Spring 4-6-2020

In Utero Nutritional Shocks and Non-Cognitive Skills: Evidence from Ramadan Fasting in Indonesia

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Submitted in partial fulfillment
of the requirements for the degree of
Master of Arts in Economics
Hunter College, City University of New York

2021

Thesis sponsor:

April 6, 2021
Date

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First Reader

April 6, 2021
Date

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Abstract

This paper estimates the effects of prenatal exposure to maternal Ramadan fasting on the development of non-cognitive skills. To study this relationship, I employ a general structural equation model (GSEM) on a sample of Muslims from the fifth wave of the Indonesian Life and Family Survey (IFLS). The results of this study find that in utero exposure to Ramadan is associated with lower levels of agreeableness and conscientiousness, and higher levels of neuroticism. The impacts I find on agreeableness and conscientiousness are driven by third trimester exposure and the sub-sample of women. The impacts on neuroticism are driven by exposure in the first and second trimesters and the sub-sample of men.

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1 Introduction

An estimated 1.8 billion Muslims celebrate the holy month of Ramadan. A major component of this holy month is a daily fast from dawn to dusk. There are several exemptions from this fast, including pregnancy, however fasting is still the norm for pregnant Muslim women around the world (Almond and Mazumder, 2011).

Medical research has studied the effects of this fasting for both maternal and fetal health. There is evidence that this fasting during pregnancy can lead to caloric deficit (Arab, 2004), a rise in cortisol levels (Dickensoy et al., 2009) and lower levels of glucose and alanine (Metzger et al., 1982) in mothers. Less research has focused on the ramifications of fasting on the fetus, but evidence suggests that maternal fasting is associated with changes in fetal breathing movements and fetal heart rates (Mirghani et al. 2004; Mirghani et al., 2005). This work coincides with David Barker's Fetal Origins Hypothesis (FOH), which poses that the fetal stage of development impacts a variety of persistent health and well being outcomes (Almond and Currie, 2011). This hypothesis has been tested further in several economics studies as well, which seek to measure the persistent effects of prenatal exposure to various shocks. Evidence examining health outcomes suggests that prenatal exposure to Ramadan fasting is associated with lower birth weight, a higher likelihood of disability in adulthood and a lower general health status (Almond and Mazumder, 2011; Van Ewijk, 2011). Majid (2015) finds that prenatal Ramadan exposure is also associated with lower cognitive scores and hours worked. Additional research studying other in utero shocks finds that social, educational, health, and economic outcomes are all affected by disruptions occurring during fetal development. However, the relationship between the FOH and the development of non-cognitive skills is unexplored.

This lapse in research is important to address, as non-cognitive skills have been shown to be powerful predictors of various outcomes (Almlund et al., 2011). Research studying the relationship between education and personality finds that non-cognitive skills are associated with years of educational attainment (Van Eijck

and De Graaf, 2004), high school graduation rates (Barón and Cobb-Clark, 2010), and college GPA (Noftle and Robins, 2007). Regarding labor market outcomes, personality traits are associated with wages (Heckman et al., 2011), unemployment (Gallo et al., 2003), and other employment variables. Additional work has found that non-cognitive skills successfully predict health outcomes, including life expectancy (Roberts et al., 2007) and smoking behavior (Hampson et al., 2007), as well as criminal activity (Vazsonyi et al., 2001).

This paper uses Ramadan fasting as a natural experiment to examine the relationship between a prenatal nutritional shock, and the development of non-cognitive skills. Non-cognitive skills are captured by the Big Five Personality Traits: extraversion, agreeableness, conscientiousness, neuroticism and openness to experiences. The data for this study is sourced from the fifth wave of the Indonesian Family Life Survey (IFLS). Historical dates of Ramadan are utilized to estimate in utero exposure to Ramadan for the IFLS sample. To estimate effects of exposure on the big five outcomes, I employ a general structural equation model (GSEM) that develops two latent classes for each trait: one with a higher level and one with a lower level of the respective trait. The model then predicts membership of the latent class with higher levels of each personality traits. The results of this study show a significant negative impact of prenatal exposure to Ramadan on non-cognitive skills, particularly having significant effects on the neuroticism, agreeableness and conscientiousness traits.

The structure of this paper will progress as follows. In section 2, I provide a summary of literature outlining medical literature concerned with Ramadan fasting, economics literature concerned with the fetal origins hypothesis, and literature concerned with socio-emotional capital. Section 3 offers a description of the data source for this paper, including descriptive and summary statistics of my sample. In section 4, I explain the empirical methodology used in this study. Section 5 offers the results and specification checks, and section 6 offers a brief conclusion of the paper.

2 Literature Review

2.1 Ramadan Fasting: Medical Literature

A significant amount of literature has been written studying the impacts that maternal fasting during pregnancy can have on the mother, specifically those fasting during the holy month of Ramadan. In a sample of women in Iran fasting during Ramadan, Arab (2004) found that over the course of 24 hours, 90 percent of the sample had a caloric deficit of at least 500 calories and 68 percent had a deficit of at least 1000 calories. Metzger et al. (1982) studies groups of non-pregnant women and women in third-trimester pregnancy that observe two types of fasts. The first type begins at 6 PM and ends at 6 AM (12h fast) and the second type begins at 6pm and extends to noon (18h fast). The study observes an "accelerated starvation" that occurred in pregnant women observing the 18h fast in both obese and lean women. This phenomenon of "accelerated starvation" has subsequently been observed in mothers specifically fasting during the holy month of Ramadan within the contexts of both a developing country (Prentice et al, 1983) and a developed country (Malhotra et al., 1989). Additionally, Dickensoy et al. (2009) finds that Ramadan fasting during pregnancy was associated with a rise in cortisol levels. Mirghani et al. (2004) studies a sample of pregnant women (30+ weeks) observing Ramadan and finds that not only are glucose levels significantly lower during periods of fasting, but that there is a statistically significant association between glucose levels and number of days fasted. This conclusion poses a significant relevance to Ramadan fasting, which typically lasts 30 days.

