Demography (2019) 56:201–228
https://doi.org/10.1007/s13524-018-0747-7

Dimensions of Reproductive Attitudes and Knowledge Related to Unintended Childbearing Among U.S. Adolescents and Young Adults

Karen Benjamin Guzzo[1] · Sarah R. Hayford[2] · Vanessa Wanner Lang[1] · Hsueh-Sheng Wu[3] · Jennifer Barber[4] · Yasamin Kusunoki[5]

Published online: 6 December 2018

Abstract

Measures of attitudes and knowledge predict reproductive behavior, such as unintended fertility among adolescents and young adults. However, there is little consensus as to the underlying dimensions these measures represent, how to compare findings across surveys using different measures, or how to interpret the concepts captured by existing measures. To guide future research on reproductive behavior, we propose an organizing framework for existing measures. We suggest that two overarching multidimensional concepts—*reproductive attitudes* and *reproductive knowledge*—can be applied to understand existing research using various measures. We adapt psychometric analytic techniques to analyze two data sets: the National Longitudinal Survey of Adolescent to Adult Health (Add Health) and the Relationship Dynamics and Social Life study (RDSL). Although the specific survey measures and sample composition of the two data sets are different, the dimensionality of the concepts and the content of the items used to measure their latent factors are remarkably consistent across the two data sets, and the factors are predictive of subsequent contraceptive behavior. However, some survey items do not seem strongly related to any dimension of either construct, and some dimensions of the two concepts appear to be poorly measured with existing survey questions. Nonetheless, we argue that the concepts of reproductive attitudes and reproductive knowledge are useful for categorizing and analyzing social psychological measures related to unintended fertility. The results can be used to guide secondary data analyses to predict reproductive behavior, compare results across data sets, and structure future data collection efforts.

Keywords Attitudes · Contraception · Measurement · Unintended fertility

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s13524-018-0747-7) contains supplementary material, which is available to authorized users.

✉ Karen Benjamin Guzzo
kguzzo@bgsu.edu

Extended author information available on the last page of the article

Introduction

Attitudes and knowledge about pregnancy and contraception are important determinants of reproductive behavior (Brückner et al. 2004; Craig et al. 2014; Deptula et al. 2006; Garfield et al. 2016; Hayford and Guzzo 2013; Jaccard et al. 2003; Ryan et al. 2007; Shneyderman and Schwartz 2013). Yet despite (or perhaps because of) the massive body of research studying this relationship, there is no clear consensus as to the types of attitudes and knowledge that are most important for understanding reproductive outcomes or the degree to which current surveys capture attitudes and knowledge. One challenge in building consensus in this body of research is the range of different concepts and measures used to predict outcomes. For instance, Jaccard et al. (2003) found that subsequent teen pregnancy rates are higher among adolescents who agree that, "It would not be all that bad if I got pregnant at this time in my life," and disagree that, "Getting pregnant at this time in my life is one of the worst things that could happen to me." In contrast, Frost et al. (2012) reported that agreeing with the statement, "Every pregnancy is a blessing," is not significantly associated with contraceptive use in a sample of unmarried young adults. It is not clear whether the apparent contradictions across studies reflect true differences in the way attitudes are linked to various outcomes across samples and age groups or are simply the result of measurement differences.

In this study, we draw on existing theories, two data sets, and psychometric methods to propose an organizing conceptual framework for studying attitudes and knowledge that predict reproductive behavior. We seek to systematically identify the different underlying factors linked to reproductive behavior and analyze the extent to which measures currently available in widely used surveys appear to capture those factors. We focus on adolescents and young adults in the United States, for whom unintended pregnancy is most common, and propose two core concepts: (1) reproductive attitudes about preventing pregnancy, and (2) reproductive knowledge. To identify the dimensions of these concepts, we apply factor analysis to two data sets: the widely used National Longitudinal Study of Adolescent to Adult Health (Add Health) and the more recent Relationship Dynamics and Social Life (RDSL) study. We concentrate on measures linked to contraceptive use, the primary source of variation in reproductive outcomes among adolescents and young adults (Lindberg et al. 2016; Santelli et al. 2004, 2007; Sweeney and Raley 2014), and test whether our proposed concepts predict subsequent contraceptive behavior.

Classifying Attitudes and Knowledge About Reproduction

Multiple theories address the relationships between social psychological characteristics and behavior. Those most widely used by demographers include the theory of planned behavior (TPB; see Fishbein and Ajzen 2010; Philipov et al. 2009), the traits-desires-intentions-behaviors model (TDIB; see Miller 1994, 1995; Miller et al. 2004), and the cognitive-social model (Bachrach and Morgan 2013). These theories, for the most part, propose complementary rather than competing explanations for reproductive behavior. They all share the understanding that reproductive behavior is determined by a combination of rational, deliberative decision-making and more intuitive or

emotionally driven processes that may be semi- or subconscious. Thus, for example, TPB proposes that behavior is shaped by the interaction of intentions, normative environment, and the level of perceived control over behavior, while TDIB hypothesizes that persistent traits (including general attitudes) as well as desires for children drive reproductive intentions and, ultimately, behavior. The cognitive-social model focuses explicitly on "the interplay of automatic and deliberative processes" (Bachrach and Morgan 2013:460). A key shared insight across these frameworks is that attitudes and knowledge both contribute to the formation of intentions and influence behavior net of intentions. Thus, for example, even a woman who does not want or intend to conceive a child may become pregnant if she does not know how to contracept effectively or if she believes that family planning is immoral. And even among women who do not intend to have a child, those who have more positive attitudes toward childbearing are more likely to become pregnant (Hayford et al. 2016).

These frameworks have generated a large body of empirical research on the measures that predict contraceptive use and fertility. However, for the most part, they do not provide clear guidelines for organizing the types of attitudes and knowledge that predict behavior, nor do they address the extent to which existing survey items fully capture these multifaceted concepts. The current work addresses these issues in two ways. First, we attempt to impose order on the mass of existing measures by proposing two core concepts: attitudes toward preventing pregnancy (hereafter, *reproductive attitudes*) and knowledge about contraception and the reproductive process (hereafter, *reproductive knowledge*). These concepts synthesize earlier research by incorporating most of the predictors discussed in existing theoretical frameworks or studied in existing empirical research on contraceptive use and unintended pregnancy. Following long-standing practice in demography (e.g., Coale 1973; Green 1969; Heisel 1968), we separate knowledge about contraception and reproduction from attitudes toward preventing pregnancy because these two domains represent different types of cognitive processes. Attitudes toward preventing pregnancy are internalized notions of reasons to have (or avoid having) children but also reasons to take (or avoid taking) the steps to control reproductive outcomes, whereas knowledge about contraception and reproduction captures the tools necessary to allow individuals to implement reproductive preferences and goals.

Second, we combine existing research and theory with psychometric methods to draw conclusions about the ways specific measures that are available in current data sets represent reproductive attitudes and knowledge and their underlying factors. Ideally, researchers would use psychometric techniques to explore and identify constructs underlying these items *prior* to using these items in research to draw substantive conclusions. Psychometric analysis is an iterative process involving creating and testing survey measures, conducting exploratory factor analysis to determine whether the measures represent a latent factor or factors, revising and retesting measures, using confirmatory factor analysis to demonstrate the relationship among survey measures and latent factor(s), and validating that the latent factor being measured is sufficiently correlated with gold-standard measures or outcomes (Worthington and Whittaker 2006). This process should produce measures that researchers can adopt to operationalize key concepts. For example, many social science surveys include some version of the Center for Epidemiological Studies Depression (CESD) scale, the properties of which have been widely tested and established. As such, both data

collectors and researchers have a standard set of survey measures to examine depressive symptoms and their relationship to other characteristics and behaviors. To date, though, this is not how indicators of attitudes and knowledge about reproduction have been generally developed and used in the demographic literature, making it difficult to synthesize the findings. This difficulty, in turn, reinforces the piecemeal approach to choosing measures in secondary data analyses and likely contributes to variation in which measures will be included in future data collection efforts. Our goal in this article is not to explicitly identify new measures; rather, we seek to understand how to better use and interpret the multiple measures that already exist in large population-based data sets. Moreover, we also note where existing measures appear to be weakly linked or unrelated to concepts or where underlying factors are measured with very few survey questions.

In our conceptualization, *reproductive attitudes* incorporate attitudes toward pregnancy and childbearing as well as attitudes toward contraception. This conceptualization follows earlier frameworks that treated attitudes toward pregnancy and attitudes toward contraceptive methods as distinct but related predictors of reproductive behavior (e.g., Lee and Bulatao 1983; Miller 1986). Existing research analyzing these attitudes has drawn on different theoretical framings while sharing the common argument that attitudes about childbearing are important predictors. For instance, many studies—particularly those focused on teens—used a rational choice framework that considers the costs and benefits of having children, (e.g., Deptula et al. 2006; Driscoll et al. 2005; Liefbroer 2005). Other research focused on the combination of positive and negative attitudes (labeled as indifference, ambivalence, antinatalism, or pro-pregnancy/pronatalism) (e.g., Brückner et al. 2004; Jaccard et al. 2003; Miller et al. 2017). Reproductive behavior is also closely linked to attitudes about the acceptability of using methods to avoid childbearing (Brückner et al. 2004; Ryan et al. 2007; Sieving et al. 2007). Although most research using attitudes to predict reproductive outcomes incorporated multiple measures, few researchers have explicitly paid attention to the measurement properties; the few exceptions (Deptula et al. 2006; Miller 1995) did not consider attitudes toward using (or not using) contraception as part of attitudes toward avoiding pregnancy. As such, the general takeaway from these studies is unclear.

We do not include direct measures of fertility intentions or desires (e.g., "on a scale of one to five, how much do you want to get pregnant right now?" or "do you plan to have a child in the next two years?") in our conceptualization of reproductive attitudes. Instead, we focus on the more distal determinants of fertility behavior that theoretically have a causal link to intentions and desires. Some theoretical frameworks conceptualize intentions and desires as independent of attitudes (e.g., Fishbein and Ajzen 2010), whereas others describe a causal relationship between general attitudes, desires, and specific intentions (Miller 1994, 1995). Empirically, attitudes toward pregnancy and contraception vary even within women who do not intend to become pregnant, and attitudes have predictive power independent of intentions (Hayford et al. 2016).

