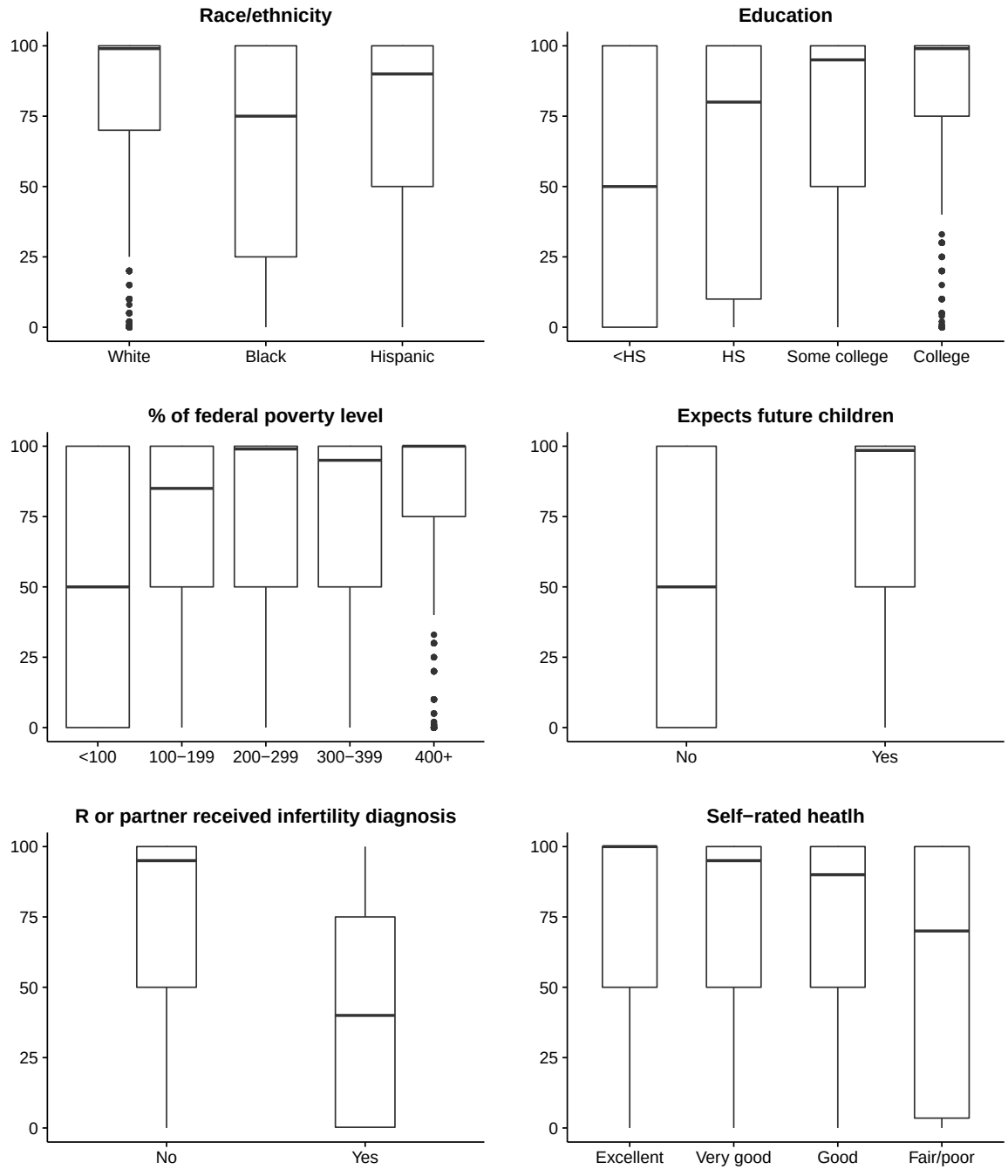

Figure 3.3: Boxplots of fecundity perceptions, by selected characteristics, n=3,022.

Table 3.1: Descriptive statistics for the sample (n=3,181).

Measure	Full sample	Mean (SD)	Distribution by: Perceived likelihood of future pregnancy <50%	50-74%	75-100%	"Don't know"	p-value
Entire sample	3,181	71.7 (0.7)	0.18	0.14	0.62	0.05	
Race/ethnicity							<.001
White	1,608	77.7 (0.9)	0.13	0.12	0.69	0.06	
Black	874	62.7 (1.4)	0.27	0.19	0.52	0.03	
Hispanic	699	69.6 (1.5)	0.22	0.13	0.61	0.04	
Education							<.001
Less than high school	274	54.1 (2.7)	0.35	0.20	0.41	0.05	
High school graduate	709	61.8 (1.7)	0.29	0.15	0.63	0.04	
Some college	1,242	72.7 (1.1)	0.18	0.15	0.63	0.04	
College graduate	937	83.6 (0.9)	0.08	0.11	0.76	0.06	
Region							<.001
Northeast	495	75.2 (1.8)	0.16	0.12	0.65	0.07	
North central	630	71.7 (1.5)	0.19	0.15	0.62	0.04	
South	1,305	67.9 (1.1)	0.22	0.16	0.58	0.04	
West	726	76.1 (1.4)	0.16	0.10	0.69	0.05	
Residence							0.12
Rural	476	69.3 (1.9)	0.22	0.12	0.60	0.06	
Urban/other	2,675	72.1 (0.8)	0.18	0.14	0.63	0.05	
Any health insurance							<.001
No	824	66.2 (1.5)	0.23	0.16	0.56	0.05	
Yes	2,356	73.6 (0.8)	0.17	0.13	0.65	0.04	
% of federal poverty level							<.001
<100	549	56.2 (1.9)	0.35	0.17	0.45	0.03	
100-199	515	68.2 (1.7)	0.20	0.18	0.58	0.05	
200-299	460	73.8 (1.8)	0.17	0.13	0.66	0.04	
300-399	392	75.3 (1.8)	0.16	0.12	0.68	0.04	
400 or more	890	81.5 (1.1)	0.10	0.12	0.73	0.05	
Low numeracy							0.09
No	2,253	73.4 (0.8)	0.17	0.15	0.64	0.05	
Yes	470	69.1 (1.9)	0.22	0.13	0.61	0.04	
Partnership status							<.001
Never married, not cohabiting	1,355	68.6 (1.1)	0.20	0.17	0.56	0.06	
Never married, cohabiting	568	73.3 (1.7)	0.19	0.10	0.66	0.04	
Married	1,023	76.0 (1.2)	0.15	0.13	0.69	0.03	
Divorced/widowed/separated	227	66.0 (2.9)	0.27	0.12	0.58	0.03	

Table continues on next page

Measure	Full sample	Mean (SD)	Distribution by: Perceived likelihood of future pregnancy <50%	50-74%	75-100%	"Don't know"	p-value
Parity							<.001
0	1,456	75.6 (0.9)	0.14	0.15	0.64	0.08	
1	710	77.1 (1.3)	0.13	0.15	0.69	0.03	
2	610	67.7 (1.7)	0.25	0.12	0.61	0.02	
3	403	55.4 (2.3)	0.38	0.13	0.49	0.01	
Expects at least one future child							<.001
No	794	53.9 (1.7)	0.38	0.12	0.47	0.03	
Yes	2,386	77.7 (0.7)	0.12	0.15	0.68	0.05	
Any sex in last year							<.001
No	479	60.4 (2.0)	0.28	0.18	0.48	0.06	
Yes	2,624	73.7 (0.7)	0.17	0.13	0.65	0.04	
Ever received a diagnosis of infertility							<.001
No	3,050	73.3 (0.7)	0.17	0.14	0.64	0.05	
Yes	131	39.3 (3.3)	0.51	0.21	0.24	0.04	
Reported multiple miscarriages or stillbirths							<.01
No	3,066	72.1 (0.7)	0.18	0.14	0.63	0.05	
Yes	115	60.2 (4.1)	0.30	0.18	0.48	0.03	
Absence of conception							<.001
None reported	2,158	76.9 (0.8)	0.14	0.12	0.68	0.05	
After 6 months of unprotected sex (but less than 12 months)	208	70.8 (2.6)	0.20	0.15	0.63	0.02	
After 12 months of unprotected sex	815	58.8 (1.5)	0.30	0.19	0.48	0.04	
Self-rated health							<.01
Excellent	675	78.0 (1.4)	0.14	0.11	0.70	0.05	
Very good	1,202	76.4 (1.0)	0.14	0.13	0.67	0.06	
Good	964	67.7 (1.3)	0.22	0.16	0.59	0.03	
Fair/poor	339	57.0 (2.4)	0.33	0.17	0.46	0.04	
Distress							<.001
No	2,347	74.0 (0.8)	0.17	0.14	0.65	0.04	
Yes	630	65.5 (1.7)	0.25	0.16	0.55	0.05	

points higher than that provided by women with less than a high school education. Moreover, around one-third of women with lower levels of education rate their fecundity as low, compared to only 8% of college-educated women. Poverty level shows a similar positive gradient with perceived fecundity; those living in households less than 100% of the federal poverty level rated their fecundity 25 percentage point lower, on average, than those living at or above 400%.

Expectations or intentions to have children in the future are also a key correlate of fecundity perceptions in the sample. More than two-thirds of women (38%) who expect no more children rate their fecundity as low (i.e. <50%) compared to only 12% among those who expect future children. Because this relationship is at the bivariate level, it is unclear if some of this relationship may be driven by women who report no expectations for children after experiencing difficulties becoming pregnant.

Not surprisingly, ever receiving a diagnosis of infertility is significantly related to women's fecundity perceptions, as shown at the bottom of Figure 3.2. Self-rated health also emerges as a significant correlate at the bivariate level, with women rating their health as fair or poor reporting fecundity perceptions that are 20 percentage points lower, on average, than those rating their health as excellent or very good.

Among the remaining predictors, nearly all, with the exception of urban/rural residence, low numeracy, risk tolerance, and subjective well-being, were associated with perceived fecundity at the bivariate level (Table 3.1).

3.5.2 Multivariate results

Table 3.2 presents coefficients from five separate OLS models. To approximate the first stage of the conceptual model presented in Figure 3.1, I first model the relationship between demographic and contextual factors with perceived fecundity, since these likely have the strongest influence on how women define and identify components of fecundity. I also control for numeracy in all models to account for potential differences in how individuals understand and report ratio concepts. In this first model, all demographic and contextual predicators are significantly related to women's reported perceptions. For example, age is negatively related to perceived fecundity, such that each year increase in age is associated with a 2.4 percentage point reduction. Furthermore, after controlling for education and other factors, Black women, but not Hispanic women, are more likely to perceive their fecundity as lower (β=-6.7). The educational gradient observed in the bivariate results also persists after adjusting for other covariates, as does the gradient for poverty level.

The next set of models (Models 2-4) are a series of nested models that attempt to investigate the salience of three different sets of factors akin to those described in the first three stages of the conceptual model: situational, experiential, and

Table 3.2: Coefficients for perceived fecundity (n=3,022).