There is however a more limited body of work studying the impacts of fasting on fetal health. Mirghani et al. (2004) finds that fasting is associated with a significant jump in the time it takes to detect fetal breathing movements and a significant decline in the detection of continuous breathing movements. Also, Mirghani et al. (2005) notes that fetuses of fasting mothers had fewer episodes of large accelerations of fetal heart rates.

2.2 Fetal Origins Hypothesis: Economics Literature

As mentioned in the introduction, an emerging economics literature has sought to test the fetal origins hypothesis and observe the ramifications of various prenatal disruptions. Most relevant to this paper are studies of the impacts of in-utero nutritional shocks on different outcomes. In Indonesia, prenatal exposure to Ramadan is associated with lower math scores and cognitive tests, as well as working less hours in adulthood. In addition, exposed children are more likely to perform child labor (Majid, 2015). Van Ewijk (2011) uses data from the IFLS, and finds that prenatal exposure to Ramadan have poorer general health later in life, a dynamic that is especially visible in older populations. Almond and Mazumder (2011) utilizes Ramadan as a natural experiment to observe the development of health capital in Michigan, Uganda and Iraq. In the Michigan population the authors find negative impacts of exposure, particularly during the first two trimesters, on birth weight. In addition, the results from Uganda and Iraq indicate an estimated 20 percent increase in disability due to Ramadan fasting.

Additional work has been done studying the impacts of other shocks, testing the fetal origins hypothesis. In a study examining the gap in birth weight between poor, less educated black mothers and college educated white mothers, (Currie, 2011) found that exposure to "toxic releases" accounts for up the 6 percent of the gap. Additional literature studying the relationship of pollution and the fetal origins hypothesis found that total suspended particle (TSP) exposure is associated with a decline in educational attainment (Sanders, 2012), and prenatal exposure to Indonesian forest fires caused a persistent decline in height at 17 years old (Rosales-Rueda and Triyana, 2019). Other work has shown that low birth weight is associated with lower socioeconomic status (Currie and Moretti, 2007), and has effects on height, IQ, earnings and educational attainment later in life (Black et al., 2007). Almond (2006) studies the 1918 Influenza and finds that prenatal exposure to the pandemic was associated with reduced educational attainment, increased rates of physical disability, lower income, lower socioeconomic status, and higher transfer payments. Studies

focusing on The Great Chinese Famine (1958-1961) have found that those with prenatal exposure to this famine had negative educational, labor market, socioeconomic and marital outcomes (Almond et al., 2010; Brandt et al., 2016).

2.3 Socio-Emotional Capital

An emerging body of literature has grown regarding the relationships between non-cognitive skills and outcomes relevant to economic researchers. A significant amount of this work has studied the predictive power of personality traits. Several studies have examined the role that personality plays with educational outcomes. There is strong evidence that openness and conscientiousness are positively associated with years of schooling, while extraversion and neuroticism are negatively associated with years of schooling (Goldberg et al, 1998; Van Eijck and De Graaf, 2004). Additional work has found a positive association between the likelihood of an individual graduating high school and their locus of control (Barón and Cobb-Clark 2010; Coleman and DeLeire, 2003). Noftle and Robins (2007) found conscientiousness to be a stronger predictor of College GPA than SAT scores.

The mechanisms with which non-cognitive skills affect labor market outcomes are shown to be very intricate. Some evidence suggests that adolescent levels of self-control and self-esteem have significant impacts on hourly wages for both men and women, across educational attainments (Heckman et al., 2006), while more recent evidence suggests that personality primarily effects wages through educational attainment (Heckman et al., 2011). Additional work has focused on more specific employment outcomes. There is evidence that non-cognitive skills can be important determinants of absenteeism at work (Störmer and Fahr, 2013), occupation choice (Heckman et al., 2006), length of unemployment (Gallo et al., 2003), and management level (Cobb-Clark and Tan, 2009).

Other research has sought to study the relationships between personality and measures of health and criminal activity. Roberts et al. (2007) developed a meta-analysis examining the relationship between personality and health outcomes. They

conclude that Conscientiousness may have a significant direct and indirect impact on life expectancy. Hampson et al. (2007) studied teacher ratings of children's personality traits and their midlife health status in a cohort of Hawaiian individuals. This study found significant relationships between Extraversion and physical activity, Extraversion and Agreeableness and smoking, and Conscientiousness and health status. Vazsonyi et al. (2001) found that a self reported measure of self control was responsible 20 percent of variation in total criminal deviance (as captured by the Normative Deviance Scale).

