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Original Article

Personality and long-term reproductive success measured by the number of grandchildren

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ABSTRACT

Personality, that is, individual behavioral tendencies that are relatively stable across situations and time, has been associated with number of offspring in many animals, including humans, suggesting that some personality traits may be under natural selection. However, there are no data on whether these associations between personality and reproductive success extend over more than one generation to numbers of grandchildren. Using a large representative sample of contemporary Americans from the Health and Retirement Study (n = 10,688; mean age 67.7 years), we studied whether personality traits of the Five Factor Model were similarly associated with number of children and grandchildren, or whether antagonistic effects of personality on offspring number and quality lead to specific personality traits differently maximizing short and long-term fitness measures. Higher extraversion, lower conscientiousness, and lower openness to experience were similarly associated with both higher number of children and grandchildren in both sexes. In addition, higher agreeableness was associated with higher number of grand-offspring only. Our results did not indicate any quality–quantity trade-offs in the associations between personality and reproductive success. These findings represent the first robust evidence for any species that personality may affect reproductive success over several generations.

1. Introduction

Personality – defined as suites of correlated behavioral tendencies of individuals that are relatively stable across situations and time – has been linked to reproductive outcomes in humans and many non-human animals (Dijkstra & Barelds, 2009; Gurven, von Rueden, Stieglitz, Kaplan, & Eid Rodriguez, 2014; Jokela, Kivimäki, Elovainio, & Keltikangas-Järvinen, 2009; Jokela, Hintsa, Hintsanen, & Keltikangas-Järvinen, 2010; Jokela, Alvergne, Pollet, & Lummaa, 2011; Reis, Doernte, & von der Lippe, 2011; Skirbekk & Blekesaune, 2013; Smith & Blumstein, 2008). In humans, a larger number of children and higher probability of parenthood have been associated with extraversion and related traits, such as sociability and leadership in both sexes (Alvergne, Jokela, & Lummaa, 2010; Bailey et al., 2013; Dijkstra & Barelds, 2009; Jokela & Keltikangas-Järvinen, 2009; Jokela et al., 2009; Jokela et al., 2011), although not all studies have found evidence of these associations (Mealey & Segal, 1993; Nettle, 2005; Perkins et al., 2013). Agreeableness, particularly in women, has also been associated with higher reproductive outcomes (Dijkstra & Barelds, 2009; Jokela et al., 2011). Neuroticism, and its temperamental counterparts high emotionality and harm avoidance, on the other hand, have been associated with lower number of children, delayed parenthood and decreased probability of childbearing (Jokela et al., 2009, 2010, 2011; Reis et al., 2011; Gurven et al., 2014) but see (Dijkstra & Barelds, 2009), except in a high-fertility and high-mortality population, where neuroticism appeared to increase number of offspring in women (Alvergne et al., 2010). In addition, one study found that combinations of high neuroticism and low extraversion, or low neuroticism and high extraversion, were associated with higher number of children (Eaves, Martin, Heath, Hewitt, & Neale, 1990).

The two other central personality traits of the widely used Five Factor Model of personality (John, Naumann, & Soto, 2008), conscientiousness and openness to experience, have also been linked to reproductive outcomes, although these findings are fewer in number and less consistent. In different studies, openness to experience has been found to be positively (Gurven et al., 2014, in men), negatively (Jokela et al., 2011), or not at all related to reproductive outcomes (Dijkstra & Barelds, 2009; Alvergne et al., 2010). Conscientiousness and related traits such as persistence have been found both to decrease (Jokela et al., 2010, 2011) and increase (Dijkstra & Barelds, 2009; Gurven et al., 2014) offspring number. In addition, the negative association between openness to experience and number of children, and the negative association between

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conscientiousness and number of children in women, appear to have become evident only in cohorts born in wealthy countries in the latter part of the 20th century (Jokela, 2012), suggesting that environmental conditions may moderate the fitness consequences of personality traits. In sum, although several findings on personality and reproductive success have been documented, the specific fitness consequences of different personality traits are yet unclear, and seem to be at least partly associated with differences in the socio-economic development of the studied populations (i.e., high-fertility, high-mortality vs. low-fertility, low-mortality societies).

Most studies on personality traits and reproductive success in humans have focused on offspring quantity. However, life history theory states that individuals may decrease the number of progeny in order to improve their quality (Hill & Kaplan, 1999), that is, increase the survivorship of the offspring or, especially in the case of contemporary Western humans, increase the reproductive success of the offspring. Personality traits have been associated with parental investment styles, e.g. warmth, gentle behavioral control and support for autonomy (Prinzie, Stams, Dekovic, Reijntjes, & Belsky, 2009), and they may influence the reproductive quality of offspring. Thus, the hypothesis is that if personality traits work to steer parental investment toward focusing either on quantity or quality of offspring, the associations between personality and number of children could be nullified or reversed in the generation of the grandchildren. There is some preliminary evidence to support this hypothesis of personality effects on quality–quantity trade-off in non-human animals, although results so far have been mixed. For example, exploratory behavior was not associated with chick provisioning in great tits (*Parus major*; Patrick & Browning, 2011), whereas more explorative great tits defended their nests with more alarm calls (Hollander, Van Overveld, Tokka, & Matthysen, 2008). In one study with captive minks (*Neovison vison*), less active females had smaller litters but faster growing kits, suggesting parental investment in the quality of offspring rather than quantity (Meagher, Bechard, & Mason, 2012).