Independent Variables	**Model 1** Demographic and contextual factors	**Model 2** Model 1 + situational factors	**Model 3** Model 1 + experiential factors	**Model 4** Model 1 + health/psycho-social factors	**Model 5** Full model
Age (years)	-2.4^{***}	-1.3^{**}	-2.0^{***}	-2.3^{***}	-1.0^{*}
Race/ethnicity (ref: White)					
Black	-6.7^{***}	-5.5^{**}	-7.1^{***}	-6.1^{***}	-4.0^{*}
Hispanic	-1.7	-2.1	-2.0	-1.4	-1.9
Education (ref: High school graduate)					
Less than high school	-6.8^{*}	-6.3^{*}	-4.7	-5.8^{*}	-3.1
Some college	7.7^{***}	4.6^{*}	7.1^{***}	7.2^{***}	3.6^{*}
College graduate	16.1^{***}	11.0^{***}	12.9^{***}	14.2^{***}	6.3^{**}
Region (ref: Northeast)					
Northcentral	-3.9	-3.6	-3.3	-4.1	-3.1
South	-5.3^{**}	-4.3^{*}	-5.2^{**}	-5.3^{**}	-4.3^{*}
West	0.4	1.0	-0.3	0.1	0.3
Urban (ref: Rural)	3.3^{*}	2.9^{*}	3.4^{**}	3.0^{*}	2.8^{*}
Any health insurance (ref: No)	3.3^{*}	2.6	3.1^{*}	2.9	2.0
Poverty level (logged)	3.6^{***}	1.7^{*}	4.3^{***}	3.2^{***}	1.5^{*}
Poor numeracy	-1.8	-0.7	-2.5	-1.7	-1.2
Partnership status (ref: Never married, not cohabiting)					
Never married, cohabiting		1.2			4.2^{*}
Married		2.2			6.1^{***}
Divorced/widowed/separated		-2.5			1.2
Parity (ref: 1 child)					
0		-7.3^{***}			-6.1^{***}
2		-4.7^{***}			-6.7^{***}
3 or more		-10.2^{***}			-13.9^{***}
Intends more children (Ref: No)		22.8^{***}			20.8^{***}
Any sex in last year (Ref: No)		6.4^{**}			9.5^{***}
Ever received a diagnosis of infertility (Ref: No)			-27.9^{***}		-29.2^{***}
Reported multiple miscarriages or stillbirths (Ref: No)			-3.8		-5.0
Absence of conception (ref: None reported)					
After 6 months of unproected sex (but less than 12 months)			-0.9		-3.6
After 12 months unprotected sex			-13.7^{***}		-14.1^{***}
Self-rated health (ref: Excellent)					
Very good				-1.4	-1.1
Good				-5.1^{**}	2.4
Fair/poor				-12.5^{***}	-9.5^{***}
Distress (Ref: No)				-3.1	-2.5
Risk aversion (ref: Least risk tolerant)					
Less risk tolerant				0.4	-1.3
More risk tolerant				0.8	-0.8
Most risk tolerant				3.2	4.1^{*}
"Ladder of life" position				0.3	0.1

Note: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

health/psychosocial. The predictors used in Model 1 are retained to account for the diffuse role of demographic and contextual factors in influencing how women experience, interpret, or identify components of fecundity or how women conceptualize fecundity. For example, Model 2 displays the relationship between four situational predictors (i.e. partnership status, parity, intention for more children, and recent sexual activity) and perceived fecundity controlling for demographic and contextual factors, as well as numeracy. Results from the model indicate that with the exception of partnership status, situational factors related to sexual activity and childbearing are important predictors of perceived fecundity. Most notably, women who expect more children are more likely to rate their fecundity higher (β=22.8) than women who do not. In addition, compared to women who have 1 child, women with no children and women with two or more children were also likely to state lower probabilities of hypothetical pregnancy. Lastly, women who had engaged in sexual intercourse had higher average ratings of perceived fecundity than those who did not (β=6.4).

Model 3 investigates predictors related to experienced subfecundity, controlling for demographic and contextual factors. As expected, ever receiving a diagnosis of infertility is significantly associated with lower perceived fecundity (β=-27.9). Although experiencing multiple miscarriages or stillbirths is not independently associated with perceptions after adjusting for an infertility diagnosis, absence of conception following 12 months is independently associated.

Model 4 adds a series of predictors that include self-rated health and psychosocial measures. Interestingly, none of the psychosocial measures available for analysis, such as subjective well-being or high emotional distress, appear to be independently associated with perceived fecundity. Conversely, self-rated health is significantly associated with perceived fecundity.

Finally, Model 5 presents the full model containing all available predictors. Because many of the factors selected in Models 2-4 may be correlated, this model teases out the independent significance of each factor while holding all other factors constant. For the most part, associations found in the previous models are held in the full model, although several associations, such as those for race/ethnicity and education, become attenuated. There are several exceptions though. For example, whereas partnership status is not significantly related to fertility perceptions in Model 2, differences between married, cohabiting, and non-cohabiting women emerge in Model 5, such that non-cohabiting women are more likely to rate their fecundity as lower. Another difference relates to women's risk tolerance, with women in the most risk tolerant category rating their fecundity significantly higher than those in the least risk tolerant category.

Table 3.3 presents results from multivariate models that investigate the likelihood of respondents providing a response of 0%, 50%, 100%, or "don't know". All models

control for the full set of predictors displayed in Model 5 of Table 3.2. The first model, Model 1, presents results for the odds of stating 0% versus providing any other response. In this model, women with a high school degree are much more likely to state 0% than women with at least a bachelor's degree. Poor numeracy is also associated with stating 0%, even after controlling for education and other factors, suggesting that a response of 0, rather than another numeric value, has a tangible meaning for those who may have difficulty understanding and processing ratio concepts. Urban women and women with higher incomes had significantly lower odds of stating 0.

A 0% response is heavily influenced by situational factors. Both single women and women with 2 or more children had higher odds of stating 0, as did women who expected no (more) children in the future and women who did not engage in sexual activity in the last year. Experiential factors matter as well. A diagnosis of infertility, previous experience of multiple miscarriages or stillbirths, and absence of conception after 12 months of unprotected sex were all independently associated with higher odds of a 0% response. Lastly, while a measure of distress was not significantly related to fecundity perceptions in any of the models presented in Table 3.2, distress was associated with higher odds of stating 0% versus all other possible responses.

Model 2 in Table 3.3 presents odds ratios for stating 50%, which may adequately reflect women's uncertainty in underlying fecundity. As with Model 1, women with college degrees had lower odds of stating 50% compared to women with a high school education. No other demographic or contextual variables were associated with stating 50%. Model 2, however, highlights a potential key difference between unmarried women, such that those who are not cohabiting have higher odds of stating 50% than those who are currently cohabiting. Lastly, women who experience an absence of conception after 12 months of unprotected sex also have higher odds of stating 50%.

The next model, Model 3, investigates factors associated with higher odds of stating 100%. As a reminder, almost half of all women in the sample (43%) provide this response. Demographic factors associated with higher odds include having some college (vs. high school graduates), living in the South (vs. Northeast), and poverty level. Compared to single women, married women were more likely to state 100%, as were women with one child (vs. no children). Intending more children was also independently associated with higher odds of stating 100%. Not surprisingly, experiential factors, such including a diagnosis of infertility and 12-month conception delay, were associated with reduced odds. Lastly, women who rated their health as excellent were more likely to state 100% as were women who were classified as most risk tolerant.

Finally, Model 4 investigates the likelihood of providing a "don't know" response

versus a numeric response. White women had higher odds of saying "don't know" compared to Black women, while women living in urban areas were less likely to say "don't know" compared to those in rural areas. Finally, childless women had more than double the odds of saying "don't know" compared to mothers.

3.6 Discussion

In this sample of young women aged 25-29, a majority of women (62%) believe their likelihood of future conception is fairly high (i.e. 75% of greater), while nearly 1 in 5 women (18%) perceive their chances as conceiving as low (<50%). Importantly, results show stark class differences in these perceptions; both Black and Hispanic women, less educated women, and poorer women were more likely to perceive their fecundity as low compared to their more advantaged counterparts. With the exception of Hispanic women, these relationships persisted after controlling for a range of predictors, including self-rated health, partnership status, and intention for future children. Thus, questions remain as to what may be driving differences in fecundity perceptions between more advantaged and less advantaged populations and should be a priority area for future research.

The significant variation of perceived fecundity between women may be linked with a range of socio-demographic outcomes, although this remains understudied. However, previous literature has shown that perceived infertility is strongly related to infertility treatment seeking (White et al. 2006a) and contraceptive use behaviors (Raine et al. 2003; Downs et al. 2004). Future research should explore how fecundity perceptions influence other life course domains, including partnership, labor force participation, and timing of childbearing.

This paper offers an initial conceptual framework for describing the potential inputs and processes underlying the elicitation of a fecundity perception. The framework is grounded in Jylhä's model of self-rated health, but makes important distinctions with respect to women's reproductive potential and fecundity's culturally significant ties to motherhood and reproduction. Despite the model's usefulness as a way to think about how women perceive their reproductive potential, it may be insufficient to adequately describe the way individuals respond to survey questions about perceived biological functioning.

Another limitation with the proposed conceptual model is that it assumes that the evaluation process is a deliberate, linear flow across distinct stages or steps. However, the likelihood that all women engage in such a complex, multi-staged process is low, especially when participants face time and cognitive constraints during large-scale, survey interviews. Thus, a detailed evaluation of the cognitive processes and inputs

Table 3.3: Odds ratios for stating 0%, 50%, 100% or "don't know" (n=3,181).

Independent Variables	**Model 1** Stating 0% OR	**Model 2** Stating 50% OR	**Model 3** Stating 100% OR	**Model 4** Stating "don't know" OR
Age (years)	1.07	0.96	0.97	1.04
Race/ethnicity (ref: White)				
Black	1.49	1.41	0.82	0.49*
Hispanic	1.11	1.16	0.96	1.02
Education (ref: High school graduate)				
Less than high school	0.61	1.14	0.95	2.18
Some college	0.89	0.82	1.37*	1.09
College graduate	0.42**	0.58*	1.29	1.06
Region (ref: Northeast)				
Northcentral	0.68	1.16	0.79	0.95
South	0.82	1.46	0.74*	0.86
West	0.86	0.86	0.88	0.79
Urban (ref: Rural)	0.70*	0.93	0.97	0.56*
Any health insurance (ref: No)	0.88	0.90	1.04	0.92
Poverty level (logged)	0.85*	0.97	1.11*	0.95
Poor numeracy	1.70**	0.89	0.90	1.12
Partnership status (ref: Never married, not cohabiting)				
Never married, cohabiting	0.68	0.60*	1.31	0.66
Married	0.51**	0.84	1.42**	0.66
Divorced/widowed/separated	1.11	0.74	1.30	0.63
Parity (ref: 1 child)				
0	1.30	1.11	0.62***	2.78**
2	2.59***	0.72	0.97	0.47
3 or more	3.78***	0.74	0.78	0.22
Intends more children (Ref: No)	0.21***	1.19	1.42**	0.73
Any sex in last year (Ref: No)	0.48**	0.73	1.36*	1.04
Ever received a diagnosis of infertility (Ref: No)	3.31***	1.30	0.17***	0.43
Reported multiple miscarriages or stillbirths (Ref: No)	2.42*	0.97	0.84	1.52
Absence of conception (ref: None reported)				
After 6 months of unproected sex (but less than 12 months)	1.23	1.32	0.73	0.51
After 12 months unprotected sex	2.91***	1.87***	0.58***	1.07
Self-rated health (ref: Excellent)				
Very good	1.08	1.06	0.71***	1.25
Good	1.17	1.16	0.76	0.76
Fair/poor	1.30	1.33	0.66*	1.00
Distress (Ref: No)	1.55*	0.98	0.96	1.66
Risk aversion (ref: Least risk tolerant)				
Less risk tolerant	1.23	0.81	0.82	0.94
More risk tolerant	1.64	0.70	1.11	0.90
Most risk tolerant	0.53	0.87	1.38*	1.66
"Ladder of life" position	1.07	0.98	0.99	1.06

Note: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

that influence a perception is warranted, as these may more closely predict intentions and behaviors.