3 Data

The data for this project comes from the Indonesian Family Life Survey, a longitudinal survey conducted by RAND. The IFLS has fielded five waves of household surveys and two community and facilities questionnaires since 1993. The data from the IFLS is comprised of over 30,000 people in thirteen of Indonesia's twenty seven provinces, and is representative of approximately 83 percent of the country's population (Straus et al. 2016). Indonesia is an ideal setting for this study, as the country with the largest Muslim population. Additionally, there does not appear to be a presence of widespread prenatal gender discrimination in Indonesia. Kevane and Levine (2001) studies the first two waves of the IFLS, and finds that "patterns of births, birth spacing and nutrition allocations do not suggest son preference during the cohorts born from 1940's to the 1990". This is significant, since prenatal discrimination against daughters would add noise to this study. The opportune nature of this data for researchers seeking to study Ramadan exposure has led to utilization of IFLS data by Majid (2015) and van Ewijk (2011). Majid (2015) estimates that the fasting rate of his sample is between 68 and 82 percent. The survey gathers information on household demographics, health, socioeconomics, personality, cognition and migration. For the purposes of this study, only the fifth and most recent wave of the IFLS household survey (IFLS5) will be utilized, since is the only wave to include a personality module. The survey data for IFLS5 was gathered between

October 2014 and August 2015. Access to IFLS5 data is granted after registering on RAND's website.

The sample of data specifically used in this study is a sub-sample of the IFLS5 data set. From this data, I keep only observations who identify as Muslim, and at least "Somewhat religious" (individuals who identified as "Not religious" were left out, even if they identify as Muslim). In addition, I omit observations aged under 15 and over 70 and individuals with missing date of birth information. These omitted observations account for only a small percentage of the data and do not change the results. Table 1 illustrates the descriptive statistics of the variables used in this study.

To identify in utero exposure to Ramadan, I define the pregnancy period as the 266 days (the average length of pregnancy) prior to an individual's date of birth. I then merge the IFLS5 data with historical data noting the start and end dates of Ramadan from 1906-2015. Any individual whose pregnancy period fully encompasses a month of Ramadan is defined as seeing a full exposure. I also create three additional dummy variables that are set to one if an individual who is fully exposed to a month of Ramadan sees the start of this exposure in the first, second or third trimesters. In addition, those conceived within 21 days of Ramadan's end are captured by a dummy variable that seeks to dampen any noise that may stem from longer-than-average pregnancies. This identification strategy is consistent with prior literature that uses the IFLS to study prenatal Ramadan exposure (Majid, 2015; van Ewijk, 2011).

To measure the big five personality traits, the Personality section of Book IV is utilized. Table 2 lists the fifteen items that are used to construct the Big Five Index, as well as the trait that the item associates. Each item is prefaced with "I see myself as someone who...". Responses to each item are given on a five point scale: disagree strongly (1), disagree (2), neither agree nor disagree (3), agree (4), and strongly agree (5). Several of the items represent the inverse of a big 5 trait, so I reverse the direction of the scale for these items.

Figures 1-5 illustrate the distributions of responses to the personality items that correspond with the big five traits. Personality items on the y-axis are notated by abbreviations outlined in Table 2. A majority of the responses are comprised of individuals who either disagree or agree with the personality item, as opposed to strongly disagreeing, strongly agreeing, or neither disagreeing nor agreeing. Table 3 displays summary statistics of the independent variables used in this study. The final sample is comprised of 26,255 observations, 67.4 percent of which experience a full month of Ramadan exposure. Of the fully exposed sub-sample, 37.8 percent, 37.2 percent and 25 percent begin their exposure in the first, second and third trimester's respectively. The average age of the sample is 36.3 years old, and most of the individuals are located in an urban setting (59.7 percent).

4 Methods

To estimate the impacts of prenatal Ramadan exposure on socio-emotional skills, I will utilize a general structural equation model (GSEM) that estimates two latent classes from the three personality questions that correspond to each trait (see Table 2). A benefit of using this analysis is that is does not require an assumption of linearity in the ordinal personality data that is required in other methods of capturing personality.

Suppose that for each of the big five personality traits, we have two latent classes: $\mathbf{p}_i^h$ denoting a higher level of the respective trait, and $\mathbf{p}_i^l$ denoting a lower level of the respective trait. Allow π to be defined as the probability of belonging to the higher latent class and let vector $\mathbf{y}_i$ consist of predictors of latent class membership. The logistic form of latent class probability is:

$$\pi(\mathbf{y}_i; \boldsymbol{\theta}) = \frac{1}{1 + \exp(-\mathbf{y}_i \boldsymbol{\lambda})}. \tag{1}$$

The GSEM consists of two components: a structural model and a measurement

model. The structural model is expressed as:

$$\mathbf{y}_i = \alpha + \beta exposure_i + \boldsymbol{\lambda}\mathbf{X}_i \tag{2}$$

, where *exposure* is either a dummy variable that captures a full month of full prenatal exposure to Ramadan or a set of three dummy variables that capture whether this exposure occurs in the first, second or third trimesters. $\mathbf{X}$ denotes a vector of controls that includes: sex, whether an individual lives in an urban area, age, age squared, a dummy for being born in the three weeks after Ramadan, birth month fixed effects, and provincial fixed effects. Table 4 displays frequencies of birth months in sub-samples that are exposed and unexposed to Ramadan in utero. Since the holy month of Ramadan follows the lunar calendar, it can occur any time of the year.

The measurement model connects the latent variables to its observable indicators, notated as vector $\mathbf{psn}^*$. The measurement model is as follows:

$$\mathbf{psn}_i^* = \boldsymbol{\gamma}\mathbf{p}_\mathbf{i}^\mathbf{h} + \epsilon_i \tag{3}$$

where $\boldsymbol{\gamma}$ is vector of coefficients. Figure 6 presents this GSEM as a directed aclyctic graph (DAG). The left side of the figure displays the structural model with *exposure* and the vector of controls, $\mathbf{X}$, being utilized as predictors for latent class membership. The right side of the figure illustrates the measurement model, that links indicators of the trait being observed with the latent variable.