Reproductive knowledge includes knowledge about reproductive biology, knowledge about the existence of different contraceptive methods, and knowledge about the use and effectiveness of different methods, along with confidence in that knowledge. Previous research has demonstrated that reproductive knowledge predicts contraceptive use and pregnancy (Frost et al. 2012; Rocca and Harper 2012; Ryan et al. 2007) and that levels of reproductive knowledge in the U.S. population vary substantially, especially among

young adults (Frost et al. 2012; Guzzo and Hayford 2012; Kaye et al. 2009; Wynn et al. 2009). To date, research has organized measures of reproductive knowledge in different ways. For example, some studies measured knowledge about how to use condoms separately from knowledge about hormonal contraception or the female reproductive cycle (Frost et al. 2012; Ryan et al. 2007), and other scholars considered an individual's level of confidence about the accuracy of knowledge as a separate concept (Crosby and Yarber 2001). Some work used responses to single survey questions rather than grouping them in any fashion (Borrero et al. 2013; Craig et al. 2014). The variability across studies in which measures were analyzed and grouped together—or even included in surveys to begin with—inhibits identification of the dimensions of reproductive knowledge that are likely most salient for reproductive behaviors. Moreover, results have varied considerably across studies of sexual and reproductive behavior (Brückner et al. 2004; Ryan et al. 2007; Santelli et al. 2000). Such variability could be attributed not only to differences in the measures used but also to more basic problems, such as confusing questions or the use of unfamiliar terms, an issue perhaps especially relevant for teens and young adults. For instance, Hockenberry-Eaton and colleagues (Hockenberry-Eaton et al. 1996) suggested that technical terms such as "ovulation" or "ejaculation" are unfamiliar to many adolescents.

Current Research

Based on prior work, we propose a multidimensional set of constructs comprising attitudinal and knowledge-based precursors of reproductive behavior and test this framework by applying it to questions available in two data sets used to study adolescent and young adult fertility: the National Longitudinal Survey of Adolescent to Adult Health (Add Health) and the Relationship Dynamics and Social Life (RDSL) study. These two surveys include a wide range of measures related to reproduction, and the RDSL study includes some of the same questions used in Add Health. However, the two surveys were conducted approximately 15 years apart and have different sample frames, with Add Health including males and females and RDSL including only females (additional differences are discussed later). Thus, the two surveys constitute a useful test for the generalizability of our proposed framework.

We conducted exploratory factor analysis (EFA) to understand the structure of associations between these items and to identify potential latent factors and then tested the models generated through EFA using confirmatory factor analysis (CFA). We used an iterative model-building process guided by existing research and theory as well as model fit statistics to establish a good-fitting model (Brown and Cudeck 1992; Hu and Bentler 1999; MacCallum et al. 1996) describing the latent factors underlying the concepts of reproductive attitudes and reproductive knowledge. In maximizing model fit, and guided by our expectations of these two concepts as multidimensional, we placed secondary importance on adhering to other traditional EFA and CFA rules of thumb, such as the minimum number of items to include in a factor or ideal factor loadings, examples of which can be found in Tabachnick and Fidell (2001) or Worthington and Whittaker (2006), among others. Our approach reveals the underlying factors that comprise reproductive attitudes and reproductive knowledge but also points to where and how measures that are currently available in surveys may not thoroughly

capture the concepts they seemingly are meant to measure. This approach also permits us to identify where caution should be exercised in interpreting results using these measures and to provide insight into where future data collection efforts may need to consider adding or refining existing measures. Finally, we briefly show results documenting the association between our factors and subsequent contraceptive use as a basic demonstration of validity. We focus on contraceptive use because, as described earlier, it is the proximate determinant that explains the most variation in unintended fertility in these age groups.

Data and Methods

Data

We began with the National Longitudinal Survey of Adolescent to Adult Health (Add Health) (Harris et al. 2009). Add Health first surveyed males and females in grades 7–12 (ages 12–19) in 1995 ($N = 20{,}743$). Respondents were reinterviewed in 1996, 2001–2002, and 2007–2008. We used data from the Wave I interview in the factor analyses and data from the Wave III interview in the analysis of contraception. Only respondents aged 15 and older were asked questions about sex, reproduction, and contraception, reducing our Wave I analytic sample size to 15,072. We further excluded 1,237 respondents with missing values on the weight variables (oversamples of key groups). For reproductive attitudes, 84 respondents were missing responses on all key items (discussed later herein), producing a final analytic sample of 13,751 males and females for these analyses. For reproductive knowledge, 171 respondents had missing responses on all key items, producing a final analytic sample of 13,664 males and females.

The Relationship Dynamics and Social Life (RDSL) study is a longitudinal survey of attitudes and behavior related to sex, contraception, fertility, and intimate relationships among young women living in a single county in Michigan (Barber et al. 2011). The study began in 2008–2009 with an in-person interview using a simple random sample of 1,003 women aged 18–19 drawn from the Michigan driver's license and personal identification card database. Respondents were subsequently followed weekly for up to 130 weeks (2.5 years); we used data from the baseline survey for the factor analyses and data from the weekly follow-ups for the analysis of contraceptive behavior. The response rate for the baseline interview was 84 %. For reproductive attitudes, the analytic sample is the full sample of RDSL, but for reproductive knowledge, the analytic sample is 1,002 because one respondent did not provide valid answers to any of the questions (discussed later).

Measures

In Add Health, we searched for relevant survey questions among 39 modules, identifying items from five modules (pregnancy risk perceptions, attitudes toward birth control, attitudes toward engaging in risky behaviors, reproductive knowledge quiz, and personality and family). Specifically, we found 16 questions that potentially reflect reproductive attitudes and 13 that potentially reflect reproductive knowledge.

Reproductive attitudes items were recoded so that higher scores reflect favorable attitudes toward preventing pregnancy (less favorable attitudes toward pregnancy/childbearing or more favorable attitudes toward birth control). Seven of the reproductive knowledge questions were measured as true or false and recoded so that 1 indicates the correct answer and 0 indicates the incorrect answer. We also included a question indicating the respondent's perception of the risk of pregnancy following a single act of unprotected sex, measured on a scale ranging from 1 = almost no chance to 5 = almost certain chance. Three of the reproductive knowledge questions (confidence about specific contraceptive methods) were originally on a scale of strongly disagree to strongly agree and were recoded as dichotomous variables, with strongly agree and agree coded together (confident) and neutral, disagree, and strongly disagree coded together (not confident).

Because the RDSL study was designed primarily to measure attitudes and behavior related to sex, contraception, and pregnancy, it contains a wider range of measures of attitudes than Add Health. We identified the items most closely related to the core concept of attitudes toward preventing pregnancy and using contraception (and which corresponded as closely as possible to the Add Health measures)—namely, perceived risk of pregnancy, expected personal consequences of pregnancy, attitudes toward early childbearing, and attitudes toward contraception—for a total of 25 questions. Responses were recoded so that negative attitudes toward pregnancy/childbearing and positive attitudes toward contraception had the highest values. In the original RDSL data set, neutral response options (e.g., neither agree nor disagree) were not provided but were available for respondents who volunteered them. We recoded neutral responses as the midpoint.[1] To measure reproductive knowledge, we used eight true/false questions measuring knowledge about pregnancy and the menstrual cycle, condom use, and hormonal contraception. Responses were recoded to 1 for a correct answer and 0 for an incorrect answer. Additionally, a question from Add Health assessing the respondent's perception of the risk of pregnancy following a single act of unprotected sex ("sex once") was repeated in RDSL but with continuous response options ranging from 1 to 100; we recoded responses into quintiles to make it comparable to Add Health (1 = almost no chance to 5 = almost certain chance).

Tables 1 and 2 list the wording and variable names of the reproductive attitudes and reproductive knowledge questions, respectively, for both Add Health and RDSL. Add Health estimates are weighted to account for the survey design (Chantala 2001), but RDSL uses a simple random sample and does not require weighting. Table 1 also shows means and standard deviations for the measures that potentially indicate reproductive attitudes. For the potential reproductive knowledge items, Table 2 indicates the correct answer in parentheses for the true/false items and the proportion answering correctly; the proportion answering strongly agree/agree for the confidence items; and the mean and standard deviation for the perception of pregnancy risk from unprotected sex item.

[1] We conducted sensitivity tests to see whether this approach to handling neutral responses affected results. Specifically, we recoded the "neutral" category in both surveys to missing and reran the EFA and CFA. We found a very slight decrease in overall goodness of fit for the reproductive attitudes factor structure in RDSL, but fit statistics remained within the acceptable range. We found virtually no change in fit in Add Health. In addition, the pattern of factor loadings remained the same, and the significance of all the factor loadings remained the same.