This study employs a novel assessment of perceived fecundity that differs from measures used in prior research. Instead of directly asking women if they believe they are infertile, women are asked to gauge the probability of having a future child based on their biological ability. The resulting continuous response (i.e. 0-100%) offers greater granularity with which to investigate perceptions and may detect beliefs about fecundity that are less extreme than infertility. Nevertheless, measurement error is likely. For example, women who are divorced and women expecting no more children were more likely to rate their fecundity as low, possibly owing to stronger influences from situational factors or uncertainty. Moreover, the wording of the question uses the term "child,"' rather than pregnancy, thereby reframing the measure from a biological one to one embedded in culture and context. Finally, the vignette does not explicitly state that exposure to sex be continuous or regular over the hypothetical two-year period; this omission may also influence responses if women have different experiences or expectations around coital frequency.

Given the limitations noted above, future research is needed to develop a measure (or measures) of perceived fecundity that can be used across diverse populations and contexts. Doing so would allow investigators to incorporate measures into standard social surveys and provide the opportunity to further investigate differences and similarities in how women view their reproductive potential.

Chapter 4

I can't get pregnant anyway: Perceived fecundity and contraceptive use

In the United States, more than half (54%) of unintended pregnancies occur to women who do not use contraception or have long gaps in use. Prior research suggests that one reason women do not use contraception is because they perceive themselves to be infertile or have difficulty becoming pregnant (i.e. subfecund) and thus, at low risk of pregnancy. These beliefs, however, may provide a false sense of protection from unintended pregnancy if they are not medically accurate. To the author's knowledge, no nationally representative studies have demonstrated a link between perceived subfecundity and contraceptive use, and none have accounted for reasons underlying subfecundity perceptions. Using data from the National Longitudinal Survey of Youth-1997 cohort, a large, nationally representative survey of young adults, I demonstrate that women with low perceived fecundity have higher odds of non-use of contraception. Further, these results persist after controlling for either a medical diagnosis of infertility or absence of pregnancy following at least 6 months of unprotected sex, suggesting that fecundity risk perceptions often operate independently of experienced subfecundity.

4.1 Introduction

Reduction of unintended pregnancy remains a key public health priority in the United States, as rates have remained persistently high over the span of several decades (Finer and Zolna 2016). A substantial proportion of these unintended pregnancies

(54%) occur to women who do not use contraception or have long gaps in use (Sonfield et al. 2014), highlighting the continued importance of identifying determinants of contraceptive behavior.

Although there are myriad reasons women wishing to avoid pregnancy may not use contraception (Jaccard 2009; Mosher et al. 2015), an emerging body of research underscores how women's perceptions of their susceptibility to pregnancy may interact with intentions to use contraception (Frohwirth et al. 2013). Some of these perceptions appear to stem from women's own understanding of their biological capacity to become pregnant or give birth (i.e. their fecundity) (Downs et al. 2004, Moore et al. 2011, Frohwirth et al. 2013). That is, women may not use contraception because they perceive themselves to be infertile or have difficulty conceiving and thus, at low risk of pregnancy.

These beliefs, however, may provide a false sense of protection from unintended pregnancy if they are not medically accurate. Indeed, nationally representative data indicate that a larger share of young women perceive themselves to have difficulty conceiving than is based in reality (Polis and Zabin 2012; Chandra et al. 2013). Polis and Zabin (2012), for example, find that approximately 60% of women aged 18-29 believe themselves to be "very likely" or "slightly likely" infertile. The estimated proportion of women of the same age group experiencing infertility, however, is much smaller; only 6% of women aged 15-24 and 14% of women aged 25-29 are estimated to have impaired fecundity (Chandra et al. 2013).

The reasons for this apparent discrepancy between women's perceptions and reality are not well understood. On the one hand, women may rely on valid indicators of reproductive functioning to inform their perception. These may include not only a medical diagnosis of infertility (Polis and Zabin 2012), but also age (Lundsberg et al. 2014), characteristics of menstrual cycles (Lundsberg et al. 2014), or diagnoses of other medical conditions that are associated with impaired fertility, such as polycystic ovary syndrome or endometriosis (Trent et al. 2003; Jones et al. 2004).

On the other hand, women's evaluation of their fecundity may, for various reasons, draw from sources that are not necessarily indicative of their own reproductive functioning. One common misperception, for example, is that women may view absence of pregnancy after unprotected sex as evidence that she might have problems getting pregnant (Moore et al. 2011, Polis and Zabin 2012, Biggs et al. 2012). Other indicators leading to erroneous beliefs might include knowledge of fertility problems in peers (Sandelowski 1990), having had prior abortions (Moore et al. 2011), or a general misunderstanding of population-level risks of infertility (Biggs et al. 2012, Foster et al. 2012, Biggs and Foster 2013).

Research investigating the extent to how these and other factors may inform women's perceptions is limited. However, Polis and Zabin's (2012) work on perceived

infertility among young unmarried women provides an initial description of why women may question their fecundity. In the survey instrument the authors use, women who stated they were at least slightly likely to be infertile were asked to provide up to three, non-mutually exclusive reasons for this belief: a doctor had informed them they were infertile or would have difficulty pregnant, they had a female relative who was infertile, or they engaged in unprotected sex but had not become pregnant. The most common reason women gave was information from a doctor (41%), followed by not getting pregnant after unprotected sex (37%), and having an infertile relative (18%). Notably, one-third of the women chose none of these reasons. The authors also find that among those who cite information from a doctor as a reason, approximately 20% of them reported that they had never seen a medical provider for sexual health care, calling into question the validity of the measure.

Taken together, the research reviewed thus far suggests that women may base perceptions of their fecundity on both clinically relevant experiences and faulty inferences, with the latter possibly due to misinformation about the determinants of fecundity and objective pregnancy risks. A key question stemming from this work, however, is how women's fecundity perceptions influence their contraceptive use and risk of unintended pregnancy. Much literature finds, for example, that women with *experienced* subfecundity, such as a diagnosis of infertility or having had a hysterectomy, do indeed have higher odds of non-use of contraception (Mosher et al. 2015), likely owing to their medically based assessments of pregnancy risk. Whether this same reasoning might also operate among women who incorrectly think they have trouble conceiving remains an open question.

4.2 Prior Research

To date, the role of fecundity perceptions on contraceptive use has not been extensively examined in the literature, and most existing studies have relied on small, non-representative samples. Nevertheless, several studies suggest that perceived subfecundity is associated with contraceptive use behaviors. Raine et al. (2003), in a sample of women aged 15-24, show that women who believed they were infertile were less likely to use any contraception at last intercourse. Likewise, a study of adolescent women aged 14-18 (n=300) finds that women with perceived infertility were less likely to use condoms, thereby increasing their risk of STI acquisition (Downs et al. 2004). Importantly, both studies did not clarify if perceptions of infertility were based on medical information.

These findings have been echoed in qualitative work as well. Frohwirth et al.

(2013), in their study of abortion patients, identify perceived subfecundity as a prominent reason why women in their sample did not use contraception at the time their unintended pregnancy occurred. Moreover, Reed et al. (2014), in their study of young women attending community colleges, find that doubts about one's fecundity led some women to forgo contraceptive use.

More generally, beliefs about one's fertility have been also been linked with contraceptive practices. Among a sample of family planning clients who engaged in unprotected intercourse in the past three months, nearly one-third of respondents cited various fecundity-related beliefs as reasons why they did not use contraception (Biggs et al. 2012). The most common of these was that women doubted their ability to get pregnant because they did not become pregnant after prior unprotected sex (20%). Other reasons included beliefs that she was infertile (5%), that her partner could not get her pregnant (3%), or that she was either too old or too young to get pregnant (3%).

One important exception in this small literature, however, comes from the Polis and Zabin (2012) study mentioned above. Drawing from a large, nationally representative survey of unmarried men and women aged 18-29 (n=1,800), they find no association between women's perceived infertility with either recent contraceptive use (i.e. past month) or expectations to have sex without a contraceptive in the next three months. The authors note, however, that their analysis among a smaller subsample of women in relationships (n=255-328) may have had inadequate statistical power to detect an association. Interestingly, though, they find a relationship between *men's* perceived infertility and expected future contraceptive use.

In sum, the studies reviewed above are inclusive about the salience of perceived subfecundity as a key determinant of contraceptive behavior and unintended pregnancy. Nevertheless, there are several inadequacies with the existing literature that may account for the lack of convergence across studies. First, with the exception of Biggs et al. (2012), none of the studies reviewed above accounted for reasons for subfecundity beliefs in their analysis of contraceptive use. Accounting for such reasons has important implications for unintended pregnancy risk. It's possible, for example, that observed associations between perceived subfecundity and contraceptive use may be driven by women who have a medical indication for their infertility beliefs, and are therefore at low risk of unintended pregnancy.

Second, three of the studies reviewed above employ a measure of perceived subfecundity that asks women if they believe themselves to be (or their likelihood of being) "infertile" (Raine et al. 2003, Downs et al. 2004, Polis and Zabin 2012). Importantly, however, lay interpretations of the term infertility are highly contextual and varied (Greil et al. 2011). Moreover, "infertility" may be viewed by some women as a more extreme case of subfecundity than other indications (White et al. 2006a).

This may explain why in the Polis and Zabin paper, (2012) a larger proportion of women believed themselves to be slightly likely, rather than very likely, infertile (41 vs. 19%).

Third, existing studies either have limited generalizability due to their reliance on non-representative samples or, in the case of the nationally representative study, potentially lack adequate statistical power to detect an association between perceived subfecundity and contraceptive use behavior.

A final limitation in the literature is that previous studies are not able to distinguish between non-use of contraception and inconsistent use. Theory would suggest that non-use would be the most relevant outcome, as women's beliefs about their fecundity and pregnancy risk are likely to be static over the course of several months. However, because little is known about how fecundity perceptions form and change, it is possible that perceived subfecundity could influence inconsistent use of contraception as well.

This paper addresses these limitations in the following ways. First, I use data from a large, nationally representative, longitudinal study to examine how women's fecundity perceptions are associated with future contraceptive use behavior among a sample of sexually active females aged 25-30. Second, my analysis includes a novel measure of perceived fecundity that places these perceptions on a continuous spectrum, providing a more nuanced description of embodied risk than self-reported beliefs of "infertility." Third, my analysis includes several measures of experienced or medically indicated fecundity impairment that allow me to investigate their influence in the perceived subfecundity-contraceptive use relationship. Finally, I investigate both inconsistent and non-use of contraception in the year following the measurement of perceived subfecundity.

4.3 Data and Methods

Data: Data are from the National Longitudinal Survey of Youth (NLSY) 1997 cohort, a panel survey of 8,984 males and females in the United States. Interviews were first conducted in 1997, when participants were aged 12 to 17; subsequent interviews were conducted annually until 2011, and then biennially thereafter.