To compute starting values in this model, observations were randomly assigned to initial classes. The starting values are then refined by running the Expectation Maximization algorithm. Model parameters are estimated using Newton-Raphson maximum likelihood. The standard errors calculated in this analysis are clustered at the household level.

5 Results

5.1 Main Results

The first panel in Table 5 displays the results of my analysis on full exposure to Ramadan. Regression (1) displays the result of the estimates with the total sample, while regressions (2) and (3) display results with Male and Female samples, respectively. The coefficients of the regression capture the effect of prenatal exposure to Ramadan on the probability of being in a higher latent class of personality. The results of regression (1) show a statistically significant negative effect of exposure to Ramadan on agreeableness and conscientiousness and a positive effect on neuroticism; with the effects on neuroticism having the largest impact and most significance. Regressions (2) and (3) offer information regarding the gender dynamics of these impacts. These results suggest that the impacts of exposure on neuroticism are driven by the male sample, while the impacts on agreeableness and conscientiousness are driven by the female sample.

Panels 2, 3 and 4 in Table 5 display the results of the regressions examining the effects of trimester exposure. Similar to full exposure Regression (1) displays the result of the estimates with the total sample, while regressions (2) and (3) display results with Male and Female samples, respectively. The results indicate that the negative impacts on agreeableness and conscientiousness are driven by exposure in the third trimester. Prior literature has found that the impacts of exposure to prenatal nutritional shocks are results driven by exposure in the first two trimesters trimester, however exposure to Ramadan fasting in the third trimester has been associated with lower general health status (van Ewijk, 2011) and math scores (Majid, 2015). I also observe that the positive impacts on neuroticism are driven by exposure in the first two trimesters. The gender dynamics revealed in the results in regressions (2) and (3) are consistent with those observed in panel 1 these results as well.

5.2 Specification Checks

To study the validity of this latent class model, I also test two other strategies to estimate big five traits from the personality items in the IFLS:

1. measures of each trait are derived by adding the three ordinal items that correspond to it.

2. measures of each trait are derived by using confirmatory factor analysis of the three corresponding items.

The right hand side of my specification outlined in the methodology section remains the same.

The results of these specifications are seen in Table 6, and may be useful in determining if the use of the latent class model is warranted in this study. Columns (1), (2), and (3) display the first specification with a full, male and female sample respectively. Columns (4), (5), and (6) display the second specification with a full, male and female sample respectively. These regressions show some consistency with the results from the latent class specification, with significant impacts on Neuroticism, Conscientiousness and Agreeableness, as well as sharing some of the gender and trimester dynamics. However, these specifications demonstrate instability in significance relative to the latent class model, suggesting that there is some benefit in using a model that accounts for the ordinal nature of the data.

6 Conclusion

Studying a sample of Muslims from the Indonesian Family Life Survey, I have estimated the effects of prenatal Ramadan exposure on big five personality traits. These traits capture non-cognitive skills that are important predictors of a variety of economic, educational and health outcomes. This contributes to the economics literature that studies the fetal origins hypothesis, providing novel results regarding non-cognitive outcomes. For this study, I employ a latent class probability

model that is able to capture the nuance of the ordinal data. The results of this study indicate that prenatal exposure to Ramadan is associated with lower levels of Agreeableness and Conscientiousness, and higher levels of Neuroticism. Agreeableness and Conscientiousness are often regarded as positive traits, while Neuroticism is considered a negative trait. Therefore, I conclude that an in utero nutritional shock has negative impacts on non-cognitive skills. In addition, this study suggests that the use of a general structural equation model to capture latent classes of big five personality traits offered more stability than models that assume linearity in the ordinal data.

A key limitation of this study is that I lack data on precise conception timing, meaning that the pregnancy period used to define exposure is estimated. Additionally, I do not have data on whether or not one's mother actually fasted during pregnancy. The noise in my analysis that stems from this limitation implies that the estimated impacts of prenatal exposure to maternal Ramadan fasting in this study are smaller than the true effect. The true effect of prenatal exposure to maternal Ramadan may also be underestimated in men due to survivorship bias. Prior literature studying the impacts of prenatal Ramadan exposure observes lower rates of males in exposed samples, implying that exposure to Ramadan is particularly harmful to male fetuses (van Ewijk, 2011; Almond and Mazumder, 2011). This is particularly relevant to the I estimate on Neuroticism, which are especially robust in the male sample. The presence of survivorship bias would likely cause these results to become even stronger.

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8 Tables and Figures

Table 1: Descriptive Statistics

Variable Name	Description
Extraversion	An orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experience.*
Agreeableness	The tendency to act in a cooperative, unselfish manner.*
Conscientiousness	The tendency to be organized, responsible, and hard-working.*
Neuroticism	A chronic level of emotional instability and proneness to psychological distress.*
Openness to Experiences	The tendency to be open to new aesthetic, cultural, or intellectual experiences.*
Full Exposure	A dummy for if an individual experienced exposure to the entire month of Ramadan while in-utero.
First Trimester	A dummy for if an individual experienced exposure to the entire month of Ramadan while in-utero that started in the first trimester.
Second Trimester	A dummy for if an individual experienced exposure to the entire month of Ramadan while in-utero that started in the second trimester.
Third Trimester	A dummy for if an individual experienced exposure to the entire month of Ramadan while in-utero that started in the third trimester.
21 Days Dummy	A dummy for if an individual was exposed to the three-week period post-Ramadan.
Birth Month	The month that the respondent was born in.
Province	The Province that the respondent lives in.
Age	The age in years of the respondent.
Male	A dummy variable that equals one when an individual is a male.