Table 1 Potential reproductive attitudes measures in Add Health (weighted) and RDSL[a]

	Variable Name	Add Health Mean (SD)	RDSL Mean (SD)
Using birth control is morally wrong.	*BC morally wrong*	4.14 (1.04)	4.27 (0.72)
If a woman waits for the perfect time to have a baby, she will probably have trouble getting pregnant.	*wait perfect time*		3.57 (0.95)
Getting pregnant at this time in your life is one of the worst things that could happen to you.	*preg worst*	4.32 (1.00)	3.88 (1.26)
It wouldn't be all that bad if you got pregnant at this time in your life.	*preg not bad*	4.21 (1.00)	3.80 (1.10)
If you had a baby now, you would feel less lonely.	*baby less lonely*		3.94 (0.88)
If you got pregnant now, you could handle the responsibilities of parenting.	*preg handle parenting*		3.20 (1.33)
If you got pregnant, you would be forced to grow up too fast.	*preg grow up fast*	3.85 (1.15)	3.23 (1.22)
It is easy for you to get birth control.	*BC easy to get*	3.63 (1.22)	4.03 (0.84)
If you got pregnant, you would have to quit school.	*preg quit school*	2.39 (1.16)	2.31 (1.03)
If you got pregnant now, your partner would be happy.	*preg partner happy*		3.50 (1.77)
If you got pregnant now, you could not afford to raise the child.	*preg not afford*		3.40 (1.22)
In general, birth control is too much of a hassle to use.	*BC hassle*	4.04 (1.15)	4.22 (0.84)
It takes too much planning ahead of time to have birth control on hand when you're going to have sex.	*BC planning*	3.93 (1.10)	4.18 (0.62)
Using birth control interferes with enjoyment.[b]	*BC less pleasure*	3.76 (1.14)	4.11 (0.65)
In general, birth control is too expensive to buy.	*BC expensive*	3.89 (1.08)	3.90 (0.87)
If you got pregnant now, your family would help you raise the child.	*preg family help*		2.03 (0.92)
If a woman asks her partner to use a condom, he will think that she doesn't trust him.	*condom mistrust*		3.75 (1.22)
It is better to have kids young because the grandparents can be more involved.	*young grandparents*		3.60 (1.14)
It is better to get pregnant young because young women's bodies recover faster.	*young recover*		3.81 (1.02)
It is easier for young women to lose weight after a pregnancy.	*young lose weight*		3.23 (1.11)
It is hard for kids to have the oldest parents at their school.	*hard old parents*		3.63 (0.99)
Using birth control is likely to make a woman feel sick.	*BC sick*		3.36 (1.05)

Table 1 (continued)

	Variable Name	Add Health Mean (SD)	RDSL Mean (SD)
Babies born to older mothers have more health problems.	*older mom, baby problems*		3.19 (1.04)
If a girl uses birth control, she is looking for sex.[c]	*BC looking for sex*	3.52 (1.19)	4.07 (0.77)
You can't afford to pay for birth control.	*BC not afford*		3.92 (0.89)
If you got (If respondent is male, add: someone) pregnant, it would be embarrassing for your family.	*preg embarrass family*	3.63 (1.29)	
If you got pregnant (If respondent is male, add: someone), it would be embarrassing for you.	*preg embarrass self*	3.62 (1.36)	
If you got pregnant, you would have to decide whether or not to have the baby, and that would be stressful and difficult.	*preg abortion*	3.84 (1.26)	
If you got pregnant, you might marry the wrong person, just to get married.	*preg marry wrong*	3.18 (1.31)	
It {IS/WOULD BE} too hard to get a {GIRL/BOY} to use birth control with you.	*BC hard partner*	3.87 (1.07)	

[a] In Add Health, unless otherwise indicated, all items are measured on a scale of 1 = strongly agree to 5 = strongly disagree, with 3 = neither agree nor disagree. In RDSL, unless otherwise indicated, all items are measured on a scale of 1 = strongly disagree to 4 = strongly agree, with no neutral response offered but recorded when insisted upon by respondents. RDSL responses were recoded to correspond with Add Health. Analytically, items were reverse-coded as necessary such that higher responses indicate less favorable attitudes toward childbearing and more favorable attitudes toward contraception.

[b] In Add Health, this question was worded, "For you, using birth control interferes/would interfere with sexual enjoyment."

[c] In Add Health, this question was worded, "If you used birth control, your friends might think that you were looking for sex."

To assess whether these factors are linked to outcomes, we predicted subsequent contraceptive use based on two indicators. For Add Health, we used the Wave III survey, carried out in 2001–2002, approximately six years after Wave I.[2] The first indicator is whether the respondent used any contraception the last time they had sex (among those who had sex in the 12 months preceding the survey). The second indicator is a three-category measure of method effectiveness based on responses to a list of nine possible methods used over the past 12 months: effective (the Pill; implant; shot; morning-after pill; IUD; or male/female sterilization), least effective (condom; diaphragm; or natural family planning, such as safe periods by temperature, cervical mucus test, or calendar), or no method. For the RDSL, we use two similar measures from the weekly follow-up surveys: any contraceptive use and method effectiveness, differentiated as effective (the Pill; ring; patch; IUD; implant; or shot) or less effective (condom; withdrawal; or no method); see Kusunoki et al. (2016) for more details on the RDSL contraceptive measures. Note that the distinction between effective and less effective methods is essentially a comparison between hormonal methods and coitus-specific methods. Each analysis controls for a basic set of demographic variables: age, gender (Add Health), race/ethnicity, maternal education, and family structure during adolescence.

Analytic Approach

Variables were coded in Stata 14, and all EFA and CFA analyses were run using Mplus 7. Factor analyses using Add Health data were weighted. We used both EFA and CFA (Devellis 2012) to identify underlying factors. Because many of the items are binary or categorical, the analyses use robust weighted least squares (WSLMV), an estimator that does not assume a normal distribution (Brown 2006).

We conducted an EFA with WSLMV with standard errors and oblique rotation, which allows the factors to be correlated. We compared the fit of models with different numbers of items and factors using two goodness-of-fit criteria: root mean-squared error of approximation (RSMEA) and comparative fit index (CFI). We conducted a chi-square test of model fit to determine significant differences in the improvement of model fit across models (Hu and Bentler 1999). RSMEA values of .01, .05, and .08 are indicators of excellent, good, and mediocre fit, respectively (Brown and Cudeck 1992; MacCallum et al. 1996). We used a cutoff of .05 or lower to indicate a good-fitting model. The CFI ranges from 0 (poor fit) to 1 (perfect fit), and values of a .90 or higher provide evidence for adequate model fit, with scores above .95 indicating excellent fit (Hu and Bentler 1999).

EFA is, in essence, a method that simplifies numerous measures that are likely interrelated but does not require an *a priori* expectation of the number of latent factors or of which items load on a particular factor. In EFA, all items are allowed to load on all latent factors rather than on predetermined factors, and multiple models with different numbers of latent factors are explored. The multiple EFA results are used to determine

[2] We chose Wave III rather than Wave II to maximize sample size. Wave II reinterviewed only those still enrolled in school. Additionally, contraceptive behavior was measured only for those who were sexually active; many had not yet had sex by Wave II. Finally, of those who had sex, some reported that their most recent sex predated the Wave I survey, precluding any causal conclusions.

Table 2 Potential reproductive knowledge measures and distributions in Add Health (weighted) and RDSL: Percentages unless otherwise indicated

	Variable Name	Add Health	RDSL
True/False Questions,[a] Proportion Answering Correctly			
Most women's periods are regular, that is, they ovulate or are fertile fourteen days after their periods begin. (false)	ovulate	27.2	21.5
The most likely time for a woman to get pregnant is right before her period starts. (false)	before period	42.4	41.7
In general, a woman is most likely to get pregnant if she has sex during her period, as compared with other times of the month. (false)	during period	60.4	68.9
When a women has sexual intercourse, almost all sperm die inside her body after about six hours. (false)	sperm die	59.8	
Even if the man pulls out before he ejaculates, even if ejaculation occurs outside of the woman's body, it is still possible for the woman to become pregnant. (true)	withdraw, get preg	80.5	81.8
When putting on a condom, it is important to have it fit tightly, leaving no space at the tip. (false)	condom fit tight	57.0	63.1
Vaseline can be used with condoms, and they work just as well. (false)	Vaseline	68.5	
As long as the condom fits over the tip of the penis, it doesn't matter how far down it is unrolled. (false)	fully unroll	89.2	96.0
When using a condom, the man should pull out of the woman right after he has ejaculated. (false)	pull out	74.4	70.8
When a woman misses more than two days of birth control pills, she should use another birth control method. (true)	miss pills		70.5
If you were to have sexual intercourse once or twice without using birth control, what are the chances that you would get pregnant?[b] (mean)	sex once	3.21 (0.97)	3.30 (1.23)
Confidence Questions,[c] Proportion Answering Strongly Agree/Agree			
You are quite knowledgeable about the rhythm method of birth control and when it is a "safe" time during the month for a woman to have sex and not get pregnant.	rhythm confidence	57.8	
You are quite knowledgeable about how to use a condom correctly.	condom confidence	89.0	
You are quite knowledgeable about the withdrawal method of birth control.[b]	withdrawal confidence	70.1	

[a] Analytically, items were recoded so that 1 equals the correct answer, and 0 equals the incorrect answer.

[b] In Add Health, this item was measured on a scale of 1 = almost no chance to 5 = almost certain, In RDSL, this item was measured on a scale of 1 % to 100 %, which we recoded to correspond with Add Health.

[c] Originally measured on a scale of 1 = strongly agree to 5 = strongly disagree. Recoded as a dichotomous variable: 1 = strongly agree/agree and 0 = all other responses.

how many latent factors are sufficient to account for the covariance of these items. After determining the number of latent factors by comparing model fit statistics across models with different numbers of latent factors, researchers then identify items that are highly associated with each of these factors, guided by the size and magnitude of factor loadings as well as theory. Thus, although EFA starts with all items loading on all latent factors, it eventually leads to a more parsimonious factorial structure in which each of latent factors is defined and measured by different items.

We then used CFA to test the parsimonious model found in the EFA. CFA requires a more restrictive set of assumptions and tests whether the hypothesized factorial structure from EFA is supported within the data. Although CFA uses the same goodness-of-fit statistics and criteria, the underlying calculations are different because the researcher specifies the number of factors and which items load onto which factor. We often found that a factorial structure deemed good in EFA was unacceptable in the CFA. We then examined which factors and items seemed problematic in the CFA and returned to the EFA. As such, model identification was an iterative process in which we moved back and forth testing models in EFA and CFA, beginning with all potential items and then removing items and adjusting the number of factors as necessary to achieve the best-fitting model in the CFA. As noted earlier, maximizing model fit and consistency with prior research and theory were the guiding principles.