Perceived fecundity: In 2009 (Round 13), the NLSY administered questions concerning women's experiences and perceptions of their biological capacity to reproduce. (Any respondents who were not interviewed in 2009 were asked these questions in 2010 or 2011.) Perceived fecundity was assessed via the following vignette: "The next [question is] about your biological ability to have a child. In answering [this question], please imagine that you wanted to have a child. Suppose you started to

have unprotected intercourse today. What is the percent chance you would have a child within the next two years?" If a respondent stated that a child was not wanted within this time frame, the interviewer asked her to focus on her biological ability to have a child.

A brief discussion of this hypothetical measure is worth noting here. First, while women are not explicitly asked about their "fecundity," the measure incorporates the definition of fecundity in the vignette (i.e. their biological ability to have a child). Second, the objective probability of pregnancy after a year of unprotected intercourse is estimated to be 85%; thus, most women in the sample have a high biological likelihood of having a child within the two-year time frame. Lastly, by asking women to imagine that they wanted a child, the measure attempts to lessen potential non-biological influences in how women might answer the question.

Most participants provided numerical responses ranging from 0-100%; a small proportion of women (4%) provided a "don't know" response. Using cut points derived from the probability distribution, I create a 3-part variable corresponding to women perceiving themselves to be very likely to conceive (75-100% chance), somewhat likely (50-74% chance), and not as likely (<50% chance.) In sensitivity analyses, I model perceived fecundity as a continuous variable ranging from 0-100%, with higher values indicating higher perceived probability of conception within two years. Women who provided a "don't know" response are excluded in the main analysis, although sensitivity analyses that include these women are also conducted.

Consistency of contraceptive use: I capitalize on the longitudinal structure of the data to create a prospective measure of contraceptive use consistency in the year following the measurement of fecundity perceptions. For example, women who provide a fecundity perception in the 2009 wave are assigned a measure of contraceptive use collected in 2010.

Information on contraceptive use was collected consistently across the study. In each survey wave, participants who reported any sexual activity in the year prior to the survey were asked to report the number of times they had used a condom or any other type of birth control relative to the number of times they had sex. Respondents who could not recall the number of times they had sex or the number of times contraceptives were used were asked to estimate the proportion of times they had used contraception. I create two separate indicators for contraceptive use consistency: inconsistent use (1-99%) vs. consistent use (100%); and non-use (0%) vs. consistent use (100%).

Controls: I use several demographic, contextual, socioeconomic, and attitudinal controls commonly employed in the literature. All covariates are measured in the same year as the measurement of fecundity perceptions unless noted otherwise.

Demographic variables include age, race/ethnicity, and education. Race/ethnicity

(measured in 1997) includes White, non-Hispanic Black, and Hispanic; the few respondents classified as mixed race were dropped from analysis (n=16). Education was included to account for its well-established relationship with contraceptive use (Frost et al. 2007) and knowledge or awareness of human fecundity and objective pregnancy risks. Education was coded as less than high school, high school degree, some college, and college degree or higher. I also account for potential differences in contextual influences on perceived fecundity and contraceptive use by including a measure for current region of residence (Northeast, Northcentral, South, West.) Measures for smaller geographic areas, such as state or county, were not available for analysis.

I consider a separate set of controls for partnership and childbearing characteristics, which may affect both fecundity perceptions and contraceptive use. I use a combined measure of marital and cohabiting status to create four partnership categories: never married/not cohabiting, never married/cohabiting, currently married, and divorced/widowed/separated. Because the relationship between parity and contraceptive use or perceived fecundity may be nonlinear, I also use a categorical variable for parity (0, 1, 2, 3 or more biological children.)

To account for differences in motivation for pregnancy, I include two attitudinal controls. The first is a direct measure of stated expectations for future children assessed via the following question: "Altogether, how many (more) children do you expect to have?" I code this as a binary variable indicating whether a respondent intends any children in the future or not. (Note: Throughout this paper, I use the terms expectations and intentions interchangeably. As Hayford (2009) notes, while the two are conceptually different, they appear to operate similarly in empirical studies.) The second measure is respondents' current religious preference measured in 2008; categories include Christian, Catholic, or other (including religious "nones".)

I also include two controls capturing potential external barriers to accessing contraception. These include insurance status (any vs. none) and household income poverty level, which measures respondents' household income ratio to the federal poverty line. The poverty level variable is logged to reduce variation. Measures of internal barriers to contraceptive use such as contraceptive dissatisfaction or self-efficacy were not available for analysis.

Finally, I employ a measure of financial literacy to control for numeracy, or the ability to understand and use numerical information. I do this to both control for the complexities of the perceived fecundity measure used as well as for potential difficulties with quantifying risk perceptions (Reyna et al. 2009). I use the first question in a set of financial literacy measures that were originally designed by Lusardi and Mitchell (2006, 2008) to measure knowledge of financial concepts in social surveys. The question is: "Suppose you had $100 in a savings account and the interest rate

was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?" Possible responses include: more than $102, exactly $102, or less than $102. Those providing incorrect responses or stating they do not know are coded as having lower numeracy.

Experienced subfecundity. Experienced subfecundity may influence the relationship between fecundity perceptions and contraceptive use. The NLSY-97 contains three measures of experienced subfecundity that I consider in analysis. The first, coded as a binary variable, indicates whether a respondent or her partner had received a doctor's diagnosis regarding fertility difficulties. The second measure is a binary variable indicating whether a respondent reported having multiple miscarriages or stillbirths. The third variable was derived from two questions asking if a respondent was unable to conceive a child after 6 or 12 months of unprotected intercourse in a row. I combine these measures into a three-part variable: no reported absence of conception after 6 or 12 months, absence of conception after 6 months of unprotected sex, but not 12 months, and absence of conception after 12 months of unprotected sex. Importantly, the last category, 12 or more months of unprotected intercourse in a row without conception, meets the criteria for a clinical diagnosis of infertility (Zegers-Hochschild et al. 2009).

Analytic sample: Because contraceptive use information is only collected for sexually active women, I limit my sample to women who reported having any sex in the year following the survey (n=3,013). Women who did not provide responses for contraceptive use or perceived infertility are also excluded (n=287). I further exclude women who are sterilized or became sterilized in the following year, currently pregnant or homosexual women, as well as women who gave birth in the following year (n=538). While women who give birth in the following year may have experienced unintended pregnancies due to inconsistent or non-use of contraceptives, they are excluded because contraceptive use consistency over the course of the year would be affected by lack of contraceptive use during pregnancy. Women who are missing responses for fertility intentions or experienced subfecundity are also excluded. The final sample comprises 2,091 women.

A central limitation of this data source is that I am not able to identify women who are at risk of unintended pregnancy. I address this limitation in two ways. First, I add controls for partnership status, parity, and whether or not the respondent expects any children in the future to account for differences in pregnancy intention. Second, I create a secondary, restricted sample of women who state they do not intend any children in the future (n=502). Thus, for this latter group, contraceptives would be used to limit, rather than space, births.

Statistical analysis. I use multinomial logistic regression to predict the odds of any inconsistent or non-use of contraception (vs. consistent use) in the year following the

assessment of fecundity perceptions. I use multiple imputation by chained equations to impute missing values of control variables (Royston & White 2011), and all models use survey weights to account for complex sampling design.

4.4 Results

Descriptive results

Table 1 displays descriptive statistics for the full sample by perceived fecundity status and consistency of contraceptive use. A little over two-thirds (69%) of the sample perceived themselves to be very likely to have a future pregnancy (i.e. 75-100% chance of having a child within two years if exposed to unprotected sex.) 14% of the sample thought their chances of becoming pregnant were 50-74%, while the remaining 17% believed they had a less than 50% chance. Because perceived fecundity has received little attention in the literature, it is worth noting that, with the exception of religious preference, all control variables available for analysis are significantly associated with perceived fecundity. For example, larger proportions of black and Hispanic women, women with lower levels of education, women having 3 or more children, and women intending no more children were more likely to perceive themselves as having a lower chance of future pregnancy. Numeracy was also associated with perceived fecundity, with those classified as having lower numeracy more likely to state lower chances of conception.

A little over half the sample (52%) had either used contraceptives inconsistently or not at all one year after baseline. Race/ethnicity, education, partnership status, parity, intentions for future children, insurance status, and poverty level were all significantly associated with consistency of use at the bivariate level. Consistent with prior research, consistent use of contraception was more common among women holding college degrees, never married non-cohabiting women, and women with health insurance.

The descriptive findings in Table 1 demonstrate that all four measures of experienced fecundity, such as receiving a doctor's diagnosis or reporting absence of conception following 6-12 months of unprotected sex, are significantly associated with perceived fecundity at the bivariate level, suggesting that various measures of experienced fecundity serve as important inputs into the evaluation process of one's own fecundity.

4.4.1 Multivariate results

4.4.1.1 Full sample

We turn now to the results of the multivariable analysis to build on the relationships observed in Table 1. Table 2 displays risk ratios predicting inconsistent or non-use use of contraception (vs. consistent use) in the year following the measurement of fecundity perceptions among all women in the sample. Model 1 shows the crude association between perceived fecundity and contraceptive non-use. In unadjusted analyses, both categories of women who perceive themselves to have less than a 75% chance of a future pregnancy have a significantly higher risk of non-use of contraception compared to women who perceived themselves as very likely to conceive.

Model 2 contains the full set of controls described in the methods section above. In this fully adjusted model, risk ratios for contraceptive non-use for women who perceive themselves as subfecund (i.e. <75% chance) become slightly attenuated, but remain significant ($p<0.001$). Women who perceive themselves as having the lowest chances of future pregnancy (i.e. <50%) have almost 2.5 times the risk of contraceptive non-use compared to women who perceive themselves as having at least a 75% chance. This relationship is similar for women who rate their chances as somewhat likely (i.e. 50-74%), as these women have almost 2 times the risk compared to women who rate their fecundity more positively (aRR=1.93). Notably, age, education, and partnership status also emerge as significant determinants of contraceptive non-use in this sample.

Model 3 displays the crude relationship between perceived fecundity and *inconsistent* use. Here, women who believe they have low chances of future pregnancy have reduced, rather than greater, risk of inconsistent use compared to women who perceive themselves as very likely to become pregnant. There was no relationship between women who perceived themselves as somewhat likely to become pregnant and inconsistent use. These patterns hold after adding the full set of controls (Model 4). Race/ethnicity, education, intention for more children, and having health insurance are also associated with inconsistent contraceptive use.

As previously noted, women's perceptions of their fecundity may be strongly influenced by personal recognition of fertility problems, suggesting that women's perceived fecundity may lie on the causal pathway between experienced subfecundity and contraceptive use. Table 3 presents a series of models investigating how a range of objective and subjective measures of experienced fecundity may ultimately drive the relationships observed in Table 2. Because measures of experienced subfecundity may be highly collinear, I chose to model each measure individually. All models adjust for the full range of covariates included in the final models shown in Table

2, but for presentation purposes, only risk ratios for the perceived and experienced fecundity measures are shown.

Models 1-4 in Table 3 present risk ratios for contraceptive non-use in the full analytic sample. Model 1 presents the fully adjusted results for perceived fecundity and contraceptive non-use that were observed in Table 2. In Model 2, I add an indicator for whether or not a respondent or her partner received a doctor's diagnosis regarding fertility difficulties. When this predictor is added, the relationship between perceived fecundity and contraceptive non-use is somewhat attenuated, but still significant ($p<0.001$). We also see that ever receiving a diagnosis is significantly associated with higher risk of non-use of contraception, which echoes prior research (Mosher et al. 2015).