*Definition sourced from the APA Dictionary of Psychology

Table 2: Personality Trait Questions

Big Five Trait	I See Myself As Someone Who...	Abbreviation
Extraversion	Is talkative.	Talkative
	Is reserved.^{R}	Reserved
	Outgoing, sociable.	Outgoing
Agreeableness	Has a forgiving nature.	Forgiving
	Is considerate and kind to almost everyone.	Considerate
	Is sometimes rude to others.^{R}	Rude
Conscientiousness	Does a thorough job.	Thorough
	Tends to be lazy.^{R}	Lazy
	Does things efficiently.	Efficient
Neuroticim	Is relaxed, handles stress well.^{R}	Relaxed
	Worries a lot.	Worries
	Gets nervous easily.	Nervous
Openness	Is original, comes up with new ideas.	Original
	Has an active imagination.	Active Imagination
	Values artistic, aesthetic experiences.	Artistic

An (^{R}) denotes that the question is reversed in the estimating of its respective trait.

Table 3: Summary Statistics

	N	Mean	Standard Deviation	Minimum	Maximum
Male	26255	0.461	0.498	0	1
Age	26255	36.287	13.629	15	70
Urban	26255	0.597	0.491	0	1
Full Exposure	26255	0.674	0.469	0	1
First Trimester	26255	0.256	0.437	0	1
Second Trimester	26255	0.251	0.434	0	1
Third Trimester	26255	0.167	0.373	0	1
21 Days Dummy	26255	0.063	0.242	0	1

Table 4: Birth Month Frequencies

Date of Birth (Month)	Not Exposed	Exposed
January	679	989
February	596	1068
March	688	1265
April	749	1320
May	845	1452
June	792	1478
July	820	1730
August	656	1703
September	797	2603
October	561	1368
November	527	1172
December	855	1542
Total	8565	17690

Table 5: Latent Class Model Results

	Total (1)	Male (2)	Female (3)
Panel 1: Full Exposure			
Extraversion	-0.002	0.002	0.039
	(0.046)	(0.067)	(0.063)
Agreeableness	-0.063	-0.025	-0.091
	(0.037)*	(0.054)	(0.051)*
Conscientiousness	-0.080	-0.056	-0.107
	(0.045)*	(0.066)	(0.062)*
Neuroticism	0.134	0.194	0.005
	(0.043)***	(0.063)***	(0.062)
Openness	-0.014	-0.004	-0.088
	(0.043)	(0.062)	(0.059)
Panel 2: First Trimester Exposure			
Extraversion	0.025	0.033	-0.051
	(0.056)	(0.081)	(0.077)
Agreeableness	-0.048	-0.038	-0.048
	(0.045)	(0.065)	(0.062)
Conscientiousness	-0.054	-0.054	-0.066
	(0.054)	(0.079)	(0.076)
Neuroticism	0.138	0.193	0.010
	(0.051)***	(0.076)**	(0.075)
Openness	-0.004	-0.031	0.065
	(0.052)	(0.076)	(0.072)
Panel 3: Second Trimester Exposure			
Extraversion	0.001	0.004	-0.064
	(0.055)	(0.081)	(0.075)
Agreeableness	-0.043	0.004	-0.082
	(0.045)	(0.065)	(0.062)
Conscientiousness	-0.070	-0.015	-0.125
	(0.055)	(0.079)	(0.076)
Neuroticism	0.171	0.224	0.050
	(0.053)***	(0.077)***	(0.076)
Openness	-0.009	0.058	0.100
	(0.052)	(0.075)	(0.072)
Panel 4: Third Trimester Exposure			
Extraversion	-0.045	-0.047	0.013
	(0.062)	(0.092)	(0.085)
Agreeableness	-0.115	-0.048	-0.168
	(0.050)**	(0.074)	(0.070)**
Conscientiousness	-0.133	-0.122	-0.145
	(0.062)**	(0.091)	(0.085)*
Neuroticism	0.077	0.149	-0.065
	(0.058)	(0.086)*	(0.083)
Openness	0.075	-0.058	0.106
	(0.058)	(0.086)	(0.082)
N	26255	12091	14164

Standard errors in parenthesis, p-value < 0.10*, p-value < 0.05**, p-value < 0.01***.