Widely used rules of thumb are that there should be at least three items in a factor and that EFA factor loadings should be statistically significant and at least 0.3 (Grice 2001; Tabachnick and Fidell 2001; Worthington and Whittaker 2006). However, we did not strictly adhere to these rules of thumb. Low factor loadings or latent factors with only two measures can point to how existing measures are insufficient to fully capture the hypothesized latent construct; understanding these weaknesses in existing measures is one of our goals. Although higher factor loadings suggest that a particular measure strongly indicates the underlying factor, the primary concern in CFA is that all factor loadings are significantly different from 0; low loadings do not take away from the validity of a factor itself.

One concern is that the shared wording of many of the items could lead to similar responses due to question wording rather than due to content (method effects). To address this possibility, we tested for correlated residuals among similarly worded questions in the final model identified in the CFA, setting the factor variance to 1 to allow all factor loadings to be freely estimated. Using the Santorra-Bentler scaled chi-square difference test, we identified which items (if any) had significant correlations. Only the reproductive attitudes models had any significant correlations; the models shown adjust for these method effects, but accounting for correlations did not change the fit or the factorial structure.

We begin by presenting factor analysis results for reproductive attitudes. We first analyzed the Add Health data and then replicated the results with RDSL. We followed the aforementioned iterative process for both data sets because the RDSL had substantially more items than Add Health, and we present the results for the EFA and CFA for both data sets. Next, we present the results for reproductive knowledge, again beginning with Add Health. Here, because of substantial overlap across surveys (of the eight items in RDSL, seven were identical to those in Add Health, with only one new variable), we were able to proceed directly to CFA in RDSL guided by the model identified in the Add Health analysis. As such, we present the EFA results for Add Health only but have CFA results for both Add Health and RDSL.

Finally, we present the results for analyses using the factors to predict subsequent contraceptive use using Stata 14, with factor scores exported from Mplus. In Add Health, the analysis is restricted to those with valid factor scores for both reproductive attitudes and knowledge at Wave I (N = 13,640), who participated in Wave III and had valid longitudinal weights (N = 10,131), and who had sex in the 12 months prior to the survey (N = 8,049). To predict use of any contraception, we estimated a logistic regression among those with valid responses about contraceptive use with most recent partner (N = 8,035). To analyze method effectiveness, we used multinomial logistic regression among those who provided responses about specific methods used over the past year (N = 8,020). For RDSL, we used logistic and multinomial logistic regression to analyze the weekly data. Person-weeks are the unit of analysis, and we adjusted the standard errors to account for the clustering of weeks within individuals. For models of any contraceptive use, we used the 12,994 person-weeks in which respondents had heterosexual intercourse; for method effectiveness, we used the 12,909 person-weeks in which the respondent reported contraceptive method information. For both data sets, we estimated two sets of models: one with our reproductive attitudes factors and one with our reproductive knowledge factors. Both sets of models control for basic sociodemographic variables.

Sensitivity Analyses

As noted earlier, Add Health and RDSL have different samples. A key difference is that Add Health includes both boys and girls, while RDSL includes young women only. For Add Health, we repeated the factor analyses for boys and girls separately. Factor structures for girls were identical to those identified in the full sample of both genders. For boys, questions about female reproductive biology did not load on any factor, but otherwise, the factor structure was the same. Full details from these gender-specific analyses are available on request from the authors.

Results for Reproductive Attitudes

Add Health Factor Analyses

For reproductive attitudes, we applied the aforementioned iterative EFA-CFA process to Add Health to identify measures and determine what factor or factors they indicated. In this process, we identified four measures ("preg abortion," "preg marry wrong," "BC easy to get," and "BC looking for sex") that did not fit into any factorial structure and were then removed from subsequent factor analyses. We then tested equivalent one-, two-, three-, and four-factor models using the remaining measures and determined that a three-factor model fit the data best (fit statistics across models are available in the online appendix), with 12 reproductive attitudes questions measuring three latent factors in Add Health. The EFA factor loadings from the best-fitting factorial pattern in both the EFA and CFA are shown in Table 3. We determined that two measures ("preg worst," and "preg not bad") loaded on the first factor; six measures ("BC morally wrong," "BC hassle," "BC hard partner," "BC planning," "BC less pleasure," and "BC expensive") loaded on the second factor; and four measures ("preg grow up fast," "preg quit school," "preg embarrass family," and "preg embarrass self") loaded on the third factor.

Table 3 Factor loadings from exploratory factor analysis (EFA) for three-factor model of reproductive attitudes in Add Health

	1	2	3
Factor 1			
Getting (If respondent is male, add: someone) pregnant at this time in your life is one of the worst things that could happen to you.[a] (*preg worst*)	**.812***	–.090*	–.005
It wouldn't be all that bad if you got (If respondent is male, add: someone) pregnant at this time in your life. (*preg not bad*)	**.648***	.013*	.086*
Factor 2			
Using birth control is morally wrong.[a] (*BC morally wrong*)	.011	**.514***	–.045*
In general, birth control is too much of a hassle to use.[a] (*BC hassle*)	.030	**.684***	.033
It takes too much planning ahead of time to have birth control on hand when you're going to have sex.[a] (*BC planning*)	–.015	**.796***	.011
It {IS/WOULD BE} too hard to get a {GIRL/BOY} to use birth control with you.[a] (*BC hard partner*)	–.049*	**.683***	–.003
For you, using birth control {interferes/would interfere} with sexual enjoyment.[a] (*BC less pleasure*)	.009	**.646***	–.002
In general, birth control is too expensive to buy.[a] (*BC expensive*)	.005	**.683***	–.022
Factor 3			
If you got (If respondent is male, add: someone) pregnant, you would be forced to grow up too fast. (*preg grow up fast*)	.018	–.138*	**.332***
If you got (If respondent is male, add: someone) pregnant, you would have to quit school. (*preg quit school*)	.181*	.017	**.330***
If you got (If respondent is male, add: someone) pregnant, it would be embarrassing for your family. (*preg embarrass family*)	–.075*	–.011	**.890***
If you got pregnant (If respondent is male, add: someone), it would be embarrassing for you. (*preg embarrass self*)	.020*	.013	**.886***

[a] Item is reverse-coded.

*$p < .05$

The final and best-fitting model from CFA is depicted in Fig. 1. The CFA confirmed that this three-factor model had very good model fit (CFI = .982, RSMEA = .024), and both the loadings and covariances of these factors were all significantly different from 0. Therefore, the CFA confirms that in the Add Health data, the correlations among the 12 measures of reproductive attitudes are adequately explained by three factors. Each of these factors is measured by a unique set of questions, and these factors appear to represent three logical subdimensions of reproductive attitudes.

The first factor, which we term *feelings toward pregnancy*, assesses how respondents feel about a hypothetical pregnancy. The second factor, which we term *birth control attitudes*, represents the respondent's overall orientation toward contraception; we interpret this as how costly (on a social, relational, and financial basis) it is to take steps to avoid pregnancy. The final factor, which we term *life course consequences*, measures how a hypothetical pregnancy—and specifically, a pregnancy at this age—would affect particular aspects of the respondent's life. The first factor has only two items: "preg worst" and "not bad." The general rule is that a factor should have at least three items, but

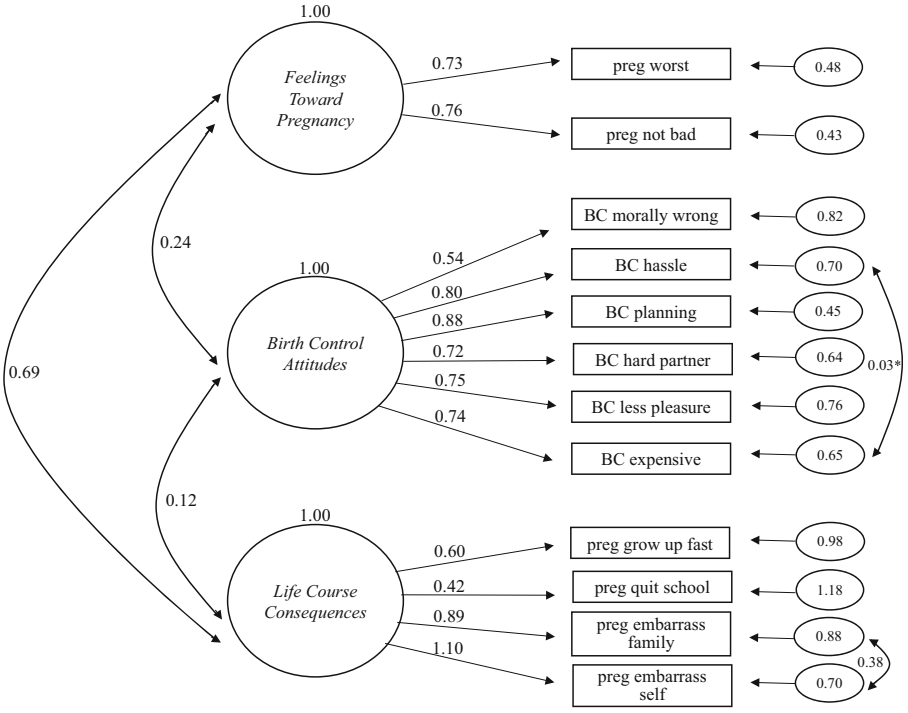

Fig. 1 Factorial model of reproductive attitudes from confirmatory factor analysis (CFA), Add Health. Model fit: RMSEA = .024, and CFI = .982. All factor loadings and covariances are significant at $p < .001$ unless otherwise indicated. *$p < .05$

Worthington and Whittaker (2006) noted that it is possible to keep a factor with only two items if the items are highly correlated ($r > .70$), relatively uncorrelated with other items, and have substantive meaning. These two items are moderately correlated at $r = .62$ (the highest correlation between any two items among the full set of variables) and are only weakly correlated with other items. Despite the modest correlation, we chose to retain this factor for substantive reasons linked to the findings for the RDSL data, as discussed later. Additionally, these two items have been used as a scale in prior work with Add Health to predict fertility (Garfield et al. 2016; Jaccard et al. 2003).