In Model 3, I consider a different measure of experienced subfecundity: whether or not a respondent reported experiencing multiple miscarriages or stillbirths. In this model, women reporting multiple miscarriages or stillbirths have 3.12 times the risk of non-use contraception. However, the associations with perceived fecundity remain effectively unchanged.

Because not all women seek care for potential infertility (White et al. 2006b), it is unclear how knowledge of other indicators of subfecundity may influence perceptions. In Model 4, I include a measure for absence of a conception after different durations of unprotected sex, and find that durations of 6-11 months or 12 months or more are both significantly predictive of contraceptive non-use (adjRR=2.88 for 6-11 months and 5.85 for 12 or more months; $p<0.001$). Importantly, adding these measures attenuates the relationship between perceived subfecundity and contraceptive non-use, such that the relationship between perceived subfecundity and contraceptive non-use for the "somewhat likely" group is no longer significant. Those who perceive themselves as not very likely to have a future pregnancy still have significantly higher risk of non-use, although this result is not as significant ($p<0.05$) as it was in Model 1. Thus, only one measure of experienced subfecundity, absence of conception after 6 months or more, appears to explain away a large proportion of the association between perceived subfecundity and non-use of contraception.

Models 5-8 in Table 3 present the same set of analyses that were presented in Models 1-4, but here, the outcome is for inconsistent use of contraception, rather than non-use. Across models 5-8, we see that women who perceive themselves as not very likely to become pregnant (i.e. <50% chance) have significantly reduced risk of inconsistent use of contraception compared to women who perceive themselves as very likely. Importantly, this relationship holds after adding the three separate measures of experienced fecundity. Moreover, with the exception of reporting multiple miscarriages or stillbirths, all experienced subfecundity measures are independently associated with higher risk of inconsistent use of contraception.

4.4.1.2 Women intending no more children

The above analysis includes women who may use contraceptives inconsistently or not at all because they are not at risk of unintended pregnancy (for example, women actively trying for pregnancy). Although I include controls for partnership status, parity, and intentions for future children, as well as exclude women who become pregnant in the year following baseline, it's possible that my inability exclude those not at risk of unintended pregnancy may artificially inflate estimates. Thus, I further restrict my sample to women who state they intend no more children in the future (n=502). Contraceptive use among this group, therefore, would be used to limit births.

Table 4 shows the results for this limited sample using the same series of models presented in Table 2; Models 1 and 2 show crude and adjusted associations with contraceptive non-use, while Models 3 and 4 show crude and adjusted relationships with inconsistent use. The crude association between perceived subfecundity and non-use of contraception (Model 1) differs from results obtained using the full sample. Here, only women who perceive themselves as not very likely to conceive (i.e. <50%) have significantly higher risk of non-use. Women perceiving themselves as somewhat likely to conceive (i.e. 50-74%) are not significantly different than those who perceive themselves as very likely to conceive (i.e. 75-100%). These results differ, however, when the full set of controls are added (Model 2). The adjusted risk of non-use of contraception is significantly higher in both perceived subfecundity groups. Notably, there were no significant relationships between perceived subfecundity and inconsistent use of contraption among women intended no more children (Models 3 and 4).

Lastly, Table 5 presents the same series of models that were presented in Table 3, in which measures of experienced subfecundity are separately added to predict either non-use (Models 1-4) or inconsistent use (Models 5-8) of contraception. In models predicting non-use of contraception, adding measures of experienced subfecundity does not substantially change the association with either women who perceive themselves as somewhat likely or not very likely to become pregnant in the future. As with the full sample, adding a measure for absence of pregnancy after 6 or 12 or more months of unprotected sex attenuates the relationship somewhat. Unlike the full sample, however, only diagnosis of infertility and absence of pregnancy after 12 months or more are associated with higher risks of non-use. Models predicting inconsistent use among women who intend no children yield few significant results.

4.4.2 Sensitivity analysis

In the first sensitivity analysis, I use ordinary least squares (OLS) regression to model the relationship between continuous measures of perceived fecundity and contraceptive use. Results from crude and adjusted OLS models yield the same substantive findings found using categorical variables. In the fully adjusted model among the full sample of women, for example, a 1 percentage point increase in perceived fecundity is associated with a 0.2 percentage point increase in contraceptive consistency ($p<0.001$). In addition, there was no evidence of curvilinear relationship, as a quadratic term for perceived fecundity was not significant in any model.

In the second sensitivity analysis, I include the small subset of women (n=94) who stated "don't know" in response to the perceived fecundity measure. I classify these women as perceiving themselves to be "slightly likely" to become pregnant (i.e. 50-74%), rather than very likely or not at all likely. Including these women in the analysis does not change the results.

4.5 Discussion

In this nationally representative sample of young, sexually active women, perceived subfecundity is associated with greater risk of non-use of contraception. This important finding is bolstered by analyses that attempt to disentangle the roles of experienced subfecundity and erroneous thinking as ultimate drivers of contraceptive use. In the full sample of women, the relationship between perceived subfecundity and contraceptive non-use persists after separately controlling for three distinct measures of experienced subfecundity, suggesting that fecundity risk perceptions often operate independently of experienced subfecundity and therefore may influence unintended pregnancy risk.

Importantly, the extent to which contraceptive behaviors attributable to fecundity perceptions are ultimately linked with unintended pregnancy remains an open question. Unfortunately, this was not possible to ascertain in the current study, as retrospective measures of pregnancy intention, such as those used in the NSFG, were not collected in my sample. However, qualitative research on abortion patients, in conjunction with the current study and related literature, provides preliminary evidence that infertility perceptions are a commonly cited reason for perceived insusceptibility to pregnancy (Frohwirth et al. 2013)

Accounting for women's experiences of subfecundity turns up additional, noteworthy findings. In particular, the absence of conception after at least 6 months of unprotected sex "explains away" more of the relationship between fecundity per-

ceptions and contraceptive non-use than a medical diagnosis of infertility. Moreover, women who did not become pregnant after 6-11 months of unprotected sex were more likely to perceive themselves as having less than a 75% chance of future pregnancy compared to those who did not become pregnant after 12 months (67% vs. 50%), suggesting that the 6-month mark may offer an important signal to women about their reproductive potential. Indeed, while a large proportion of women who do not becoming pregnant after 6 months of unprotected sex eventually become pregnant, it's estimated that about 20% of couples who havent conceived after 6 months are at least slightly subfecund (Gnoth et al. 2004). As such, this finding raises important questions about the validity of womens inferences and the personal relevance of shorter durations of conception delay that may be overlooked in the clinical setting.

This study employs a novel assessment of perceived fecundity that differs from measures used in prior research. Instead of directly asking women if they believe they are infertile, women are asked to gauge the probability of having a future child based on their biological ability. The resulting continuous response (i.e. 0-100%) offers greater granularity with which to investigate perceptions and may detect beliefs about fecundity that are less extreme than infertility. Nevertheless, measurement error is likely. For example, women who are divorced and women expecting no more children were more likely to rate their fecundity as low, possibly owing to stronger influences from situational factors or uncertainty. Moreover, the wording of the question uses the term "child," rather than pregnancy, thereby reframing the measure from a biological one to one embedded in culture and context. Finally, the vignette does not explicitly state that exposure to sex be continuous or regular over the hypothetical two-year period; this omission may also influence responses if women have different experiences or expectations around coital frequency.

Outside of Polis and Zabin (2012) and the current paper, little research has investigated fecundity perceptions in their own right. Given that perceptions are strongly predictive of contraceptive non-use in the current study, more research is needed to both understand how women evaluate their fecundity and to develop measures that capture a broad spectrum of these perceptions. Doing so may reveal areas for potential interventions, such as addressing erroneous thinking or misinformation about objective, biological risks of pregnancy

Despite the merits of this study, it is not without limitations. First, I am not able to identify women who are at risk of unintended pregnancy; thus, some women in the sample may not use contraception consistently because they are either attempting to become pregnant or are ambivalent about pregnancy. I attempt to address this limitation by (1) adding controls for partnership status, parity, and stated intentions for children and (2) creating a secondary sample of women who state they intend no more children. Furthermore, it should be noted that the observed proportion

of women "trying" for pregnancy in cross-sectional surveys is small (around 6%; McQuillan et al. 2011).

Second, measurement of consistency of contraceptive use is subject to both recall and measurement bias, with the latter influenced by both the complexity of administered questions and comfort with using numerical information and concepts. Third, I am unable to control for other determinants of contraceptive use commonly identified in the literature, such as provider- or method-related experiences. Future research should investigate potential correlations between these factors with perceived fecundity. Lastly, because the analysis is observational in nature, causal inference is limited.

The results suggest that erroneous thinking about fecundity may be an important barrier to consistent use of contraception. While the current study lacks information about exposure to sex education or related content, education level is strongly correlated with perceived fecundity, suggesting that perhaps health literacy or knowledge of reproductive functioning may influence how women come to understand their biological risk. Thus, addressing misinformation of biological functioning may offer a potential low-hanging fruit intervention in this regard. Future research is needed to identify messaging and delivery mechanisms that can effectively target faulty influences around fecundity risk, as well as evaluate if such strategies affect contraceptive use and ultimately, unintended pregnancy risk.

Lastly, limiting the analysis to women who intend no more children highlights an additional potential target for intervention. While nearly half of women who complete childbearing rely on male or female sterilization for protection against unintended pregnancy, a substantial number of women must use other, non-reversible methods effectively and consistently over the remainder of the reproductive life courses to mitigate pregnancy risk. Many of these women in my sample, however, appear to hold lower perceptions of fecundity, and these perceptions are independently associated with contraceptive non-use. While issues of measurement error of perceived subfecundity are likely among this group (as mentioned above), the observed relationship warrants further consideration, especially among older women who may be experiencing age-related declines in fecundity, but are still susceptible to pregnancy.

Table 4.1: Descriptive statistics for the sample (n=2,091).