Table 6: Specification Check Results

	Added personality variables			Factored personality variables		
	Total (1)	Male (2)	Female (3)	Total (4)	Male (5)	Female (6)
Panel 1: Full Exposure						
Extraversion	-0.006	0.008	-0.017	-0.004	0.008	-0.014
	(0.009)	(0.014)	(0.013)	(0.008)	(0.011)	(0.011)
Agreeableness	-0.016	-0.016	-0.016	0.000	0.008	-0.008
	(0.007)	(0.010)	(0.010)*	(0.006)	(0.008)	(0.008)
Conscientiousness	-0.014	-0.016	-0.013	-0.013	-0.012	-0.014
	(0.008)*	(0.011)	(0.011)	(0.007)*	(0.010)	(0.009)
Neuroticism	0.030	0.046	0.016	0.021	0.037	0.007
	(0.009)	(0.013)	(0.013)	(0.008)***	(0.011)***	(0.010)
Openness	-0.007	-0.022	0.005	-0.007	-0.020	0.004
	(0.009)	(0.013)*	(0.013)	(0.008)	(0.012)	(0.011)
Panel 2: First Trimester Exposure						
Extraversion	-0.007	0.011	-0.023	-0.005	0.010	-0.019
	(0.011)	(0.017)	(0.015)	(0.009)	(0.014)	(0.013)
Agreeableness	-0.013	-0.023	-0.006	-0.003	0.006	-0.012
	(0.009)	(0.013)*	(0.012)	(0.007)	(0.009)	(0.010)
Conscientiousness	-0.012	-0.021	-0.005	-0.010	-0.018	-0.004
	(0.009)	(0.013)	(0.013)	(0.008)	(0.012)	(0.011)
Neuroticism	0.033	0.046	0.021	0.024	0.034	0.016
	(0.011)***	(0.016)***	(0.015)	(0.009)***	(0.014)**	(0.013)
Openness	0.003	-0.022	0.024	0.002	-0.020	0.020
	(0.011)	(0.016)	(0.015)	(0.010)	(0.015)	(0.013)
Panel 3: Second Trimester Exposure						
Extraversion	0.000	0.008	-0.005	0.000	0.007	-0.004
	(0.011)	(0.017)	(0.016)	(0.009)	(0.014)	(0.013)
Agreeableness	-0.020	-0.015	-0.025	0.007	0.011	0.005
	(0.009)**	(0.013)	(0.012)**	(0.007)	(0.009)	(0.010)
Conscientiousness	-0.015	-0.016	-0.014	-0.013	-0.009	-0.017
	(0.009)	(0.014)	(0.013)	(0.008)	(0.013)	(0.011)
Neuroticism	0.033	0.054	0.013	0.022	0.044	0.003
	(0.011)***	(0.016)***	(0.015)	(0.001)**	(0.014)***	(0.013)
Openness	-0.014	-0.030	0.000	-0.013	-0.028	0.000
	(0.011)	(0.016)*	(0.016)	(0.010)	(0.015)*	(0.014)
Panel 4: Third Trimester Exposure						
Extraversion	-0.012	0.003	-0.024	-0.009	0.004	-0.021
	(0.013)	(0.019)	(0.017)	(0.011)	(0.015)	(0.015)
Agreeableness	-0.014	-0.009	-0.019	-0.006	0.007	-0.019
	(0.010)	(0.014)	(0.013)	(0.008)	(0.010)	(0.011)*
Conscientiousness	-0.017	-0.008	-0.025	-0.017	-0.008	-0.023
	(0.010)*	(0.015)	(0.015)*	(0.009)*	(0.014)	(0.013)*
Neuroticism	0.024	0.034	0.014	0.013	0.029	-0.001
	(0.012)*	(0.018)*	(0.017)	(0.010)	(0.016)*	(0.014)
Openness	-0.012	-0.010	-0.015	-0.011	-0.008	-0.014
	(0.012)	(0.018)	(0.017)	(0.011)	(0.017)	(0.015)
N	26255	12091	14164	26255	12091	14164

Standard errors in parenthesis, p-value < 0.10*, p-value < 0.05**, p-value < 0.01***.

