25

Physiological Correlates of Volunteering

René Bekkers (The Netherlands), Sara H. Konrath (USA), and David H. Smith (USA)

Chapter forthcoming in Smith, D.H., Stebbins, R.A. & Grotz, J. (Eds., 2016). *Palgrave Research Handbook on Volunteering and Nonprofit Associations*.

A. Introduction

We review research on physiological correlates of volunteering, a neglected but promising research field. Some of these correlates seem to be causal factors influencing volunteering. Volunteers have better health, both self-reported and expert-assessed, and perform better on cognitive tasks. Research thus far has rarely examined neurological, neurochemical, hormonal, and genetic correlates of volunteering to any significant extent, especially controlling for other factors. Evolutionary theory and behavior genetic research suggest the importance of such factors in humans. Studies on charitable giving suggest that physiological characteristics are related to volunteering, including specific genes (such as oxytocin receptor [OXTR] genes, Arginine vasopressin receptor [AVPR] genes, dopamine D4 receptor [DRD4] genes, 5-HTTLPR). We recommend that future research on physiological factors be extended to non-Western populations, focusing specifically on volunteering, and differentiating between different forms and types of volunteering.

In what way could the physiology of volunteers be different from non-volunteers? We discuss six groups of physiological correlates: in the areas of health, cognition, neurology, hormones, and genetic factors. The chapter is written from a growing awareness that most of the research on volunteering in the social sciences has ignored physiological aspects of human

sociality (Baerman 2008; Von Scheve 2011), while a comprehensive explanation of volunteering clearly requires an integration of physiological aspects (Smith 2014; more generally, see Freese et al. 2003). An important part of research on volunteering is conducted by sociologists, as the reviews by David Horton Smith (1994) and John Wilson (2000, 2012) show. In the spirit of Durkheim (1897), who sought to establish sociology as a science of human behavior separate from biology, sociologists "have allowed the fact that we are social beings to obscure the biological foundations upon which our behavior ultimately rests" (Massey 2002; also see Van den Berghe 1990).

Perhaps the neglect of physiological correlates of social behavior by many social scientists is in part a result of fear that evidence may be found that indeed there are such physiological correlates. Such knowledge could be dangerous to those who view nearly all of human behavior patterns as socially learned (i.e., the result of socialization into socio-cultural systems). The holocaust reminds us that knowledge on physiological correlates of human behavior can be very dangerous when it gets into the wrong hands or is misinterpreted (Benton 1991). While sociologists have only recently become more open to biosocial explanations of social behavior (Freese 2008), economists have been more open to behavior genetics since the 1970s (Bowles and Gintis 2001). Similarly, in demography (D'Onofrio and Lahey 2010) and criminology the acceptance of biological factors is growing (Boisvert and Vaske 2011; DeLisi et al. 2008; Ishikawa and Raine 2002). In the past five years an impressive body of evidence on physiological correlates of political attitudes and behavior has been amassed (Fowler and Dawes 2008, 2013; Hatemi et al. 2009; Smith et al. 2012).

We have set ourselves the ambitious task of reviewing the literature and weeding out the false positives by seeking out replicated research results. We seek to contribute to a correction of the ignorance of physiological correlates of volunteering by reviewing the evidence on genes, hormones, neurological phenomena, and health as correlates of volunteering. We distinguish between physiological causes of volunteering and the physiological consequences of volunteering. While the health consequences of volunteering on volunteers have been studied quite extensively in social epidemiology and gerontology (see also Handbook Chapter 17), very little attention has been paid to physiological causes of volunteering, other than the effects of sex and age, mediated by social role expectations.

B. Definitions

The general definitions in the Appendix of the Handbook are accepted in this chapter. The chapter will focus generally on *formal volunteering*, done through some association or organization, not *informal volunteering*, done directly with no association or organization involved. To date, few studies have directly assessed physiological correlates of volunteering, especially while controlling for other important factors. There is more research on physiological correlates of related social behaviors, such as voting, giving to charitable organizations, and money transfers to specific other individuals. To some extent the results of these studies can be generalized to volunteering, because they share a common core: they are all forms of prosocial behavior, which have collective benefits but are costly for individuals. The willingness to sacrifice one's own resources for the benefit of others lies at the foundation of voting (Fowler 2006), as well as other forms of prosocial behavior like charitable giving and blood donation (Bekkers 2004; Ferguson et al. 2008; Lee et al. 1999), and also helping strangers, which may be seen as informal volunteering (Ottoni-Wilhelm and Bekkers 2010). Civic duty (Loewen and Dawes 2012), social capital (Putnam 2000), and the moral principle of care (Ottoni-Wilhelm and Bekkers 2010), but not the "prosocial personality" (Bekkers 2004), are among the variables that could explain why volunteering is positively correlated with other forms of prosocial behavior. However, volunteering also differs from other forms of prosocial behavior in its dependence on time, energy, and physical strength as resources. These unique features are in part physiological – hence this chapter.