Measure	Full sample	Distribution by: Perceived likelihood of future pregnancy <50%	50-74%	75-100%		Distribution by: Consistency of use No use	Inconsistent	Consistent	
Population share (%)	100	17	14	69		27	25	48	
Number of cases	2,091	360	281	1,450		574	507	1,010	
Race/ethnicity					***				**
White	1,146	0.13	0.11	0.76		0.26	0.23	0.51	
Black	507	0.24	0.19	0.57		0.26	0.30	0.45	
Hispanic	438	0.21	0.15	0.65		0.33	0.23	0.44	
Education					***				***
Less than high school	143	0.32	0.21	0.47		0.46	0.19	0.35	
High school graduate	447	0.30	0.15	0.55		0.38	0.18	0.43	
Some college	843	0.15	0.15	0.70		0.28	0.28	0.44	
College degree	645	0.07	0.11	0.82		0.15	0.25	0.60	
Partnership status					**				***
Never married, not cohabiting	778	0.18	0.17	0.65		0.16	0.28	0.55	
Never married, cohabiting	421	0.17	0.11	0.72		0.30	0.23	0.48	
Married	738	0.15	0.12	0.73		0.36	0.22	0.41	
Divorced/separated/widowed	149	0.25	0.12	0.63		0.35	0.20	0.45	
Parity					***				***
0	933	0.13	0.16	0.71		0.22	0.27	0.51	
1	492	0.12	0.13	0.75		0.27	0.23	0.50	
2	424	0.21	0.12	0.67		0.32	0.23	0.45	
3 or more	240	0.38	0.10	0.52		0.43	0.20	0.36	
Region					**				
Northeast	330	0.16	0.14	0.69		0.23	0.25	0.51	
Northcentral	441	0.19	0.15	0.66		0.32	0.21	0.47	
South	828	0.19	0.16	0.66		0.28	0.25	0.47	
West	473	0.14	0.09	0.77		0.25	0.27	0.49	
Religion									
Christian	1,130	0.17	0.14	0.69		0.28	0.25	0.47	
Catholic	437	0.20	0.14	0.66		0.29	0.21	0.49	
Other/none	451	0.13	0.13	0.74		0.25	0.27	0.48	

Table continues on next page

Note: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Measure	Full sample	Distribution by: Perceived likelihood of future pregnancy				Distribution by: Consistency of use			
		<50%	50-74%	75-100%		No use	Inconsistent	Consistent	
Any health insurance					**				**
No	517	0.20	0.18	0.63		0.31	0.28	0.41	
Yes	1,574	0.16	0.13	0.71		0.26	0.24	0.50	
% of federal poverty level					***				*
<100	292	0.34	0.16	0.50		0.36	0.24	0.40	
100-199	329	0.17	0.19	0.63		0.29	0.27	0.45	
200-299	333	0.17	0.13	0.70		0.29	0.22	0.49	
300-399	281	0.15	0.12	0.72		0.27	0.24	0.49	
400 and above	627	0.10	0.12	0.78		0.23	0.25	0.52	
Intends more children					***				***
No	502	0.36	0.11	0.53		0.35	0.18	0.48	
Yes	1,589	0.11	0.15	0.74		0.25	0.27	0.48	
Low numeracy					*				
No	1,546	0.15	0.14	0.71		0.25	0.25	0.50	
Yes	317	0.21	0.14	0.65		0.30	0.25	0.45	
Ever received a diagnosis of infertility					***				***
No	1,993	0.15	0.14	0.71		0.26	0.25	0.49	
Yes	98	0.52	0.21	0.27		0.57	0.20	0.23	
Reported multiple miscarriages or stillbirths					**				***
No	2,007	0.17	0.14	0.70		0.26	0.24	0.49	
Yes	79	0.30	0.14	0.56		0.53	0.23	0.23	
Absence of conception					***				***
None reported	1,348	0.11	0.11	0.78		0.15	0.26	0.59	
After 6 months unprotected sex (but less than 12 months)	136	0.32	0.35	0.33		0.32	0.35	0.33	
After 12 months unprotected sex	607	0.31	0.19	0.51		0.53	0.20	0.28	

Note: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4.2: Risk ratios from multinomial regression models predicting inconsistent or non-use of contraception (vs. consistent use) in the following year among all women in the sample (n=2,091).

	Non-use		Inconsistent use	
Independent Variables	Model 1	Model 2	Model 3	Model 4
Perceived likelihood of future pregnancy (ref: very likely (75-100%))				
Somewhat likely (50-74%)	2.00^{***}	1.93^{***}	1.07	0.97
Not very likely (<50%)	2.86^{***}	2.42^{***}	0.64^{*}	0.65^{*}
Age (years)		1.13^{**}		1.02
Race/ethnicity (ref: White)				
Black		1.19		1.64^{**}
Hispanic		1.19		1.22
Education (ref: College degree)				
Less than high school		4.23^{***}		1.37
High school graduate		2.76^{***}		1.09
Some college		2.31^{***}		1.51^{**}
Region (ref: Northeast)				
Northcentral		1.25		0.90
South		1.03		0.92
West		0.90		1.02
Partnership status (ref: Never married, not cohabiting)				
Never married, cohabiting		2.36^{***}		1.01
Married		3.96^{***}		1.31
Divorced/widowed/separated		2.39^{***}		1.02
Parity (ref: 0 children)				
1		0.84		0.77
2		0.78		0.85
3 or more		1.08		1.14
Intends more children		1.25		1.57^{**}
Religion (ref: Christian)				
Catholic		0.94		0.85
Other		0.99		1.13
Any health insurance		0.77		0.72^{*}
% of federal poverty level (logged)		0.95		0.99
Low numeracy		1.14		1.04

Note: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4.3: Risk ratios predicting inconsistent or non-use of contraception (vs. consistent use) in the following year for selected measures of perceived and experienced fecundity among the all women in the sample (n=2,091).

	Non-use				Inconsistent use			
Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Perceived likelihood of future pregnancy (ref: very likely (75-100%))								
Somewhat likely (50-74%)	1.93^{***}	1.82^{***}	1.90^{***}	1.43	0.97	0.94	0.96	0.90
Not very likely (<50%)	2.42^{***}	2.05^{***}	2.36^{***}	1.53^{*}	0.65^{*}	0.60^{**}	0.62^{*}	0.56^{**}
Ever received a diagnosis of infertility (ref: No)		3.03^{***}				2.02^{*}		
Reported multiple miscarriages or stillbirths (ref: No)			3.12^{***}				1.96	
Absence of conception (ref: None reported)								
After 6 months unprotected sex (but less than 12 months)				2.88^{***}				2.51^{***}
After 12 months unprotected sex				5.85^{***}				1.69^{***}

Note: All models control for age, race/ethncity, education, region, low numeracy, partnership status, parity, expectation for future children, religion, health insurance status, and poverty level.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4.4: Risk ratios from multinomial regression models predicting inconsistent or non-use of contraception (vs. consistent use) in the following year among women who intend no more children (n=502).

	Non-use		Inconsistent use	
Independent Variables	Model 1	Model 2	Model 3	Model 4
Perceived likelihood of future pregnancy (ref: very likely (75-100%))				
Somewhat likely (50-74%)	2.02	3.13**	0.98	0.94
Not very likely (<50%)	5.30***	5.46***	0.67	0.55
Age (years)		1.16		0.86
Race/ethnicity (ref: White)				
Black		0.68		2.20*
Hispanic		0.83		3.23*
Education (ref: College degree)				
Less than high school		4.74*		1.28
High school graduate		4.83**		1.69
Some college		3.62*		1.28
Region (ref: Northeast)				
Northcentral		1.56		0.76
South		1.42		0.83
West		0.74		0.56
Partnership status (ref: Never married, not cohabiting)				
Never married, cohabiting		1.19		1.31
Married		1.96		0.79
Divorced/widowed/separated		1.47		0.65
Parity (ref: 0 children)				
1		1.28		0.46
2		2.47*		0.66
3 or more		3.07*		0.68
Religion (ref: Christian)				
Catholic		1.30		0.37
Other		1.61		1.28
Any health insurance		0.95		0.54*
% of federal poverty level (logged)		0.96		1.06
Low numeracy		1.13		0.99

Note: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 4.5: Risk ratios predicting inconsistent or non-use of contraception (vs. consistent use) in the following year for selected measures of perceived and experienced fecundity among women who intend no more children (n=502).

	Non-use				Inconsistent use			
Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Perceived likelihood of future pregnancy (ref: very likely (75-100%))								
Somewhat likely (50-74%)	3.13^{**}	3.14^{**}	3.09^{**}	2.48^{*}	0.94	0.97	0.83	0.92
Not very likely (<50%)	5.46^{***}	5.01^{***}	5.38^{***}	3.35^{***}	0.55	0.57	0.53	0.51
Ever received a diagnosis of infertility (ref: No)		2.62^{***}				0.51		
Reported multiple miscarriages or stillbirths (ref: No)			1.32				2.20	
Absence of conception (ref: None reported)								
After 6 months unprotected sex (but less than 12 months)				2.17				2.58
After 12 months unprotected sex				6.54^{***}				1.32

Note: All models control for age, race/ethncity, education, region, low numeracy, partnership status, parity, religion, health insurance status, and poverty level.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Chapter 5

Conclusion

The three empirical chapters presented in this dissertation highlight the importance of integrating biological variables into explanatory models of socio-demographic outcomes. I specifically focus on the understudied intersection of infertility and fertility in the contemporary United States and reveal new insight as to how biology, and specifically fecundity, can create a frame in which individuals make decisions across their reproductive life course. This approach echoes anthropologist Marcia Inhorn's (1994) position that "infertility provides a convenient lens through which issues of *fertility* can be explored."

In the first empirical chapter, I provide new perspectives on the diversity of childless women by investigating the types of fertility expectation pathways that childless women report over the life course. I find that three dimensions of fertility expectation patterns—the emergence of a childless expectation, the consistency of childless expectations, and the types of patterns that precede a childless expectation—provide a more nuanced description of the composition of childless women than the standard voluntary/involuntary framework. Taken together, the results provide support for process-based explanations of eventual childlessness that are often difficult to operationalize in cross-sectional data, including the presence of biological or partnership constraints, social age deadlines, and gradual disinterest in childbearing.

The second chapter finds that the majority of young women in the NLSY-97 cohort (62%) believe their likelihood of future conception is fairly high (i.e. 75% of greater), while nearly 1 in 5 women (18%) perceive their chances as conceiving as low (<50%). Importantly, results show stark class differences in these perceptions; both Black and Hispanic women, less educated women, and poorer women were more likely to perceive their fecundity as low compared to their more advantaged counterparts. With the exception of Hispanic women, these relationships persisted after controlling for a range of predictors, including self-rated health, partnership

status, and intention for future children. Thus, questions remain as to what may be driving differences in fecundity perceptions between more advantaged and less advantaged populations and should be a priority area for future research.

In the third empirical chapter, I demonstrate that women's perceptions of their fecundity are associated with greater risk of non-use of contraception. This important finding is bolstered by analyses that attempt to disentangle the roles of experienced subfecundity and erroneous thinking as ultimate drivers of contraceptive use. In the full sample of women, the relationship between perceived subfecundity and contraceptive non-use persists after separately controlling for three distinct measures of experienced subfecundity, suggesting that fecundity risk perceptions often operate independently of experienced subfecundity and therefore may influence unintended pregnancy risk.

5.1 Future research directions

The last two empirical chapters of this dissertation suggest that investigating women's perceptions of their fecundity may be a fruitful area of future research in demographic studies of fertility. Importantly, we have little understanding of how women's internal risk perceptions about their biology may influence various life course domains, including partnership formation, career or education plans, and timing of childbearing. Further, these potential relationships may grow stronger as growing numbers of individuals are delaying parenthood and women are increasingly exposed to messages about their biological clocks.

As noted in Chapter 3, a proposed first step for future research would be the development of a measure (or measures) of perceived fecundity that can be administered across diverse populations and contexts. Doing so would allow investigators to incorporate measures into standard social surveys, thus providing not only the opportunity to further investigate differences and similarities in how women view their reproductive potential, but also to examine potential consequences of such perceptions.

Relatedly, rich, qualitative data are needed to explore the cognitive processes and inputs underlying perceptions, as these may more closely predict intentions and behaviors. Importantly, such research should be conducted across a range of socioeconomic groups, since women may rely on culturally distinct schemas or cognitive structures when forming a perception.

Lastly, as discussed in Chapter 4, the extent to which contraceptive behaviors attributable to fecundity perceptions are ultimately linked with unintended pregnancy remains an open question. Thus, integration of measures of fecundity perceptions

into longitudinal studies of fertility intentions and behavior may reveal new insight as to why more than half of unintended pregnancies (54%) occur to women who do not use contraception or have long gaps in use (Sonfield et al. 2014).