Figure 1: Extraversion Summary Statistics

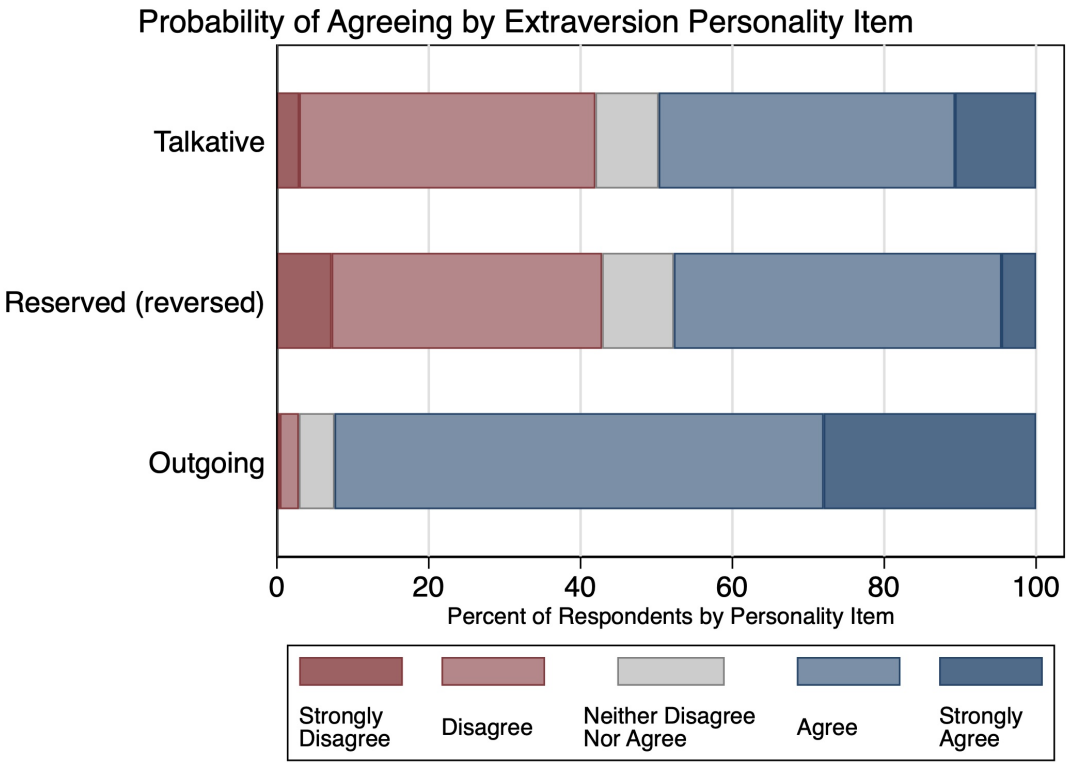

Figure 2: Agreeableness Summary Statistics

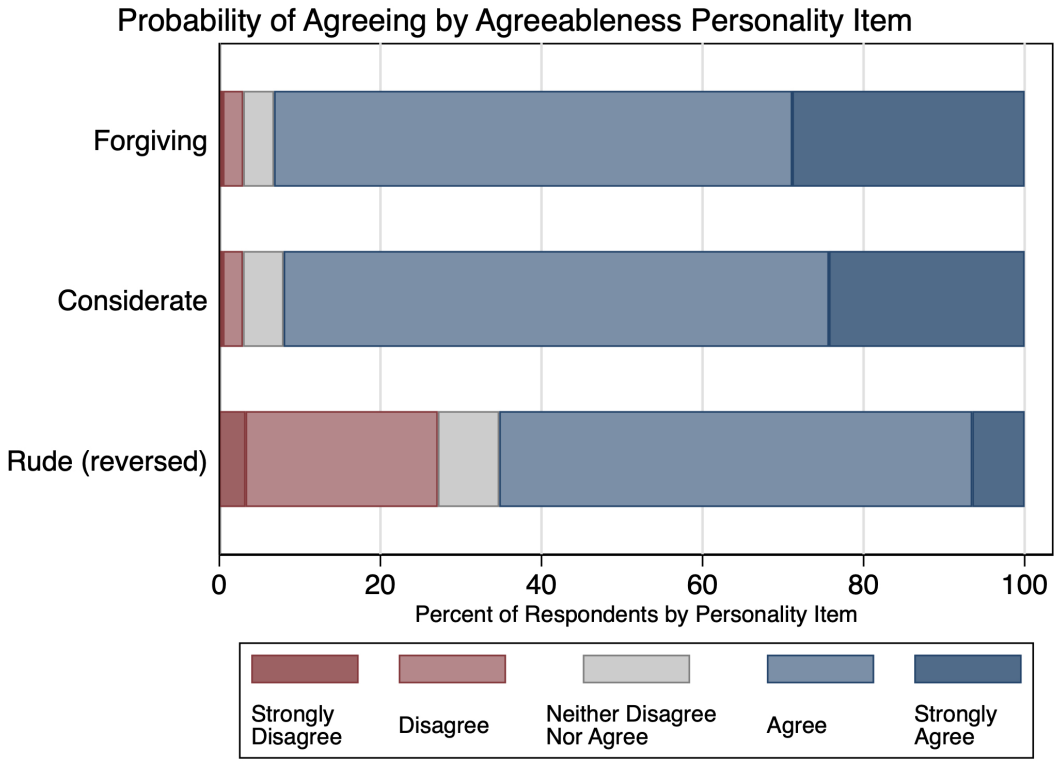

Figure 3: Conscientiousness Summary Statistics