Replication With RDSL

As shown in Table 1, the RDSL contained more potential items for reproductive motivations than the Add Health. As such, whether and how the additional items would fit into the pattern established in Add Health was unclear. We therefore used the same iterative EFA-CFA process described earlier to identify factors and measures. In doing so, we removed five questions ("BC sick," "preg family help," "condom mistrust," "BC not afford," "BC easy to get") that did not fit in any factorial structure. We then examined fit across models with successively more factors and determined that a five-factor model fit the RDSL data best and that the remaining 20 reproductive attitudes measures indicated five latent factors. Model fit statistics are available in the online appendix. Based on the magnitudes of EFA factor loadings for each of the measures (Table 4) for the best-fitting

model, four measures ("preg worst," "preg not bad," "baby less lonely," and "preg partner happy") loaded on the first factor; six measures ("BC morally wrong," "BC hassle," "BC looking for sex," "BC planning," "BC less pleasure," and "BC expensive") loaded on the second factor; four measures ("preg grow up fast," "preg quit school," "preg handle parenting," and "preg not afford") loaded on the third factor; three measures ("young grandparents," "young recover," and "young lose weight") loaded on the fourth factor; and three measures ("wait perfect time," "hard old parents," "older mom, baby problems") loaded on the fifth factor.

The final CFA model for RDSL is shown in Fig. 2. The CFA revealed that the five-factor model had adequate fit (CFI = .953, RSMEA = .030), and the loadings on these factors were all significantly different from 0. In addition, the covariances among these five factors were all significantly different from 0, with two exceptions: the fifth factor was not significantly correlated with the first and third factors. As part of the aforementioned iterative process, we explored models with both fewer and more factors and considered whether measures indicated different factors, but no other factor structure provided acceptable fit. As such, given the acceptable overall fit of this five-factor model, the significant factor loadings, and the significant covariances (correlations) between most factors, we conclude that there are five distinct subdimensions measured by unique sets of questions that make up the larger concept of reproductive motivations.

Three of the factors identified in RDSL parallel the three factors identified in Add Health: feelings toward pregnancy, birth control attitudes, and life course consequences. The *feelings toward pregnancy* factor in RDSL has two of the same questions ("preg worst" and "preg not bad") and two questions that are unavailable in Add Health ("baby less lonely" and "preg partner happy"). Like the other items, these questions measure feelings about a potential pregnancy—in this case, related to predicted relationships between the respondent and a child and between the respondent and her partner. This last item ("preg partner happy") reflects the woman's perception about her partner's reaction; its inclusion is consistent with other work demonstrating that women's own feelings about pregnancy are strongly related to the anticipated reaction or support from a partner (Aiken and Trussell 2017; Miller et al. 2017). The *birth control attitudes* factor was largely similar across the two data sets, with five of the six measures overlapping. The measure "BC hard partner" was not available in RDSL, and the measure "BC looking for sex" loaded on this factor in RDSL but not in Add Health. The latter discrepancy may be driven by slight differences in question wording, with the RDSL question more generally referring to how women who use birth control are perceived, but the Add Health question specifically referring to how the respondent might be perceived by his or her friends. Two of the measures in the *life course consequences* factor were identical for both RDSL and Add Health, while the other two measures in the factor for each data set were not available in the other data set. The two additional RDSL factors use measures not available in Add Health. The first of these factors, which we term *advantages of early fertility*, describes respondents' views of how being a young parent can potentially be beneficial. The second factor, which we term *disadvantages of delayed fertility*, represents respondents' perceptions of the problems that may occur if they delay having children. We conducted a sensitivity test to ensure that the acceptability of the full factorial pattern was not due to these two factors by excluding these items and rerunning the CFA. Model fit remained high in a model including only the first three factors (RMSEA = .030 and CFI = .972; not shown).

Table 4 Factor loadings from exploratory factor analysis (EFA) for five-factor model of reproductive attitudes in RDSL

	1	2	3	4	5
Factor 1					
Getting pregnant at this time is one of worst things that could happen.[a] (*preg worst*)	**.553***	–.027	.166	.070	–.060
It wouldn't be all that bad if you got pregnant at this time in your life. (*preg not bad*)	**.792***	–.018	.039	.011	.019
If you had a baby now, you would feel less lonely. (*baby less lonely*)	**.333***	.136*	–.029	.100*	.015
If you got pregnant now, your partner would be happy. (*preg partner happy*)	**.416***	.109*	.190*	–.061	.029
Factor 2					
Using birth control is morally wrong.[a] (*BC morally wrong*)	–.040	**.676***	.032	.057	–.121*
In general, it is too much of a hassle to use birth control.[a] (*BC hassle*)	.023	**.590***	.031	.029	.015
It takes too much planning ahead of time to have birth control on hand when you're going to have sex.[a] (*BC planning*)	.125	**.638***	–.041	–.057	.069
Birth control interferes with enjoyment.[a] (*BC less pleasure*)	–.072	**.416***	.042	.091*	.005
In general, birth control is too expensive to buy.[a] (*BC expensive*)	.065	**.404***	–.083	.087*	–.062
If a girl uses birth control, she is looking for sex.[a] (*BC looking for sex*)	–.036	**.535***	.013	–.074	.101
Factor 3					
If you got pregnant now, you could handle the responsibilities of parenting. (*preg handle parenting*)	.019	–.006	**.750***	.098*	.018
If pregnant now, would have to grow up too fast. (*preg grow up fast*)	.115	–.001	**.506***	–.035	.006
If pregnant now, would have to quit school. (*preg quit school*)	–.032	–.128*	**.448***	.016	–.045
If you got pregnant now, could not afford to raise the child. (*preg not afford*)	.088	.062*	**.622***	–.052	–.002
Factor 4					
It is better to have kids young because the grandparents can be more involved. (*young grandparents*)	.032	–.004	.038	**.707***	–.013
It is better to get pregnant young because young women's bodies recover faster. (*young recover*)	.014	.019	–.046	**.713***	.074
It is easier for young women to lose weight after a pregnancy. (*young lose weight*)	–.116	.056	.061	**.242***	.094
Factor 5					
If a woman waits for the perfect time to have a baby, she will probably have trouble getting pregnant. (*wait perfect time*)	.047	.018	.080	.041	**.445***
It is hard for kids to have the oldest parents at their school. (*hard old parents*)	–.019	.029	–.028	.028	**.570***
Babies born to older mothers have more health problems. (*older mom*, *baby problems*)	–.017	–.076	–.018	.045	**.324***

[a] Item is reverse-coded.

*$p < .05$

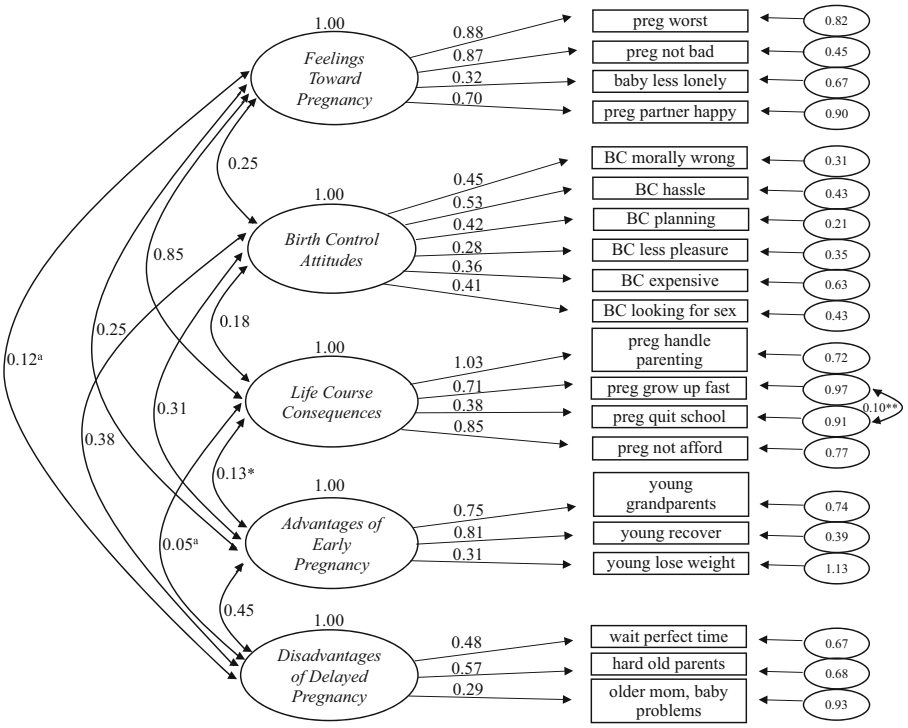

Fig. 2 Factorial model of reproductive attitudes from confirmatory factor analysis (CFA), RDSL. Model fit: RMSEA = .030, and CFI = .953. All factor loadings and covariances significant at $p < .001$ unless otherwise indicated; *$p < .05$; **$p < .01$. [a]Not significant.

Results for Reproductive Knowledge

Add Health Factor Analyses

We repeated the process to establish the dimensional structure of reproductive knowledge, starting again with Add Health. Through the iterative process, we removed measures that led to poor model fit because they did not fit into any factorial structure. Four measures ("pull out," "sex once," "sperm die," and "ovulate") were removed at this stage. With the remaining measures, we tested equivalent one-, two-, three-, and four-factor models using a chi-square difference test to determine improvement of model fit as a result of each additional factor, finding that a three-factor model fit the data best (derived from chi-square difference tests $p < .001$); full fit statistics are in the online appendix. Based on the final EFA factor structure (Table 5), two measures ("before period" and "during period") loaded on the first factor; four measures ("withdraw, get preg," "condom fit tight," "Vaseline," and "fully unroll") loaded on the second factor; and three measures ("rhythm confidence," "condom confidence," and "withdrawal confidence") loaded on the third factor.

