Risk taking, aging, and childbearing expectations

Nathalie Herles, Jana B. Jarecki

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Main Hypothesis

The key hypothesis of this project is that reproductive risk taking increases with chronological age and childbearing intention for women.[1]

[1] Biological gender assigned at birth.

Research Questions

Background

We investigate a qualitative prediction about risky choices, which follows from risk sensitivity theory (Houston & McNamara, 1986, 1988), in the context of human reproductive risk taking. Risky choices involve conscious or unconscious decisions about options with variable (risky) consequences that hold potential costs or benefits. Risk taking can be defined, in a social context, as engaging in actions, without appropriate preparation and consideration for events with potential negative outcomes, and possible socially unacceptable consequences (e.g., Killianova, 2013). A high risk preference, in this context, means engaging more in behavior with variable consequences compared to behaviors with stable and hence predictable consequences.

Risk-sensitivity theory, which was developed for animal foraging contexts, predicts that risk preference are a function of situational factors (Houston & McNamara, 1985). It assumes that two main factors increase risk taking: A high **need** for resources and **limited time** to gather them. We test these predictions in the context of human reproductive risk taking. In this context, risk-sensitivity theory predicts that higher reproductive goals (need) in combination with a limited time horizon for having children (limited time), should increase reproductive risk taking behaviors.

The time horizon for human reproduction and fertility[2] can be approximated by a person's age when trying to have biological children; and women face what can be considered limited time for reproduction. Female fertility decreases from the age of 30 and markedly declines after the age of 35. The average age of menopause onset in the United States is 51 (NHS, 2018). A woman's age at conception is not only correlated with their fertility levels (ASRM, 2012), but is positively correlated to undesirable outcomes, such as miscarriages,

[2] One's natural ability to reproduce.

which increase in likelihood with maternal age (Miller, Weinberg, Canino, Klein, & Soules, 1999). By contrast, the probability of men fathering a pregnancy within 12 months of a pregnancy attempt decreases only by 3% for every year that a man is over the age of 24 (Rolf & Nieschlag, 2001). Therefore, women (who do not use technological means to prolong fertility) have a finite time horizon for having children, and men face a less steep change in reproductive capabilities.

Detailed Hypotheses

Based on risk sensitivity theory, we hypothesize that reproductive risk-taking is a function of a person's reproductive goals (desire for children) interacting with their fertility time horizon (approximated by age), with the latter being gender-specific. Because of the gender differences in the fertility time horizon, we predict a gender difference in the influence of reproductive goals and age on risk taking. Specifically, our primary (confirmatory) hypothesis is:

- H1. Women show more reproductive risk-taking behavior with higher reproductive goals and higher maternal age, compared to women that are younger and have fewer reproductive goals.

Additionally, we explore two auxiliary hypotheses (exploratory analysis):

- H2. The effect of age and reproductive goals on reproductive risk taking is stronger in women than in men.
- H3. With higher childbearing goals, men change their reproductive risk-taking behaviors without being affected by age.

We will test each of the effects stated in H1, H2, H3 will using three dependent variables that measure aspects of reproductive risk taking (Table 1). The dependent variables consist of the number of sexual partners during the past year, the use of pregnancy assistance, and the number of sexual partners other than the current partner. Further and as an exploratory fourth variable, we explore the effects of the independent variables on women's adoption intentions (adoption data is only available for women).

Table 1: Overview of the hypotheses and dependent variables

		Variable		
No.	**(1) No. of opposite-sex partners in the last 12 months**	**(2) Any medical fertility assistance**	**(3) No. of sexual partners not including current partner**	**(4) Ever considered adoption**
H1	H1.1	H1.2	H1.3	H1.4
H2	H2.1	H2.2	H2.3	–
H3	H3.1	H3.2	H3.3	–

Data Description

State of Data Collection

The data set we use is open to the public. It is a multi-stage probability-based, nationally representative random sample, collected by the National Survey of Family Growth department (NSFG). The NSFG is a sub-organization of the Center for Disease Control and Prevention (CDC) organization in America (National Survey of Family Growth, 2002). This data was made accessible by the CDC on the NSFG home page; under the file name "questionnaires, datasets and other related documents" and can be accessed at https://www.cdc.gov/nchs/nsfg/nsfg_questionnaires.htm. Data from the CDC are collected through the National Notifiable Diseases Surveillance System (NNDSS), which is used by the CDC as a multi-collaboration data collection and analysis system (National Survey of Family Growth, 2002). The NNDSS annually collects data over a variety of survey portals, health organization and collaborative medical data record platforms like the NSFG.

We utilized this public platform to access and download the raw data for this project on the 12. Aug. 2019 and blinded the data by randomizing the values of all our variables across participants (blinding by noise, e.g., Duthil, Sarafoglu, & Wagenmakers, 2019).