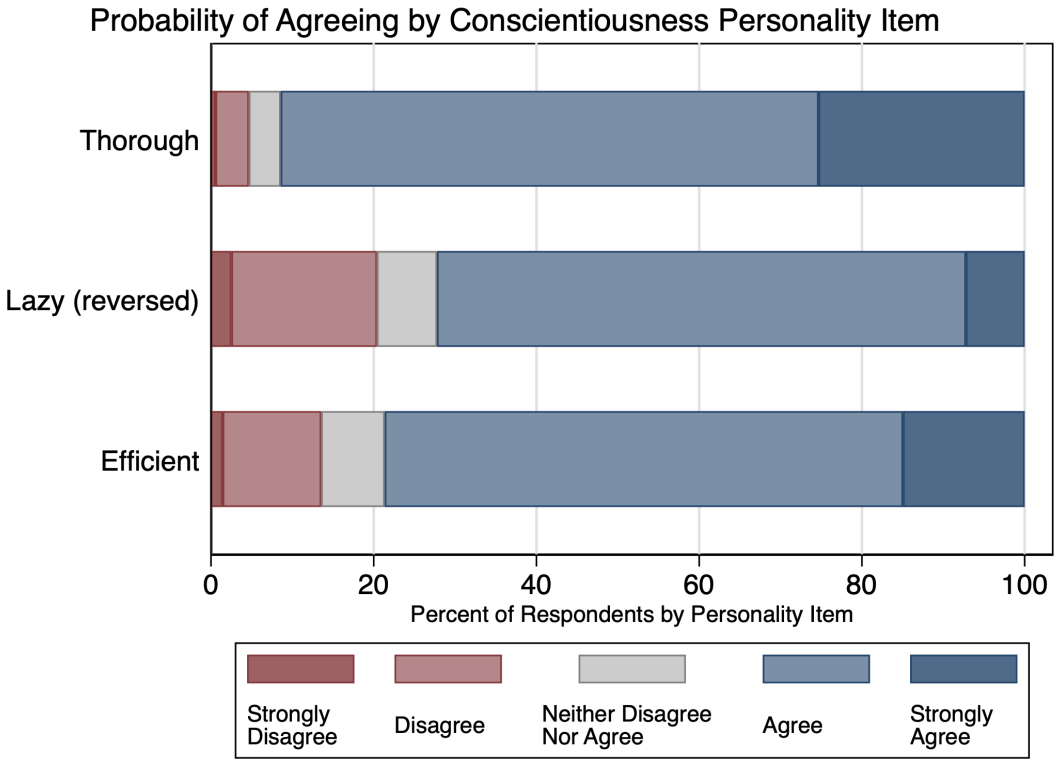

Figure 4: Neuroticism Summary Statistics

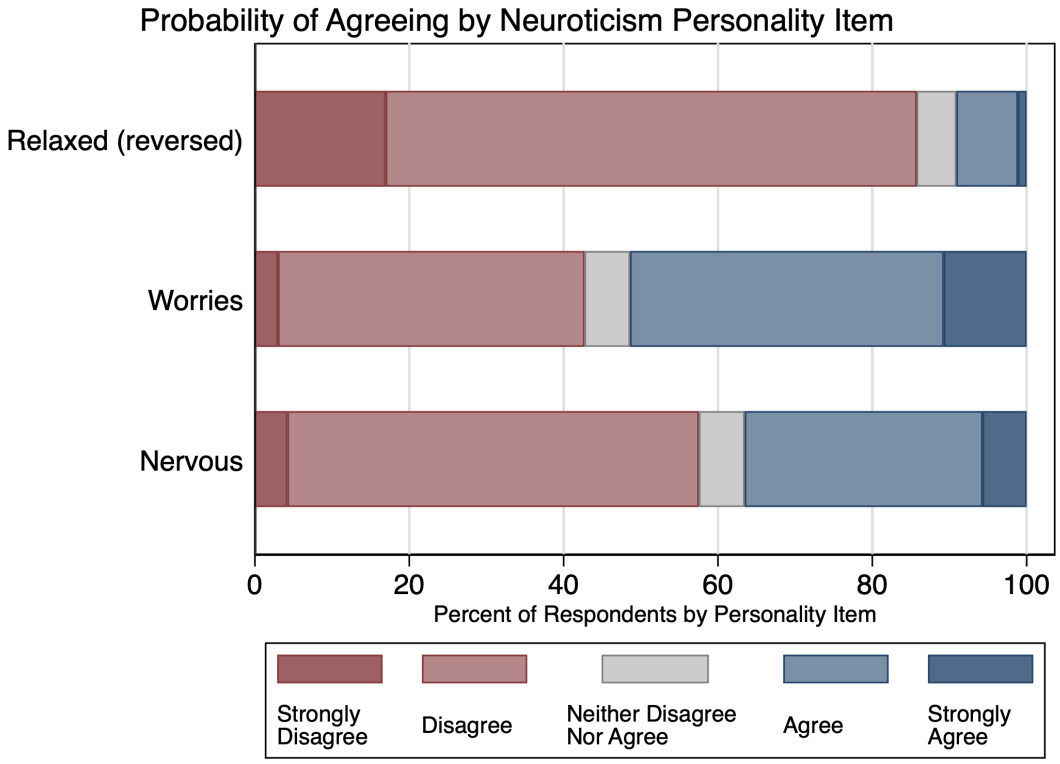

Figure 5: Openness Summary Statistics

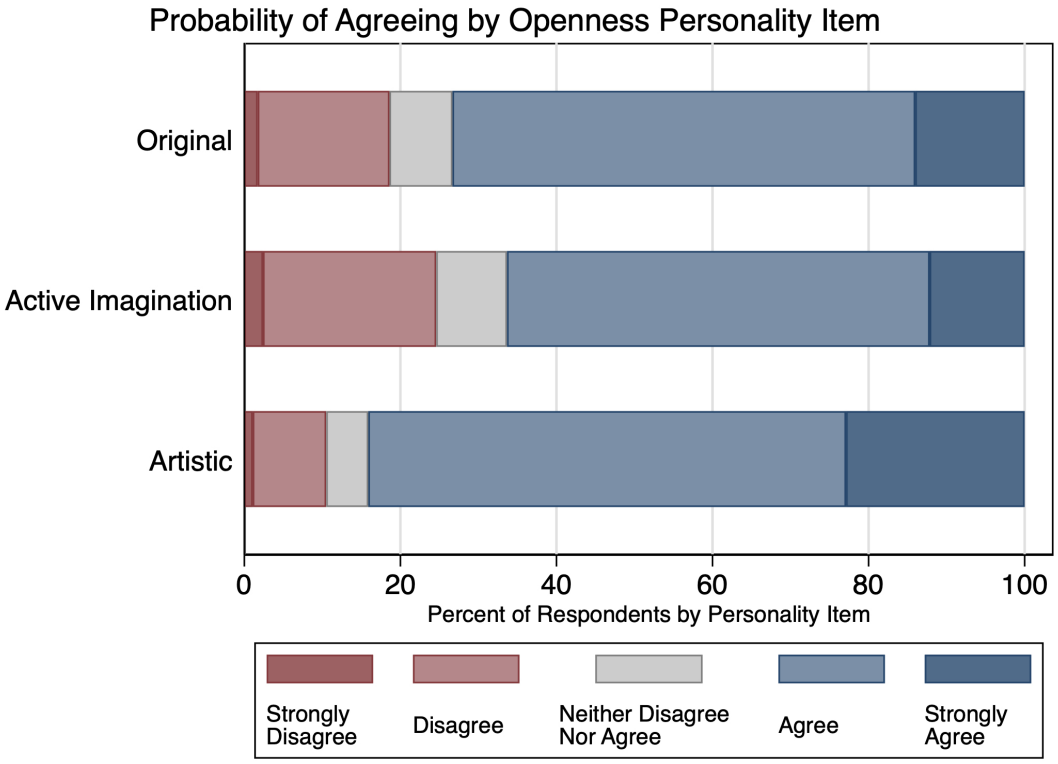

Figure 6: Latent Class Model DAG