C. Historical background

The current review draws primarily upon what has been called *biosocial research* (Udry 1995) in a variety of disciplines that are normally not considered to belong to the social sciences, such as behavior genetics, neurology, and gerontology. An implicit assumption in much of the literature is that biological traits and phenomena are fairly stable over time at the population level. From a long-run historical perspective, it is clear that this is not the case: huge population health gains

have been realized in the past centuries, and relationships obtained in high-income countries do not necessarily generalize to low- or middle-income countries (Calvo et al. 2012).

D. Key issues

1. Six sets of physiological correlates

While few studies have examined physiological correlates of volunteering directly, many correlates of volunteering have physiological aspects. Also, many studies on other forms of prosocial behavior have documented biological correlates. Therefore, the chapter takes a broader view, discussing six types of biological correlates of volunteering and related behaviors and traits:

(a) health correlates, including physiological measures;

(b) cognitive performance, including intelligence tests;

(c) neurological correlates: brain size and activity measured using fMRI techniques;

(d) neurochemicals, including dopamine and serotonin;

(e) hormones, including oxytocin, testosterone, and cortisol;

(f) genetic factors, including specific genes (such as OXTR genes, AVPR genes, DRD4, 5-HTTLPR).

2. Data and methods

Biosocial research typically relied on small samples, until biomarkers were collected among respondents in several large US national panel surveys, such as AddHealth, Midlife in the United States (MIDUS), the Wisconsin Longitudinal Study (WLS), the National Social Life, Health, and Aging Project (NSHAP), and the Health and Retirement Survey (HRS). Recently, health data have also been collected and made available for researchers in the British Household Panel Survey (BHPS) and the Whitehall II Study. Each of these panel surveys also includes measures

of volunteering. To date, very few scholars have used these data to investigate physiological correlates of the dynamics in volunteering. We expect more work to be published in the near future.

While the empirical evidence on physiological correlates of volunteering is fairly limited, the body of evidence on physiological correlates of human prosociality in the biosocial sciences has exploded in the past decade due to the development of cheaper and faster techniques to collect biomarkers from DNA and hormone levels with noninvasive procedures, such as collecting saliva (D'Onofrio and Lahey 2010). In earlier research, hormone levels could only be identified with blood samples. Genetic association studies require collection of DNA material such as hair, nails, or saliva.

The collection of neurological data still requires expensive and impractical equipment located mostly in (university) hospitals and that only specialized personnel can handle. The methods include PET (positron emission tomography), fMRI (functional magnetic resonance imaging), EEG (electroencephalography), and TMS (Temporary Magnetic Stimulation). The noisy fMRI machines require research participants to lie still in a confined space that does not allow for natural social interaction. This lowers the ecological validity of the research. The location of the equipment in hospitals implies that research participants need to be recruited and paid specifically for the study. Participants can only be run one by one, increasing the costs and time required to collect fMRI data.

In the near future, collecting data on physiological correlates of volunteering will become much cheaper and more convenient. The spread of smartphones will allow for the collection of several physiological measures, such as heartbeat, physical location, movement, and emotional states (Lakens 2013).

3. Health correlates

Volunteering may help delay the decline, maintain, or even improve the health of volunteers (see Handbook Chapter 17). At the same time, health facilitates volunteering. Teasing out the direction of causality is difficult and requires longitudinal panel data at the individual level. Even

if longitudinal data are available, it is of paramount importance to check whether health conditions at base line influence the selection of individuals into and out of volunteering. Ignoring health-based selection is almost certainly leading to an overestimation of the health benefits of volunteering (Li and Ferraro 2005). The use of fixed effects models is one possible strategy to deal with such selection bias (Halaby 2004). Such models analyze the variance over time within individuals, ignoring differences between individuals.