Three studies in humans have tackled the question of personality and quality–quantity trade-offs. In a high-fertility and high-mortality human population, female neuroticism was associated with more offspring but also with lower body condition of the offspring, but this trade-off was only evident in women with low access to resources (Alvergne et al., 2010). Among Tsimane forager-horticulturalists, higher extraversion, conscientiousness and openness to experience, and lower neuroticism in men were associated with higher number of children, but there was no association with personality and children dying before age 15 (Gurven et al., 2014), suggesting no quality–quantity trade-offs. A study of contemporary Americans found interaction effects between offspring number and parental personality on child education: parental neuroticism was detrimental to child education only in large families and parental openness to experience only to later born children (Jokela, Alvergne, Rotkirch, Rickard, & Lummaa, 2014). To date, however, no studies have documented how personality simultaneously predicts offspring quantity and quality in contemporary low-fertility populations when this is assessed in terms of reproductive success in the second generation. Therefore, we do not know how selection acts on personality traits when "fitness" is considered across more than one generation. If personality has antagonistic effects on offspring quality and quantity, the number of children alone may not be enough to assess long-term fitness consequences of different personality traits. Thus one needs to investigate how personality traits are related to number of children *and* number of grandchildren—which combines both offspring number (quantity) and their survival and reproductive output (quality) into one measure.

We used a large ($N = 10{,}688$) representative sample of American women and men in their 60s and 70s to study how personality traits of the Five Factor Model (FFM) were related to number of children and number of grandchildren. The FFM is one of the most widely accepted personality models in humans, and consists of extraversion (sociability, talkativeness, outgoingness), neuroticism (the opposite end of emotional stability), agreeableness (kindness, willingness to cooperate with others), conscientiousness, and openness to experience (intellect, creativeness) (John et al., 2008). These data allowed us to investigate (i) how personality is related to number of children, (ii) whether and how personality is related to number of grandchildren, and (iii) whether there are differences in the relations between number of children and number of grandchildren that could be indicative of the existence of quality–quantity trade-offs. In addition, we tested whether sex affected the above mentioned associations in order to determine whether personality is under similar selection in both sexes.

2. Methods

2.1. Participants

The data were derived from the Health and Retirement Study (HRS), which is a nationally representative longitudinal study of more than 30,000 individuals representing the U.S. population older than 50 years (Juster & Suzman, 1995). Telephone or in-person interviews are conducted every second year, administered under the National Institute of Aging (NIA) and the University of Michigan's Institute for Social Research. As of 1992, the HRS consists of many different sources of data collection, and several new subsamples have been included in the study as the original cohorts have aged. In the case of married couples, both spouses (including spouses who would otherwise not be age-eligible for the study) have been interviewed. The Health Sciences Institutional Review Board at the University of Michigan approved the HRS. For complete information on the HRS, see (Juster & Suzman, 1995). The present sample (6245 women and 4434 men) consisted of persons who had information on number of grandchildren (from 1998 to 2002, including those with no children and/or no grandchildren) and personality (from either 2006 or 2008), and were at least 55 years old at the time data on the number of their grandchildren was collected.

The data thus include US men and women born between 1900 and 1947, who mostly had their children during the 1920s–1970s. During this time the US population first experienced a decline in fertility, briefly reversed by post-war "baby boom" in the 1950s, but followed by a steady decline to around replacement levels in the late 1970s (average cohort fertility was 2.9 per woman in 1920, around 2.5 in 1930 and 1940, 2.8 in 1950, 3.0 in 1960, 2.4 in 1970 and 2.0 in 1980) (Schoen, 2004). Until the 1940s, the US population was ethnically divided mainly into whites (around 86%) and blacks (around 14%), after which the proportion of blacks has remained constant, while the proportion of Hispanics and other ethnicities has increased to around 6%, and the proportion of whites diminished to around 80% toward the 1970s (Sandefur, Martin, Eggerling-Boeck, Mannon, & Meier, 2001). The descriptive statistics of the present sample are shown in Table 1, and correspond closely to the national US averages at the time.

2.2. Measures

Because of the complex data collection structure of the HRS, *number of children and number of grandchildren* were obtained from the streamlined family datasets preprocessed by the RAND Corporation, which combine information collected over the study waves. The RAND HRS Family data (respondent-level file), which includes the derived variables for number of children and grandchildren, consist of data from waves in 1998, 2000, and 2002 (http://hrsonline.isr.umich.edu). Over 98% of our sample had information on the number of children and grandchildren from 2002, 1.5% from 2000 and 0.2% from 1998. The mean age of participants at the time of data collection for number of grandchildren was 67.7 years (SD 8.1, range 55–102).