Next, we present the CFA of the final three-factor model found in the Add Health reproductive knowledge analysis (Fig. 3). The CFA revealed that the three-factor model had very good fit (CFI = .981, RSMEA = .015). In addition, the factor loadings and

Table 5 Factor loadings from exploratory factor analysis (EFA) for three-factor model of reproductive knowledge in Add Health

	1	2	3
Factor 1			
The most likely time for a woman to get pregnant is right before her period starts. (*before period*)	**.587***	–.002	.078
In general, a woman is most likely to get pregnant if she has sex during her period, as compared with other times of the month. (*during period*)	**.383***	.215*	–.021
Factor 2			
Even if the man pulls out before he ejaculates, even if ejaculation occurs outside of the woman's body, it is still possible for the woman to become pregnant. (*withdraw, get preg*)	–.063	**.289***	.027
When putting on a condom, it is important to have it fit tightly, leaving no space at the tip. (*condom fit tight*)	.091*	**.489***	.055
Vaseline can be used with condoms, and they work just as well. (*Vaseline*)	–.013	**.426***	–.053
As long as the condom fit over the tip of the penis, it doesn't matter how far down it is unrolled. (*fully unroll*)	.033	**.596***	–.011
Factor 3			
You are quite knowledgeable about the rhythm method of birth control and when it is a "safe" time during the month for a woman to have sex and not get pregnant. (*rhythm confidence*)	.007	–.108*	**.772***
You are quite knowledgeable about how to use a condom correctly. (*condom confidence*)	–.033	.177*	**.659***
You are quite knowledgeable about the withdrawal method of birth control. (*withdrawal confidence*)	.032	.003	**.951***

*$p < .05$

covariances were all significantly different from 0. Given this, the CFA confirms that in the Add Health data, the covariance structure of the nine measures of reproductive knowledge can be adequately explained by three factors. Each of these factors is measured by a unique set of questions, and the factors represent three logical subdimensions of reproductive knowledge.

The first factor, which we term *female reproductive biology knowledge*, represents respondents' knowledge of the physiological aspects of female reproduction. The second factor, which we term *condom knowledge*, describes the respondent's overall knowledge of condoms and how to use them effectively. The final factor, which we term *birth control confidence*, identifies how confident individuals feel about their general knowledge of some specific contraceptive methods. All factor loadings are significant at $p < .001$, and all factors were positively and significantly correlated, indicating that there are three interrelated factors that reflect reproductive knowledge. Again, though, we have a factor (*female reproductive biology knowledge*) with only two measures. The correlation between them is quite low ($r = .15$), suggesting that they do a fairly poor job of measuring this latent factor. We retained this factor primarily because of the overall strong model fit and because of the results from the RDSL

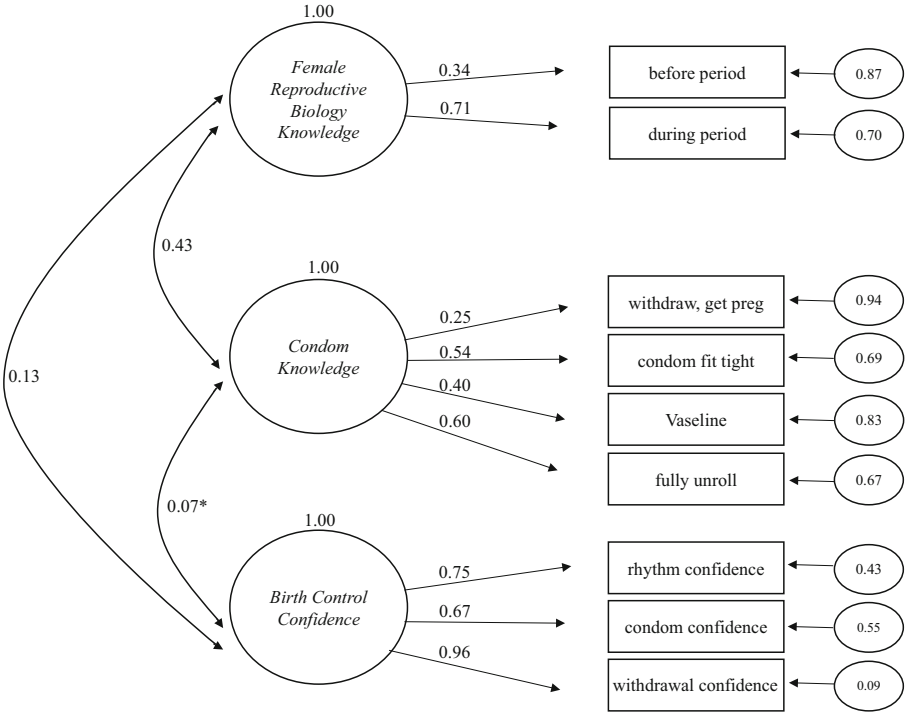

Fig. 3 Factorial model of reproductive knowledge from confirmatory factor analysis (CFA), Add Health. Model fit: RMSEA = .035, and CFI = .981. All factor loadings and covariances are significant at $p < .001$ unless otherwise indicated. *$p < .05$

replication (presented later), but we return to the substantive implications of this poor measurement in the discussion. We also ran a sensitivity test excluding the *birth control confidence* factor because such items are not available in RDSL, and the model fit remained high (RMSEA = .011, CFI = .978; not shown in tables).

Replication With RDSL

As evident in Table 2, the RDSL data contain several measures identical to those found in the Add Health data, with one additional item ("miss pills"); RDSL does not contain any measures of confidence. Given the similarity, we proceeded directly to CFA with RDSL data to replicate the reproductive knowledge model found in Add Health; we do not present EFA fit statistics or factor loadings for RDSL reproductive knowledge. Essentially, we tested whether the RDSL measures represent the same two latent factors (the model above minus *birth control confidence*) that we identified in Add Health. We tested additional models with the extra measure, "miss pills," loading on each factor and found that it loaded significantly on *female reproductive biology knowledge* but not on *condom knowledge*, consistent with substantive expectations. The final model therefore includes "miss pills" in the first factor plus the two questions about the most likely time for a woman to get pregnant. As with Add Health, "pull out" did not significantly load with any factor, so we excluded it from the model. As shown in Fig. 4, the same factorial pattern (excluding the *birth control confidence* factor) was found

in RDSL with very good model fit (CFI = .943, RSMEA = .027). In sum, these models provided additional evidence of multiple underlying factors indicating reproductive knowledge and that knowledge about female reproductive biology and about the use of condoms constitute distinct domains.

Predicting Contraceptive Outcomes

Table 6 shows adjusted odds ratios and relative risk ratios for the relationship between the reproductive attitudes factor scores and contraceptive use and between the reproductive knowledge factor scores and contraceptive use. In both data sets, positive attitudes toward birth control predict higher levels of contraceptive use, and more accurate knowledge of female reproductive biology predicts use of more effective (versus less effective) methods. However, although most aspects of both reproductive attitudes and reproductive knowledge are significantly associated with some aspect of subsequent contraceptive use, the association varies across data sets and outcomes. Perceiving negative life course consequences is linked with more contraceptive use in the Add Health sample, but not in RDSL; conversely, negative feelings toward pregnancy are associated with more contraceptive use in RDSL only. Advantages of early pregnancy and disadvantages of delayed pregnancy are never significantly associated with contraceptive use in RDSL. Knowledge about female reproductive biology is not predictive of overall levels of contraceptive use. Condom knowledge is associated with more contraceptive use in Add Health but only more effective method use (among users) in RDSL. Because of concerns over the accuracy of male reports of contraception (Garbers et al. 2017), we also reran the Add Health analyses just for females, and the results were virtually identical. Thus, these basic models demonstrate

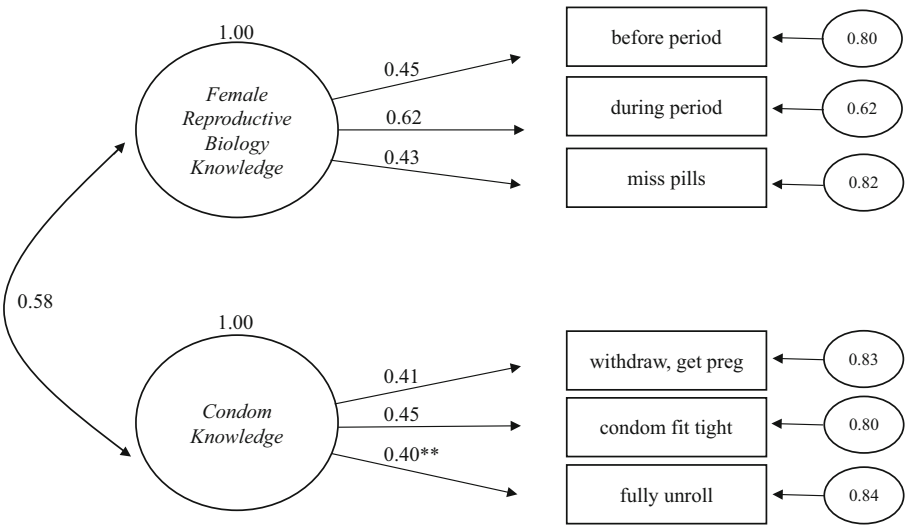

Fig. 4 Factorial model of reproductive knowledge from confirmatory factor analysis (CFA), RDSL. Model fit: RMSEA = .027, and CFI = .943. All factor loadings and covariances are significant at $p < .001$ unless otherwise indicated; $^{**}p < .01$

Table 6 Adjusted odds ratios (OR) and relative risk ratios (RRR) for the association between dimensions of reproductive attitudes and reproductive knowledge and contraceptive use and method effectiveness

	Any Contraceptive Use		Method Effectiveness			
	Add Health	RDSL	Add Health		RDSL	
			No Method vs. Effective	Least Effective vs. Effective	No Method vs. Effective	Least Effective vs. Effective
	OR	OR	RRR	RRR	RRR	RRR
Model A: Reproductive Attitudes						
Feelings toward pregnancy	0.93	2.22*	0.97	1.02	0.42*	1.01
Birth control attitudes	1.16***	1.33*	0.79***	0.95	0.55***	0.54***
Life course consequences	1.32***	1.06	0.84†	0.93	0.96	0.89
Advantages of early pregnancy	—	0.85	—	—	1.26	1.13
Disadvantages of delayed pregnancy	—	0.89	—	—	1.23	1.21
Model B: Reproductive Knowledge						
Female reproductive biology knowledge	1.09	0.92	0.70***	0.94	0.68	0.38***
Condom knowledge	1.19*	1.32	0.90	1.02	1.04	1.94*
Birth control confidence	0.90†	—	1.00	0.84**	—	—

Notes: Associations between attitudes and knowledge are modeled separately. All models control for age, gender (Add Health), race/ethnicity, maternal education, and family structure in addition to the dimensions of reproductive attitudes or reproductive knowledge.