(a) Subjective well-being

Research on the relationship between volunteering and well-being (Ryff 1989) has a long history (e.g., Carp 1968). Like prosocial spending (Aknin et al. 2013), volunteering is associated with higher well-being in many cultures worldwide (Calvo et al. 2012; Plagnol and Huppert 2010). A meta-analysis involving 29 studies from the 20th century found that on average volunteers scored higher on measures of well-being than non-volunteers, even when adjusting for health or socioeconomic status (Wheeler et al. 1998). In addition, volunteers who engaged in directly helping others had higher well-being than those who engaged in more indirect tasks. We recommend an updated meta-analysis that includes more recent studies. Longitudinal studies confirm that volunteering at one time point predicts higher life satisfaction, happiness, self-esteem, and psychological well-being, at a later time point (for reviews, see Konrath 2014a; Konrath and Brown 2012; Handbook Chapter 17). These results are typically consistent when potential confounds are considered and controlled statistically. Confounds are important to consider, since people with higher well-being are more likely to volunteer (Thoits and Hewitt 2001). Experimental and quasi-experimental interventions to increase volunteering behavior produce more positive affect and higher self-esteem compared to control groups (Hong and Morrow-Howell 2010; Midlarsky and Kahana 1994; Switzer et al. 1995). Such results lend confidence to the conclusion that volunteering actually causes some greater positive emotional outcomes.

(b) Mental health

Volunteers have lower anxiety and depression than non-volunteers (Benson et al. 2007; Handy and Cnaan 2007; Hunter and Linn 1980), with the direction of causation unclear. Moreover, people who volunteer at one time point have fewer depressive symptoms at a later time point, even when controlling for potential third variables (Kahana et al. 2013; Lum and Lightfoot 2005; Schwingel et al. 2009; Thoits and Hewitt 2001). This finding has been confirmed cross-culturally (e.g., in Singapore; Schwingel et al. 2009). Experimental interventions to increase volunteering behavior produce fewer depressive symptoms compared to control interventions (Hong and Morrow-Howell 2010; Switzer et al. 1995).

All of the foregoing studies suggest that volunteering causes better mental health, over and above selection effects leading people with better mental health to be more likely to become volunteers. However, at the extreme of poor mental health, especially for people incarcerated as in-patients in institutions, poor mental health clearly reduces volunteering, based on minimal (e.g., some group meetings for alcohol or drug addiction recovery, by Alcoholics Anonymous or Narcotics Anonymous) or non-existent volunteering opportunities for in-patients in such institutions.

The type of volunteering may be a factor in mental health outcomes. For example, one study found that volunteer firefighters had more symptoms of posttraumatic stress compared to control participants (Wagner and O'Neill 2012). Thus, the potential for vicarious traumatization must be considered in high-risk volunteer positions (e.g., crisis counseling for victims of sexual assault and violence; Baird and Jenkins 2003).

(c) Subjective health

Self-reported measures of health are strong predictors of longevity (Idler and Benyamini 1997), and volunteers score higher on self-reported measures of health (Benson et al. 2007; Harris and Thoresen 2005; McDougle et al. 2013; Oman et al 1999; Shmotkin et al. 2003). Volunteering is associated with higher subjective health in many cultures worldwide (Kumar et al. 2012).

Moreover, longitudinal studies confirm that volunteering predicts higher self-reported health at a later time point, even when controlling for plausible confounds (Lum and Lightfoot 2005; Luoh and Herzog 2002; Morrow-Howell et al. 2003; Piliavin and Siegl 2007; Thoits and Hewitt 2001; Van Willigen 2000). Hence, to some significant extent volunteering causes better subjective health in individuals.

However, there may be limits on the number of years that such health effects last, since one 30-year longitudinal study found null results (Moen et al. 1989). The people who are most likely to receive health benefits from volunteering are older adults, compared to younger adults (Van Willigen 2000), and people who are less socially integrated, compared to those who are more socially integrated (Piliavin and Siegl 2007).

(d) Objective physical functioning/health

Physical functioning indicators include objective tests (e.g., strength, agility, walking speed) and health indicators (e.g., functional limitations, physician-diagnosed health conditions, nursing home residence rates, doctor visits for physical illness, overnight hospital visits). Studies find that volunteers show better physical functioning (Choi and Tang 2014). Such research indicates that people who volunteer tend to be self-selected for better physical health and functioning. This is a clear direction of causality at the poor physical health extreme. Both short-term and long-term in-patients in hospitals, nursing homes, rehabilitation clinics, and the like have minimal or non-existent opportunities to volunteer. This limitation of volunteer opportunities is true also of bed-bound or homebound people (i.e., invalids) in poor health at home or elsewhere. Disabled people who are mobile in wheelchairs, scooters, or other personal vehicles also tend to have fewer volunteer opportunities, given physical access difficulties for many buildings, including homes, in many nations.