Question Types

We obtained the question types in the NSFG data in CAPI_Lite format, which is a compact form of the male and female interview questions (National Survey of Family Growth, 2002). The general question format included multiple-choice, rating, Likert-scale, and open-ended questions. The questionnaires and data description are available on www.cdc.gov/nchs/nsfg/nsfg_2015_2017_questionnaires.htm (21. April 2020) in addition to www.icpsr.umich.edu/icpsradmin/nsfg/index?studyNumber=10001

(21. April 2020). Details about the data collection procedure for both males and female respondents is available on www.cdc.gov/nchs/data/nsfg/NSFG_-2013-2015_Summary_Design_Data_Collection.pdf (21. April 2020).

Prior and Current Work with the Data

We have carried out no prior work on or with the raw data in their non-blinded version. We conducted a review of the aforementioned codebooks and CAPI Lite questionnaires to ensure the NSFG data set would allow testing of our hypotheses.

Operationalization of Variables

The variables we use are self-report measures. The **dependent variables** (reproductive risk taking) is operationalized as the self-reported level of sexual acts and decisions that may have variable consequences, such as high costs (financial, health and/or social). This includes the self-reported amount of partners (ranging between 1-50) over the last year and currently (reported at the time of interview), the self-reported number of partners other than the current partner, and the search for or receipt of medical assistance with regards to fertility or the consideration of adoption. In terms of the **independent variables**, the predictor *reproductive goal* is measured as the respondent's self-reported expectation of having (additional) children at the time of the interview or in the future. The predictor *available time* is measured as the respondent's self-reported chronological age in years at the time of the interview. The predictor *gender* is the self-reported gender. Moreover, **control variables** will be added (see below, section Control Variables).

Variable Use, Specifications, and Description

The following section lists the variable names in the data set to be used. Whenever we will transform variables, the variable that the transformation will be based on, is named under transformation, and the transformation will be detailed in the Section Variable Transformation.

Dependent Outcomes Variables

Variable	Transformation	Description
PARTS1YR_S	based on PARTS1YR	The total number of opposite-sex partners in the last 12 months (PARTS1YR) in relation to the baseline sexual activity

Variable	Transformation	Description
		(variable is transformed, see the section Variable Transformation).
ANYPRGHP	–	(binary variable) If the respondent or the respondent's partner have received medical fertility assistance to aid with pregnancy (INFEVER variable name for males).
CURRPRTS_S	based on CURRPRTS	The current total number of sexual partners not including respondents spouse or the cohabiting partner (CURRPRTS) in relation to the age-cohort (variable is transformed, see the section Variable Transformation).
EVWNTANO	–	(binary variable) If the respondent has ever considered adoption (only available for female respondents).

Independent Variables

Variable	Transformation	Description
ADDEXP	–	The number of future (additional) childbirths expected by the respondent (with missing values imputed by the NSFG);
AGE_R	–	Respondents reported age in years at the time of the interview.
GENDER	–	Male or female as reported by the respondent.

Control Variables

The following variables are expected to influence reproductive risk taking.

Variable	Transformation	Description
CURRPREG	–	If the respondent is currently pregnant.
HADSEX	–	Respondent's sexual status (whether they are sexually active or not).
RSTRSTAT	–	Respondent's sterility status at the time of the interview.
RELCURR	–	Respondents' religious status and type.
RELDLIFE	–	Respondents' extent of religious affiliation.
LIFPRTNR_S	based on LIFPRTNR	Baseline sexual activity: sum of opposite-sex partners in respondents' life (LIFPRTNR) in relation to the age

Variable	Transformation	Description
		cohort (variable is transformed, see the section Variable Transformation).
SEXPY_S	based on LIFPRTNR, AGE_R, AGEFSTSX	Amount of sexual partners per age cohort (variable is transformed, see the section Variable Transformation).

Additional variables used as basis for the variable transformation

The following variables are used for variable transformation and variable standardization.

Variable	Description
AGEFSTSX	Respondent's age at first sex.
LIFPRTNR	Respondent's total number of sexual partners in their lifetime.
CURRPRTS	Current total number of sexual partners not including the respondent's spouse or cohabiting partner.
PARTS1YR	Total number of opposite-sex partners in the last 12 months.

Sample weights and design variables

Variable	Description
WGT2015-2017	Weight variable, accounts for over- and undersampling of demographic characteristics, relative to the general population.
SEST	Design variable. This is a method of variance reduction that estimates the general population statistics (computational sample stratum).
SECU (	Design variable. Accounts for data falling into potential groups data clusters).