†$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

the potential of these factors for future analyses by showing that reproductive attitudes and knowledge are associated with demographically important behavioral outcomes.

Discussion

Levels of unintended fertility, particularly among teens and young adults, remain high in the United States. And despite substantial study, the underlying reasons for the persistence of unintended fertility are not well understood. In particular, although a large body of research has confirmed that attitudes and knowledge predict fertility (e.g., Brückner et al. 2004; Deptula et al. 2006; Garfield et al. 2016; Hayford and Guzzo 2013; Jaccard et al. 2003; Ryan et al. 2007; Shneyderman and Schwartz 2013), there has been little effort to synthesize findings across existing studies. We drew from this work to organize measures of attitudes and knowledge about pregnancy and contraception into two key concepts: *reproductive attitudes* and *reproductive knowledge*.

We used psychometric techniques to conduct a systematic and rigorous analysis of a wide range of survey questions related to attitudes toward preventing pregnancy and childbearing and knowledge of the reproductive process using data from two surveys of adolescents and young adults. Using data from Wave I of Add Health, a nationally representative sample of adolescents conducted in 1995, and data from RDSL, a population-based survey of 18- to 19-year-old women in a county in Michigan conducted in 2008–2009, we showed that reproductive attitudes and reproductive knowledge are multidimensional concepts that can be identified using existing survey measures. Specifically, in both surveys, factor analyses for reproductive attitudes identified latent factors representing *feelings toward pregnancy*, *birth control attitudes*, and *life course consequences* of pregnancy. In the RDSL data set, additional measures related to early childbearing represented two additional unique factors: *advantages of early fertility* and *disadvantages of delayed fertility*. Factor analyses for reproductive knowledge in both surveys suggested separate latent factors corresponding to distinctly gendered realms of reproduction: *female reproductive biology knowledge* and *condom knowledge*. In the Add Health data set, which also asked young people how confident they were about their knowledge, levels of *birth control confidence* composed a unique factor.

Our application of psychometric techniques was guided by social-psychological theory and overall model fit. Although we indeed identified multiple underlying factors within the concepts of reproductive attitudes and reproductive knowledge, the low factor loadings or few items within some factors suggest that existing items and data sets have not fully or sufficiently measured these concepts. Thus, an equally important implication of our analyses is the question of what is lacking or problematic with the measurement of reproductive attitudes and knowledge in surveys to date. For instance, although both logic and theory would lead to predictions that knowledge of female reproductive biology—ovulation, the menstrual cycle, fertile periods, and the like—is key for understanding the risks of pregnancy, the measures in Add Health seem insufficient to adequately represent this factor, given that only two measures loaded on the factor. In both Add Health and RDSL, the question about the regularity of women's periods did not fit into this factor. This finding is unexpected but may be the result of the question ("most women's periods are regular, that is, they ovulate or are fertile fourteen days after their periods begin") being poorly worded. This question

conflates "regular" cycles with cycle length, yet women can have longer or shorter cycles that are regular (and many teens have not yet developed regular cycles) (Adams Hillard 2014). It also uses the term "ovulate," which may be unfamiliar to many adolescents (Hockenberry-Eaton et al. 1996). Similarly, in neither survey did the question about the risk of pregnancy following a single act of unprotected sex load onto any of the reproductive knowledge factors. In our opinion, this is likely because there is not, in fact, a good answer to the question, given that the risk is highly dependent on the timing of sex relative to the menstrual cycle; for this reason, reproductive health experts typically discuss the risk of pregnancy over an extended period of time among those having regular unprotected sex (e.g., Trussell 2011).

The overall similarity of the measurement structures that we identified is remarkable given that the two data sets used in this analysis have different samples, were collected at different times, and include different survey measures (although with substantial overlap). These findings should encourage researchers to use a similar measurement structure when analyzing other data sets and to design future surveys with measures that assess similar structures. Further, the results suggest that because specific questions in different surveys seem to represent similar underlying concepts, it should be possible to make comparisons across data sets and align findings using different measures. Basic models using the identified factors to predict contraceptive behavior show that different dimensions of reproductive attitudes and knowledge predict subsequent contraceptive use in both samples but that the specific dimensions that are most salient vary across the data sets. This variation may be attributable to differences in contraceptive method mix across the two samples or to compositional differences; for instance, Add Health is a younger sample with more racial/ethnic diversity. These results demonstrate the utility of identifying particular elements of attitudes and knowledge and the necessity of theorizing the specific mechanisms at work in order to understand these associations.

Limitations

This article focused on how to analyze and interpret measures found in existing data sets. We were thus limited, by design, to these existing survey questions. It is likely that there are other dimensions of both reproductive attitudes and reproductive knowledge not captured by these surveys. Our findings may also be specific to question wording or sample characteristics. Other measures or samples might provide different results. Another limitation is that although the TPB and other related theories explicitly recognize the role of normative influences (Philipov et al. 2009), we did not include items reflecting perceptions of peer context because such measures were unavailable in Add Health, and we had limited measures of the respondents' perceptions of family and partner context.

Conclusions

Our primary goal was to apply psychometric methods for guidance in (1) how to use existing data sets and commonly used measures of reproductive attitudes and knowledge, and (2) how to interpret existing research using these data. This parallel analysis of two data sets provides some guidance about how to conceptualize these measures.

The consistency of our findings suggests that the latent factors we identified are generalizable, at least among adolescents and young adults in the United States, and can be used as orienting concepts both in developing measures and in examining the determinants of unintended pregnancy and other fertility outcomes. For example, future research on the relationship between attitudes and fertility might distinguish between *feelings toward pregnancy* and *life course consequences* in selecting which attitudinal measures to include in analyses. Future work on reproductive knowledge, which would no doubt include items about both reproductive physiology and contraceptive knowledge, might wish to incorporate confidence indicators; it is possible for someone to have inaccurate knowledge but high levels of confidence, for instance.

Our findings constitute a first step in understanding how various measures of attitudes and knowledge reflect broader concepts linked to sexual and reproductive health. Additional analysis is necessary to determine the robustness of the factorial structure we described. For example, future studies should analyze the degree to which this measurement structure is invariant across subgroups (e.g., racial/ethnic groups, sexual minorities), how it may change with age and fertility behaviors (many of the items here are quite specific to adolescence and young adulthood), and the degree to which it holds in other data sets with different combinations of survey questions.

The ultimate goal for this research was to stimulate more deliberate attention to how psychosocial characteristics are related to key behavioral outcomes such as sex, contraception, and pregnancy. Our basic analyses demonstrated that some dimensions of reproductive attitudes and reproductive knowledge predict subsequent contraceptive use, but that the strength and consistency of associations differs across dimensions. Future research may build on these findings to theorize why some dimensions are particularly important, understand how knowledge and attitudes may mediate relationships between sociodemographic background and outcomes of interest, or explore variation in the strength of association across subgroups. To the extent that this framework is useful in understanding the determinants of sex, contraception, and pregnancy, it could also be used to guide policy and practice. For instance, identifying the dimensions of reproductive knowledge that are most closely linked to behavior could highlight areas to be addressed in education efforts or clinical practice. By specifying the meaning and measurement of the multiple dimensions of reproductive attitudes and knowledge, this framework can facilitate the integration and comparison of research findings across data sets, outcomes, and populations, thereby magnifying the contributions of disparate analyses and forming a cohesive body of knowledge.

Acknowledgments This research was supported from a grant from the Eunice Kennedy Shriver National Institutes of Child Health and Human Development (R01 HD078412; Guzzo and Hayford, PIs) as well as center grants to Bowling Green State University's Center for Family and Demographic Research (P2C-HD050959), Ohio State University's Institute for Population Research (P2C-HD058484), and the University of Michigan's Population Studies Center (R24 HD041028). This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by Grant No. P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (http://www.cpc.unc.edu/addhealth). No direct support was received from Grant P01-HD31921 for this analysis. This research also uses data from the Relationship Dynamics and Social Life project, which was funded by two grants from the National Institute of Child Health

and Human Development (R01 HD050329, R01 HD050329-S1, PI Barber) and a grant from the National Institute on Drug Abuse (R21 DA024186, PI Axinn). We gratefully acknowledge the Survey Research Operations (SRO) unit at the Survey Research Center of the Institute for Social Research for their help with the data collection, the intellectual contributions of the other members of the original RDSL project team (William Axinn, Mick Couper, Steven Heeringa, and Heather Gatny), as well as the National Advisory Committee for the project: Larry Bumpass, Elizabeth Cooksey, Kathleen Mullan Harris, and Linda Waite.

References

Adams Hillard, P. J. (2014). Menstruation in adolescents: What do we know? And what do we do with that information? *Journal of Pediatric and Adolescent Gynecology, 27,* 309–319.

Aiken, A. R., & Trussell, J. (2017). Anticipated emotions about unintended pregnancy in relationship context: Are Latinas really happier? *Journal of Marriage and Family, 79,* 356–371.

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

Barber, J. S., Kusunoki, Y., & Gatny, H. H. (2011). Design and implementation of an online weekly journal to study unintended pregnancies. *Vienna Yearbook of Population Research, 9,* 327–334.

Borrero, S., Farkas, A., Dehlendorf, C., & Rocca, C. H. (2013). Racial and ethnic differences in men's knowledge and attitudes about contraception. *Contraception, 88,* 532–538.

Brown, M., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research, 21,* 230–258.

Brown, T. A. (2006). CFA of multitrait-multimethod matrices. In *Confirmatory Factor Analysis for Applied Research* (pp. 212–235). New York, NY: Guilford Press.