References

Abbott, A. (1995). Sequence analysis: New methods for old ideas. *Annual Review of Sociology,* 21, 93-113.

Abma, J. C., & Martinez, G. M. (2006). Childlessness among older women in the United States: Trends and Profiles. *Journal of Marriage and Family,* 68 (4), 1045-1056.

Ajzen, I., & Klobas, J. (2013). Fertility intentions: An approach based on the theory of planned behavior. *Demographic Research,* 29, 203-232.

Bachrach, C. A., & Morgan, S. P. (2013). A cognitive-social model of fertility intentions. *Population and Development Review,* 39 (3), 459-485.

Barber, J. S. (2001). Ideational influences on the transition to parenthood: Attitudes towards childbearing and competing alternatives. *Social Psychology Quarterly,* 39 (2), 101-127.

Barsky, R.B., Juster, F.T., Kimball, M.S., & Shapiro, M.D. (1997). Preference parameters and behavioral heterogeneity: An experimental approach in the Health and Retirement Study. *Quarterly Journal of Economics,* 112, 537-79.

Baudin, T., de la Croix, D., & Gobbi, P. E. Fertility and childlessness in the United States. *American Economic Review,* 105 (6), 1852-1882.

Berrington, A. (2004). Perpetual postponers? Women's, men's, and couple's fertility intentions and subsequent fertility behavior. *Population Trends,* 117, 9-19.

Berwick, D., Murphy, J., Goldman, J., Ware, A., Barsky, A., & Weinstein, M. (1991). Performance of a five-item mental health screening test. *Medical Care,* 29, 169-176.

Biggs, M.A., Karasek, D., & Foster, D.G. (2012). Unprotected intercourse among women wanting to avoid pregnancy: Attitudes, behaviors, beliefs. *Women's Health Issues,* 22, e311-e318.

Biggs, M.A. & Foster, D.G. (2013). Misunderstanding the risk of conception from unprotected and protected sex. *Women's Health Issues,* 23, e47-53.

Billari, F. C. (2001). Sequence analysis in demographic research. *Canadian Studies in Population,* 28 (2), 439-458.

Billari, F. C., Goisis, A., Liefbroer, A. C., Settersten, R. A., Aassve, A., Hagestad, G., et al. (2011). Social age deadlines for the childbearing of women and men. *Human Reproduction.,* 26 (3), 616-622.

Bloom, D. E., & Pebley, A. R. (1982). Voluntary childlessness: A review of the evidence and implications. *Population Research and Policy Review,* 1 (3), 203-224.

Bongaarts, J. (2001) Fertility and reproductive preferences in post-transitional societies. *Population and Development Review,* 27 (Supp.), 260-281.

Carmichael, G. A., & Whittaker, A. (2007). Choice and circumstance: Qualitative insights into contemporary childlessness in Australia. *European Journal of Population,* 23 (2), 111-143.

Cantril, H. (1965). *The Pattern of Human Concerns.* New Brunswick, NJ: Rutgers University Press.

Chandra, A., Copen, C.E., & Stephen, E.H. (2013). Infertility and impaired fecundity in the United States, 19822010: Data from the National Survey of Family Growth. National health statistics reports; no 67. Hyattsville, MD: National Center for Health Statistics.

Downs, J.S., Bruine de Bruin, W., Murray, P.J., & Fischhoff, B. (2004). When it only takes once fails: Perceived infertility predicts condom use and STI acquisition. *Journal of Pediatric and Adolescent Gynecology,* 17, 224.

Cunningham, M. (2008). Changing attitudes toward the male breadwinner, female homemaker family model: influences of women's employment and education over the lifecourse. *Social Forces,* 87 (1), 299-323.

Egan, M., Daly, M., & Delaney, L. (2016). Adolescent psychological distress, unemployment, and the Great Recession: Evidence from the National Longitudinal Study of Youth 1997. *Social Science & Medicine,* 156, 98-105.

Elzinga, C. H., & Liefbroer, A. C. (2007). De-standardization of family-life trajectories of young adults: a cross-national comparison using sequence analysis. *European Journal of Population,* 23 (3/4), 225-250.

Evans-Lacko, S., Knapp, M., McCrone, P., Thornicroft, G., Mojtabai, R. (2013). The mental health consequences of the recession: economic hardship and employment of people with mental health problems in 27 European countries. *PLOS ONE,* 8, e69792.

Finer, L. B., & Zolna, M. R. (2016). Declines in unintended pregnancy in the United States, 2008-2011. *New England Journal of Medicine,* 374 (9), 843-852.

Ford, K. (1990). Duration of residence in the United States and the fertility of U.S. immigrants. *The International Migration Review,* 24 (1), 34-68.

Foster, D.G., Higgins, J.A., Karasek, D., Ma, S., & Grossman, D. (2012). Attitudes toward unprotected intercourse and risk of pregnancy among women seeking abortion. *Women's Health Issues,* 22, e149-155.

Frohwirth, L., Moore, A.M., & Maniaci, R. (2013). Perceptions of susceptibility to pregnancy among U.S. women obtaining abortions. *Social Science & Medicine,* 99, 18-26.

Frost, J.J., Singh, S., & Finer, L.B. (2007). Factors associated with contraceptive use and nonuse, United States, 2004. *Perspectives on Sexual and Reproductive Health,* 39, 90-99.

Gabadinho, A., Ritschard, G., Müller, N. S., & Studer, M. (2011). Analyzing and Visualizing State Sequences in R with TraMineR. *Journal of Statistical Software,* 40 (4), 1-37.

Gnoth, C., Godehardt, E., Frank-Herrmann, P., Friol, K., Tigges, J., & Freundl, G. (2005). Definition and prevalence of subfertility and infertility. *Human Reproduction,* 20, 1144-1147.

Gold, R.B., & Nash, E. (2001). State-level policies on sexuality, STD education. *Guttmacher Policy Review,* 4, 4.

Greenstein, T. N. (1995). Gender ideology, marital disruption, and the employment of married women. *Journal of Marriage and Family,* 57 (1), 31-42.

Greil, A., McQuillan, J., & Slauson-Blevins, K. (2011). The social construction of infertility. *Sociology Compass,* 5, 736-746.

Greil, A., Slauson-Blevins, K, & McQuillan, J. (2010). The experience of infertility: a review of recent literature. *Sociology of Health & Illness,* 32, 140-162.

Hagestad, G. O., & Call, V. R. A. (2007). Pathways to childlessness. *Journal of Family Issues,* 28 (10), 1338-1361.

Hakim, C. (2002). A new approach to explaining fertility patterns: Preference theory. *Population and Development Review,* 29 (3), 349-373.

Hayford, S. R. (2009). The evolution of fertility expectations over the life course. *Demography,* 46 (4), 765-783.

Heaton, T. B., Jacobson, C. K., & Holland, K. (1999). Persistence and change in decisions to remain childless. *Journal of Marriage and Family,* 61 (2), 531-539.

Houseknecht, S. K. (1979). Timing of the decision to remain voluntary childless: evidence for continuous socialization. *Psychology of Women Quarterly,* 4 (1), 81-96.

Iacovou, M., & Tavares, L. P. (2011). Yearning, learning, and conceding: Reasons men and women change their childbearing intentions. *Population and Development Review,* 37 (1), 89-123.

Idler, E.L, & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior,* 38, 21-37.

Inhorn, M.C. (1994). Interpreting infertility: Medical anthropological perspectives. *Social Science & Medicine,* 39, 459-461.

Jaccard, J. (2009). *Unlocking the contraceptive conundrum: Reducing unplanned pregnancies in emerging adulthood.* Washington, DC: National Campaign to Prevent Teen and Unplanned Pregnancy.

Jones, G., Jenkinson, C., & Kennedy, S. (2004). The impact of endometriosis upon quality of life: A qualitative analysis. *Journal of Psychosomatic Obstetrics and Gynecology,* 25, 123-133.

Jones, J. 2008. Adoption experiences of women and men and demand for children to adopt by women 18-44 years of age in the United States, 2002. *Vital and Health Statistics,* Series 23, 1-36.

Jones, R. K. (2017). Are uncertain fertility intentions a temporary or long-term outlook? Findings from a panel study. *Women's Health Issues,* 27 (1), 21-28.

Juhn, C., & Potter, S. (2006). Changes in labor force participation in the United States. *Journal of Economic Perspectives,* 20 (3), 27-46.

Keizer, R., Dykstra, P. A., & Jansen, M. D. (2008). Pathways into childlessness: Evidence of gendered life course dynamics. *Journal of Biosocial Science,* 40 (6), 863-878.

Lesnard, L. (2010). Setting cost in optimal matching to uncover contemporaneous socio-temporal patterns. *Sociological Methods & Research,* 38 (3), 389-419.

Letherby, G. (2002). Childless and bereft?: Stereotypes and realities in relation to voluntary and involuntary childlessness and womanhood. *Sociological Inquiry,* 72 (1), 720.

Lundsberg, L.S., Pal, L., Gariepy, A.M., Xu, X., Chu, M.C., & Illuzzi, J.L. (2014). Knowledge, attitudes, and practices regarding conception and fertility: a population-based survey among reproductive-age United States women. *Fertility and Sterility,* 101, 767-774.

Lusardi, A., & Mitchell, O.S. (2006). Financial literacy and planning: Implications for retirement wellbeing. Working Paper, Pension Research Council, Wharton School, University of Pennsylvania.

Lusardi, A., & Mitchell, O.S. (2008). Planning and financial literacy: How do women fare? *American Economic Review,* 98, 413-417.

Martinez, G., Daniels, K., & Chandra, A. (2012). Fertility of men and women aged 15-44 years in the United States: National Survey of Family Growth, 2006-2010. *National Health Statistics Reports,* 51, 1-28.

McAllister, F., & Clarke, L. (1998). *Choosing Childlessness.* London: Family Policy StudiesCentre.

McQuillan, J., Greil, A.L., & Shreffler, K.M. (2011). Pregnancy intentions among women who do not try: Focusing on women who are okay either way. *Maternal and Child Health Journal,* 15, 178-187.

Miilunpalo, S., Vuori, I., Oja, P., Pasanen, M., & Urponen, H. (1997). Self-rated health status as a health measure: the predictive value of self-reported health status on the use of physician services and on mortality in the working-age population. *Journal of Clinical Epidemiology,* 50, 517-528.

Moore, A.M., Singh, S., & Bankole, A. (2011). Do women and men consider abortion as an alternative to contraception in the United States? An exploratory study. *Global Public Health,* 6, S25-S37.

Morgan, S. P. (1982). Parity-specific fertility intentions and uncertainty: the United States, 1970 to 1976. *Demography,* 19 (3):315-334.

Mosher, W., Jones, J., & Abma, J. (2015). Nonuse of contraception among women at risk of unintended pregnancy in the United States. *Contraception,* 92, 170-176.

Mynarska, M., Matysiak, A., Rybińska, A., Tocchioni, V., & Vignoli, D. (2015). Diverse paths into childlessness over the life course. *Advances in Life Course Research,* 25, 35-48.

Ní Bhrolcháin, M., & Beaujouan, E. (2011). Uncertainty in fertility intentions in Britain, 1979-2007. *Vienna Yearbook of Population Research,* 9, 99-129.