Variable Transformation

Since there are recognized age-cohort differences in sexual activity (e.g., Herbenick et a.l, 2010), we will standardize the reproductive risk-taking variables within age brackets. The variables listed below will be transformed to account for recognized differences in the baseline sexual behavior between age cohorts and sexes. The age cohorts we use are 18-19; 20-24; 25-29; 30-39; 40-49 years of age (Herbenick et a.l, 2010).

LIFPRTNR_S is based on the within-cohort within-sex z-standardized variable LIFPRTNR.

PARTS1YR_S is based on the within-cohort within-sex z-standardized variable PARTS1YR.

CURRPRTS_S is based on the within-cohort within-sex z-standardized

variable CURRPRTS.

SEXPY_S is based on the within-cohort within-sex z-standardized variable SEXPY, which itself is a computed variable that measures the baseline risky sexual behavior, which we define as the respondent's number of sexual partners per year of sexual activity, see Equation @ref(eq:sexpy):

$$\text{SEXPY} = \frac{LIFPRTNR}{\text{AGE\_R} - \text{AGEFSTSX} + 1}(\#eq : sexpy)$$

where *LIFPRTNR* = total number of sexual partners in lifetime, *AGE_R* = current age, *AGEFSTSX* = age of first sex.

Data inclusion or exclusion

We include women and men who are sexually active, fertile, cohabiting or married or not, and are between 18 and 50 years old. We exclude those respondents who are under the age of 18 (n = 1,057), who are surgically or non surgically sterile (n = 1,462) in addition to those who have never been sexually active (n = 1,490). The sterile female respondents will be included in the exploratory hypotheses about consideration of adoption (H1.4).

Outlier Removal

For the initial analyses, no outliers will be removed. We will run a robustness check for the results after, removing participants who deviate from the sample mean by more than 3 standard deviations, regarding the total number of partners in a lifetime (*LIFPRTNR_S*), frequency of sexual intercourse (*SEXPY_S*), and total expectancy for children (*ADDEXP*). Outliers will be determined and removed using the z-score method (M +/- 3 x SD).

Data weighting

As the data provided by the NSF is not a perfect representation of the U.S. American population, the NSFG recommends the use of the weight variable (*WGT2015_2017*) in combination with two design variables (*SEST* and *SECU*) to make inferences regarding the whole U.S. population (Hyattsville, Maryland, 2015-2017). We will add these variables to the analyses as a further robustness check.

Sample Description

The sample size before exclusion equals N = 10,094, and N = 6,915, is the sample that we will use, which includes 3,601 women (1,953 excluded) and 3,314 me (1,226) excluded.

Sample Type

The data contains missing values in the dependent variable about pregnancy assistance (ANYPRGHP), which is compensated by using its imputed form; in addition there are missings in the adoption intention (EVWNTANO) as this question was not provided to male participants, and in some control variables CURRPREG, RELDLIFE). For these cases, we use list-wise deletion in the corresponding analysis.

Study End Point:

Because this is a secondary data analysis, we will only consult the data mentioned in this documentation. Our study will end after our analysis and robustness checks.

Data Analysis Plan and R-Code

Statistical analyses will be conducted in the statistical framework system R version 3.6.1 (R Core Team, 2019) using Bayesian linear regression models, implemented in the brms R package, version 2.10.0 (Bürkner, 2017, 2018).

No follow-up analysis after the study endpoint.

Model Specification

Bayesian models will be used to test our hypotheses about the relationship between childbearing expectancy, age, gender, and risk-taking.

Priors

We use normal (0,10) priors and cauchy priors (0, 2.5), for the coefficients in models of the normal and Benoulli family (respectively).