Brückner, H., Martin, A., & Bearman, P. S. (2004). Ambivalence and pregnancy: Adolescents' attitudes, contraceptive use and pregnancy. *Perspectives on Sexual and Reproductive Health, 36,* 248–257.

Chantala, K. (2001). *Constructing weights to use in analyzing pairs of individuals from Add Health data* (Report). Chapel Hill: Carolina Population Center, University of North Carolina. https://doi.org/10.17615/C6GM23

Coale, A. J. (1973). The demographic transition reconsidered. In *Proceedings of the International Population Conference, Liege* (pp. 53–72). Liege, Belgium: International Union for Scientific Study of Population.

Craig, A. D., Dehlendorf, C., Borrero, S., Harper, C. C., & Rocca, C. H. (2014). Exploring young adults' contraceptive knowledge and attitudes: Disparities by race/ethnicity and age. *Women's Health Issues, 24*(3), e281–e289. https://doi.org/10.1016/j.whi.2014.02.003

Crosby, R. A., & Yarber, W. L. (2001). Perceived versus actual knowledge about correct condom use among US adolescents: results from a national study. *Journal of Adolescent Health, 28,* 415–420.

Deptula, D. P., Henry, D. B., Shoeny, M. E., & Slavick, J. T. (2006). Adolescent sexual behavior and attitudes: A costs and benefits approach. *Journal of Adolescent Health, 38,* 35–43.

DeVellis, R. F. (2012). *Scale development: Theory and applications*. Thousand Oaks, CA: Sage Publications.

Driscoll, A. K., Sugland, B. W., Manlove, J., & Papillo, A. R. (2005). Community opportunity, perceptions of opportunity, and the odds of an adolescent birth. *Youth & Society, 37,* 33–61.

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press.

Frost, J. J., Lindberg, L. D., & Finer, L. B. (2012). Young adults' contraceptive knowledge, norms and attitudes: Associations with risk of unintended pregnancy. *Perspectives on Sexual and Reproductive Health, 44,* 107–116.

Garbers, S., Scheinmann, R., Gold, M. A., Catallozzi, M., House, L., Koumans, E. H., & Bell, D. L. (2017). Males' ability to report their partner's contraceptive use at last sex in a nationally representative sample: Implications unintended pregnancy prevention evaluations. *American Journal of Men's Health, 11,* 711–718.

Garfield, C. F., Duncan, G., Peters, S., Rutsohn, J., McDade, T. W., Adam, E. K., & Chase-Lansdale, P. L. (2016). Adolescent reproductive knowledge, attitudes, and beliefs and future fatherhood. *Journal of Adolescent Health, 58,* 497–503.

Green, L. W. (1969). East Pakistan: Knowledge and use of contraceptives. *Studies in Family Planning, 1*(39), 9–14.

Grice, J. W. (2001). Computing and evaluating factor scores. *Psychological Methods, 6,* 430–450.

Guzzo, K. B., & Hayford, S. (2012). Race-ethnic differences in sexual health knowledge. *Race and Social Problems, 4,* 158–170.

Harris, K. M., Halpern, C. T., Whitsel, E., Hussey, J., Tabor, J., Entzel, P., & Udry, J. R. (2009). The National Longitudinal Study of Adolescent Health: Research design. Chapel Hill: Carolina Population Center, University of North Carolina at Chapel Hill. Retrieved from http://www.cpc.unc.edu/projects/addhealth/design

Hayford, S. R., & Guzzo, K. B. (2013). Racial and ethnic variation in unmarried young adults' motivation to avoid pregnancy. *Perspectives on Sexual and Reproductive Health, 45,* 41–51.

Hayford, S. R., Guzzo, K. B., Kusunoki, Y., & Barber, J. S. (2016). Perceived costs and benefits of early childbearing: New dimensions and predictive power. *Perspectives on Sexual and Reproductive Health, 48,* 83–91.

Heisel, D. F. (1968). Attitudes and practice of contraception in Kenya. *Demography, 5,* 632–641.

Hockenberry-Eaton, M., Richman, M. J., DiIorio, C., Rivero, T., & Maibach, E. (1996). Mother and adolescent knowledge of sexual development: The effects of gender, age, and sexual experience. *Adolescence, 31*(121), 35–47.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6,* 1–55.

Jaccard, J., Dodge, T., & Dittus, P. (2003). Do adolescents want to avoid pregnancy? Attitudes toward pregnancy as predictors of pregnancy. *Journal of Adolescent Health, 33*(2), 79–83.

Kaye, K., Suellentrop, K., & Sloup, C. (2009). *The fog zone: How misperceptions, magical thinking, and ambivalence put young adults at risk for unplanned pregnancy.* Washington, DC: Power to Decide (formerly The National Campaign to Prevent Teen and Unplanned Pregnancy).

Kusunoki, Y., Barber, J. S., Ela, E. J., & Bucek, A. (2016). Black-white differences in sex and contraceptive use among young women. *Demography, 53,* 1399–1428.

Lee, R. D., & Bulatao, R. A. (1983). The demand for children: A critical essay. In R. A. Bulatao & R. D. Lee (Eds.), *Determinants of fertility in developing countries: A summary of knowledge* (Part A, pp. 233–287). Washington, DC: National Academies Press.

Liefbroer, A. C. (2005). The impact of perceived costs and rewards of childbearing on entry into parenthood: Evidence from a panel study. *European Journal of Population/Revue européenne de Démographie, 21,* 367–391.

Lindberg, L., Santelli, J., & Desai, S. (2016). Understanding the decline in adolescent fertility in the United States, 2007–2012. *Journal of Adolescent Health, 59,* 577–583.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1,* 130–149.

Miller, W. B. (1986). Proception: An important fertility behavior. *Demography, 23,* 579–594.

Miller, W. B. (1994). Childbearing motivations, desires, and intentions: A theoretical framework. *Genetic, Social, and General Psychology Monographs, 120,* 223–258.

Miller, W. B. (1995). Childbearing motivation and its measurement. *Journal of Biosocial Science, 27,* 473–487.

Miller, W. B., Barber, J. S., & Schulz, P. (2017). Do perceptions of their partners' childbearing desires affect young women's pregnancy risk? Further study of ambivalence. *Population Studies, 71,* 101–116.

Miller, W. B., Severy, L., & Pasta, D. (2004). A framework for modelling fertility motivation in couples. *Population Studies, 58,* 193–205.

Philipov, D., Thévenon, O., Klobas, J., Bernardi, L., & Liefbroer, A. C. (2009). *Reproductive decision-making in a macro-micro perspective (REPRO): State-of-the-art review* (European Demographic Research Paper). Vienna: Austrian Academy of Sciences/Vienna Institute of Demography. Retrieved from https://www.oeaw.ac.at/fileadmin/subsites/Institute/VID/PDF/Publications/EDRP/edrp_2009_01.pdf. Accessed 1/22/18.

Rocca, C. H., & Harper, C. C. (2012). Do racial and ethnic differences in contraceptive attitudes and knowledge explain disparities in method use? *Perspectives on Sexual and Reproductive Health, 44,* 150–158.

Ryan, S., Franzetta, K., & Manlove, J. (2007). Knowledge, perceptions, and motivations for contraception: influence on teens' contraceptive consistency. *Youth & Society, 39,* 182–208.

Santelli, J. S., Abma, J., Ventura, S., Lindberg, L., Morrow, B., Anderson, J. E., & Hamilton, B. E. (2004). Can changes in sexual behaviors among high school students explain the decline in teen pregnancy rates in the 1990s? *Journal of Adolescent Health, 35,* 80–90.

Santelli, J. S., Lindberg, L. D., Abma, J., McNeely, C. S., & Resnick, M. (2000). Adolescent sexual behavior: estimates and trends from four nationally representative surveys. *Family Planning Perspectives, 32,* 156–165, 194.

Santelli, J. S., Lindberg, L. D., Finer, L. B., & Singh, S. (2007). Explaining recent declines in adolescent pregnancy in the United States: The contribution of abstinence and improved contraceptive use. *American Journal of Public Health, 97,* 150–156.

Sieving, R. E., Bearinger, L. H., Resnick, M. D., Pettingell, S., & Skay, C. (2007). Adolescent dual method use: Relevant attitudes, normative beliefs and self-efficacy. *Journal of Adolescent Health, 40,* 275.e15–275.e22. https://doi.org/10.1016/j.jadohealth.2006.10.003

Shneyderman, Y., & Schwartz, S. J. (2013). Contextual and intrapersonal predictors of adolescent risky sexual behavior and outcomes. *Health Education & Behavior, 40,* 400–414.

Sweeney, M. M., & Raley, R. K. (2014). Race, ethnicity, and the changing context of childbearing in the United States. *Annual Review of Sociology, 40,* 539–558.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston, MA: Allyn and Bacon.

Trussell, J. (2011). Contraceptive failure in the United States. *Contraception, 83,* 397–404.

Worthington, R. L., & Whittaker, T. A. (2006). Scale development research: A content analysis and recommendations for best practices. *The Counseling Psychologist, 34,* 806–838.

Wynn, L. L., Foster, A. M., & Trussell, J. (2009). Can I get pregnant from oral sex? Sexual health misconceptions in e-mails to a reproductive health website. *Contraception, 79,* 91–97.

Affiliations

Karen Benjamin Guzzo[1] · Sarah R. Hayford[2] · Vanessa Wanner Lang[1] · Hsueh-Sheng Wu[3] · Jennifer Barber[4] · Yasamin Kusunoki[5]

[1] Department of Sociology, Bowling Green State University, Bowling Green, OH 43403-0222, USA

[2] Department of Sociology, Ohio State University, 238 Townshend Hall, 1885 Neil Avenue Mall, Columbus, OH 43210, USA

[3] Center for Family and Demographic Research, Bowling Green State University, Bowling Green, OH 43403-0222, USA

[4] Department of Sociology, University of Michigan, 500 S. State Street, Ann Arbor, MI 48109, USA

[5] Department of Systems, Populations and Leadership, School of Nursing, University of Michigan, 400 N. Ingalls Street, Ann Arbor, MI 48109, USA