Ní Bhrolcháin, M., & Beaujouan, E. (2012). Fertility postponement is largely due to rising educational enrolment. *Population Studies,* 66 (3), 311-327.

Park, N. K., & Hill, P. W. (2014). Is adoption an option? The role of importance of motherhood and fertility help-seeking in considering adoption. *Journal of Family Issues,* 35 (5), 601-626.

Pew Research Center. (2015). *Childlessness Falls, Family Size Grows Among Highly Educated Women.* Washington, D.C.: May.

Quesnel-Vallée, A., & Morgan, S. P. (2003). Missing the target? Correspondence of fertility intentions and behavior in the U.S. *Population Research and Policy Review,* 22 (5), 497-525.

Raine, T., Minnis, A.M., & Padian, N.S. (2003). Determinants of contraceptive method among young women at risk for unintended pregnancy and sexually transmitted infections. *Contraception,* 68, 19-25.

Reed, J., England, P., Littlejohn, K., Bass, B.C., & Caudillo, M.L. Brooke Conroy Bass. (2014). Consistent and inconsistent contraception among young women: Insights from qualitative interviews. *Family Relations,* 63: 244-258.

Reyna, V.F., Nelson, W.L., Han, P.K., & Dieckmann, N.F. (2009). How numeracy influences risk comprehension and medical decision making. *Pyshcological Bulletin,* 135, 943-973.

Royston, P. & White, I. R. (2011). Multiple imputation by chained equations (MICE): Implementation in Stata. *Journal of Statistical Software,* 45 (4).

Russo, N. F. (1976). The motherhood mandate. *Journal of Social Issues,* 32 (3), 143-153.

Polis, C.B., & Zabin, L.S. (2012). Missed conceptions or misconceptions: perceived infertility among unmarried young adults in the United States. *Perspectives on Sexual and Reproductive Health,* 44, 30-38.

Sandefur, G. D., Martin, M. A., Eggerling-Boeck, J., Mannon, S., & Meier, A. (2001). An overview of racial and ethnic demographic trends. In: Smelser, N.J., Wilson, W.J., & Mitchell, F., editors. *America Becoming: Racial Trends and Their Consequences.* Washington, DC: National Academy Press; pp. 40102.

Sandelowski, M., Holditch-Davis, D, & Harris, B.G. (1990). Living the life: Explanations of infertility. *Sociology of Health and Illness,* 12, 195-215.

Schmidt, L. (2008). Risk preferences and the timing of marriage and childbearing. *Demography,* 45, 439-460.

Schoen, R., Astone, N. M., Kim, Y.J., Nathanson, C. A., & Fields, J. M. (1999). Do fertility intentions affect fertility behavior? *Journal of Marriage and Family,* 61 (3), 790-799.

Settle, B., & Brumley, K. (2014). "Its the choices you make that get you there": decision-making pathways of childfree women. *Michigan Family Review,* 18 (1), 1-22.

Sonfield, A., Hasstedt, K., & Gold, R.B. (2014). Moving forward: Family planning in the era of health reform. New York: Guttmacher Institute.

Steele, E. J., Giles, L. C., Davies, M. J., & Moore, V. M. (2014). Is precarious employment associated with women remaining childless until age 35 years? Results from an Australian birth cohort study. *Human Reproduction,* 29 (1), 155-160.

Stewart, S. D. The effect of stepchildren on childbearing intentions and births. *Demography,* 39 (1), 181-197.

Studer, M. (2013). WeightedCluster Library Manual: A practical guide to creating typologies of trajectories in the social sciences with R. LIVES Working Papers 24.

Tanturri, M. L., & Mencarini, L. (2008). Childless or childfree? Paths to voluntary childlessness in Italy. *Population and Development Review,* 34 (1), 51-77.

Trent, K. (1994). Family context and adolescents' fertility expectations. *Youth & Society,* 26 (1), 118-137.

Trent, M.E., Rich, M., Austin, S.B., & Gordon, C.M. (2003). Fertility concerns and sexual behavior in adolescent girls with polycystic ovary syndrome: implications for quality of life. *Journal of Pediatric and Adolescent Gynecology,* 16:33-37.

Veevers, J. E. (1973). Voluntary childless wives: An exploratory study. *Sociology and Social Research,* 57, 356-366.

Waren, W., & Pals, H. (2013). Comparing characteristics of voluntarily childless men and women. *Journal of Population Research,* 30 (2), 151-170.

White, L., McQuillan, J., Greil, A.L., & Johnson, D.R. (2006a). Infertility: Testing a helpseeking model. *Social Science & Medicine,* 62, 1031-1041.

White, L., McQuillan, J., & Greil, A.L. (2006b). Explaining disparities in treatment seeking: The case of infertility. *Fertility and Sterility,* 85, 853-857.

Willekens, F. J. (1991). Understanding the interdependence between parallel careers. In: *Female Labour Market Behaviour and Fertility: a Rational-Choice Approach.* Edited by Siegers, J.J., de Jong-Gierveld, J., & van Imhoff, E. New York, New York/Berlin, Germany, Springer-Verlag, 11-31.

Zegers-Hochschild, F., Adamson, G.D., de Mouzon, J., Ishihara, O., Mansour, R., Nygren, K., Sullivan, E., van der Poel, S. (2009). International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) revised glossary of ART terminology, 2009. *Fertility and Sterility,* 92: 1520-1524.

Appendix

The selection of the clustering algorithm (Ward's or k-medoid) and number of clusters was jointly determined by evaluating several measures of partition quality provided in the WeightedCluster package in R (for more details about the measures presented here, see Studer (2013)).

I use the following measures of partition quality summarized in the table below (adapted from Studer (2013)).

Name	Abrv.	Range	Min/Max	Interpretation
Average Silhouette Width (weighted)	ASWw	[-1; 1]	Max	Coherence of assignments. High coherence indicates high between-group distances and strong within-group homogeneity.
Hubert's Gamma	HG	[-1; 1]	Max	Measure of the capacity of the clustering to reproduce the distances (order of magnitude).
Point Biserial Correlation	PBC	[-1; 1]	Max	Measure of the capacity of the clustering to reproduce the distances.
Hubert's C	HC	[0; 1]	**Min**	Gap between the partition obtained and the best partition theoretically possible with this number of groups and these distances.
Pseudo R^2	R2	[0; 1]	Max	Share of the discrepancy explained by the clustering solution (only to compare partitions with identical number of groups).
Pseudo R^2 (squared)	R2sq	[0; 1]	Max	As previous, but using squared distances.

I graph standardized values of each of these measures across 15 possible cluster solutions to assess the performance of the clustering algorithm and aid in the selection of the number of clusters (Appendix Figure 1). As implied by the "Min/Max" column in the table, higher values for all metrics except HC suggest better performance.

As seen in Appendix Figure 1, the k-medoid clustering algorithm outperforms Ward's for most cluster solutions across all quality measures. Exceptions come from the 3-cluster solution using Ward's, which may be due to assumptions of hierarchical clustering underlying the algorithm. Notably, however, both measures of R2 and R2sq are higher for the k-medoid algorithm across all possible cluster solutions.

The selection of the number of clusters based on the k-medoid algorithm is aided by identifying local maxima for the ASWw, HG, and PBC measures, and local minima for the HC metric. Both ASWw and PBC show local maximum peaks at 2, 5, and 7 clusters. For both the HG and HC, however, no local maximum or minimum peaks emerge; instead, values for these measures suggest better performance as cluster number increases.

Using these quality measures as a guide, I choose a 5-cluster k-medoid solution to provide sufficient varation across groups without introducing excessive complexity with inadequately sized groups.

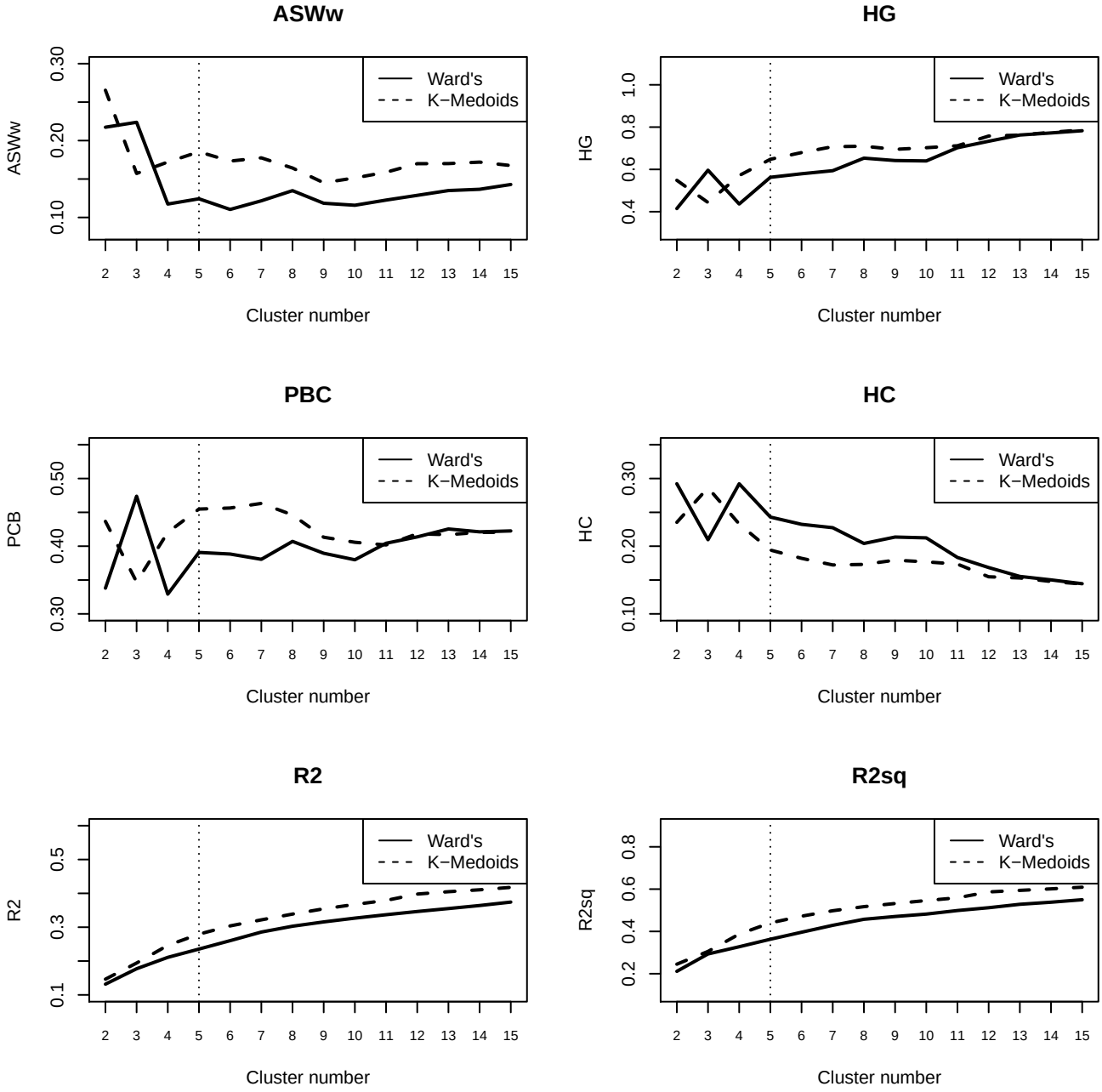

Figure 1: Quality measures of clustering results.