R-Code

The R-code for model fitting is provided

```
library(brms)

# Setup ------------------------------------------------------------------
niter <- 2000 # my be changed if needed
# Normal priors for H123.1 and H123.3
prior1 <- set_prior("normal(0, 10)", class = "b") +
          set_prior("normal(0, 10)", class = "sigma")
# Cauchy priors for H123.2 and H1.4  for the Bernoulli family
```

```
prior2 <- set_prior("cauchy(0, 2.5)", class = "b")


# Setup statistical models ------------------------------------------------------
# Read data after inclusion
D <- readRDS(file="../../data/processed/data.rds")

# Model formula
formula <- parts1yr_s ~ currpreg + age_r  * addexp * gender + sexpy_s
# Robustness Checks: Adding Variables: lifprtnr_s , hadsex, rstrstat relcurr:reldlife

# Effects coding
options(contrasts= c("contr.sum","contr.poly"))


# Fit ---------------------------------------------------------------------------
# Dependent variable: No. of opposite-sex partners in the last 12 months
# H1.1, H2.1, H3.1
FitH123.1 <- brm(formula, D, iter = niter, prior = prior1,
  sample_prior = TRUE, save_all_pars = TRUE,
  file = "Fitted Models/fith123.1.sexpy_s")
# Null model, excluding 3-way interaction
NullH123.1 <- update(FitH123.1, ~ . - age_r:addexp:gender,
  file = "Fitted Models/fith123.1.null.sexpy_s")
# Null model, excluding 2-way interaction
NullTwoH123.1 <- update(NullH123.1, ~ . - age_r:addexp,
  file = "Fitted Models/fith123.1.null.2.sexpy_s")

# Dependent variable: Any medical fertility assistance
# H1.2, H2.2, H3.2
FitH123.2 <- brm(update(formula, anyprghp ~.), D, iter = niter, prior = prior2,
  sample_prior = TRUE, save_all_pars = TRUE, family = "bernoulli",
  file = "Fitted Models/fith123.2.sexpy_s")
NullH123.2 <- update(FitH123.2, ~ . - age_r:addexp:gender,
  file = "Fitted Models/fith123.2.null.sexpy_s")
NullTwoH123.2 <- update(NullH123.2, ~ . - age_r:addexp,
  file = "Fitted Models/fith123.2.null.2.sexpy_s")

# Dependent Variable: No. of sexual partners not including current partner
# H1.2, H2.2, H3.2
FitH123.3 <- update(FitH123.2,  currprts_s ~ ., D,
  file = "Fitted Models/fith123.3.sexpy_s")
NullH123.3 <- update(FitH123.3, ~ . - age_r:addexp:gender,
```

```
  file = "Fitted Models/fith123.3.null.sexpy_s")
NullTwoH123.3 <- update(NullH123.3, ~ . - age_r:addexp,
  file = "Fitted Models/fith123.3.null.2.sexpy_s")


# Female-only exploratory hypothesis
# H1.4
FitH1.4  <-   brm(evwntano ~ currpreg + age_r * addexp + sexpy_s, D, iter = niter, prior = prior2,
  sample_prior = TRUE, save_all_pars = TRUE, family = "bernoulli",
  file = "Fitted Models/fith1.4.sexpy_s")
NullFitH1.4 <-   update(FitH1.4,   ~ . - age_r:addexp,
  file =  "Fitted Models/fith1.4.null.sexpy_s")
```

Inferential Criteria

In the regression analyses, the statistics reported will be 89% and 95% **highest-density intervals** of the estimated regression coefficients and **Bayes Factors** (potentially as natural logarithms), which describe the amount of relative evidence of a model that has a non-zero regression term over a model with zero regression term (Dienes, 2014). Bayes Factors > 3 (< ⅓) are considered substantial support for (against) a model (Dienes, 2014). Additionally, **Bayesian R2** will be reported, describing the proportion of variance in the dependent variable (risk-taking) explained by the regressors (Dienes, 2014). Post-hoc tests of the direction of the regression coefficients will be conducted and the statistic reported will be the **evidence strength/Bayes Factor** quantifying the posterior probability of a (directed) hypothesis against its alternative; and values > 3 (< ⅓) are considered substantial evidence strength for (against) a hypothesis.

Rules to Accept or Reject the Main and Exploratory Hypotheses

H1. The main hypothesis is about risk-taking behavior in women (three dependent risk-taking variables, H1.1, H1.2, H1.3). For each dependent variable, H1 will be accepted if there is a substantial positive two-way interaction of age and reproductive goal (AGE_R x ADDEXP) in the female sub-group (which may also take the form of a three-way interaction with gender, if the two-way interaction in the female sub-group is substantial), and if additionally the Bayes-Factor-based model comparison supports the complexity of this regression specification. The exploratory/auxiliary hypothesis (H1.4) will be accepted if the model comparison supports a model with a two-way interaction (AGE_R x ADDEXP), and if the coefficient of this interaction is positive.

H2. The exploratory hypothesis about the gender difference in the influence of age and reproductive goals on risk taking (with three dependent variables H2.1, H2.2, H2.3) will be accepted for each dependent variable, if the Bayes Factor analysis supports a model that includes the three-way interaction (AGE_R x ADDEXP x GENDER) and if the post-hoc analysis shows substantial evidence for that the interaction of age and reproductive need (AGE_R x ADDEXP) is more positive for the female sub-group compared to the male sub-group.

H3. The exploratory hypothesis about the null effect of age on risk-taking in men (H3.1, H3.2, H3.3) will be accepted if in the male sub-group there is no substantial main effect of age on reproductive risk-taking (AGE_R) and a substantial positive main effect of need (ADDEXP) and no substantial positive interaction of need with age (AGE_R x ADDEXP).

Sensitivity Test

To account for under- and oversampling, in relation to the general U.S. population, we will repeat the aforementioned analysis in a weighted regression (using the variable WGT2015_2017).

Addressing Statistical Issues

If the models fail to converge we will reduce the number of control variables to simplify the model.

In the case of the data not being normally distributed we will use appropriate transformations.

Notes

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