Health limitations can have very deep roots, dating back to birth or even prenatal conditions (Almond and Currie 2011; Nathanielsz 1996). Low birth weight limits life chances (Black et al. 2007). In order to avoid health-selection effects, it is important to control for initial/baseline indicators of physical functioning/health when trying to isolate effects of volunteering. Longitudinal studies often find that volunteering predicts having fewer functional

limitations at a later time point, even when controlling for a number of plausible confounds (Choi and Tang 2014; Lum and Lightfoot 2005; Luoh and Herzog 2002; Morrow-Howell et al. 2003). In addition, another longitudinal study found that volunteering predicted fewer doctor visits for physical illness and fewer overnight hospital stays in a nationally representative sample of older adults, even when adjusting for covariates (Kim and Konrath 2014). However, other studies have found that volunteering is unrelated to the later number of physician-diagnosed health conditions or nursing home residence rates (Lum and Lightfoot 2005). Experimental interventions to increase volunteering behavior increase participants' physical strength and balance, halt declines in walking speed over time, and produce fewer falls and functional limitations compared to control interventions (Fried et al 2013; Hong and Morrow-Howell 2010). Because there is limited cross-cultural research on physical functioning indicators, it is unclear whether these results would generalize widely across cultures.

(e) Health risk behaviors

Health risk behaviors include smoking, drinking, extremes of Body Mass Index (BMI), physical activity, and preventative healthcare utilization (e.g., getting flu vaccines). Among adolescents, pregnancy, school failure, and problem behaviors at school are also considered health risk behaviors. Compared to non-volunteers, volunteers report engaging in fewer health risk behaviors, such as smoking, drinking, or sedentary lifestyles (Harris and Thoresen 2005; Musick et al. 1999; Oman et al. 1999; Shmotkin et al. 2003). Among teens, volunteering is associated with fewer risky behaviors (e.g., alcohol, tobacco, and drug use; antisocial behavior; violence) and more beneficial ones (e.g., physical activity, school success; Benson et al. 2007; Murphey et al. 2004; Uggen and Janikula 1999). In a longitudinal study, volunteering predicted more preventative healthcare utilization (e.g., flu vaccine, cholesterol test) in a nationally representative sample of older adults, even when adjusting for covariates (Kim and Konrath 2014). Experimental interventions to increase volunteering behavior produced increased physical activity among older adults (Fried et al. 2004; Tan et al 2009), and decreased rates of pregnancy, school failures, and problem behaviors at school among adolescents (Allen et al. 1997; Switzer et al. 1995). It is unclear whether the links between volunteering and health risk behaviors would generalize widely across cultures.

(f) Basic physiological measures

Research has clearly shown that volunteering is associated with better physical health. Yet knowledge about physiological pathways to such outcomes (e.g., cardiovascular measures, hormones, biomarkers) remains sparse. Elevated resting pulses and blood pressure (i.e., hypertension) are both risk factors for cardiovascular disease and later mortality, even when controlling for other lifestyle-based risk factors (Chobanian et al. 2003; Gillum et al. 1991). Only two known studies have examined the link between volunteering and such cardiovascular variables, finding that in nationally representative samples of older adults, volunteers have lower resting pulses and lower blood pressure compared to non-volunteers, controlling for plausible confounds (Burr et al. 2011; Konrath 2013). C-reactive protein as a biomarker of systemic inflammation is also associated with cardiovascular disease (Van Lente 2000). Volunteers have lower c-reactive protein levels compared to non-volunteers (Konrath 2013). This effect was confirmed in an experimental study that found that adolescents who were randomly assigned to a four-month volunteering program had marginally lower inflammatory biomarkers (c-reactive protein and interleukin 6) than waitlist control-group participants (Schreier 2012; Schreier et al. 2013). They also had lower levels of cholesterol and a lower BMI. However, there was no effect of the intervention on blood pressure. All these studies used real-time physiological assessments conducted by trained personnel. More studies are needed. In particular, it is unclear whether the physiological consequences of volunteering would generalize across cultures.

(g) Longevity

Ultimately, the better health of volunteers may reduce their mortality risk. Indeed, a meta-analysis of 14 longitudinal studies conducted from 1986 to 2012 found that volunteering at one time point was associated with a 47% reduction in mortality risk (24% for adjusted models) a few years later (Okun et al. 2013). This meta-analysis also found that the mortality risk benefits associated with volunteering are especially strong for people who are more religious. Other research finds that the reasons why people volunteer can also affect whether they experience lower mortality risk after volunteering (Konrath et al. 2012). Even when adjusting for covariates, people who volunteer for more other-oriented reasons (e.g., compassion) have a significant

mortality risk reduction, but those who volunteer for more self-oriented reasons (e.g., to learn something new, or to feel good about themselves) have a marginally *higher* risk of mortality. Although there are some experimental studies that assess health consequences of volunteering, we know of none that assesses mortality risk. Moreover, there are only limited cross-cultural studies examining longevity benefits of volunteering.

4. Cognitive performance

Several US surveys show that membership and active participation in voluntary associations are positively related to verbal ability measured in a vocabulary test, but once the level of education is controlled, verbal ability does not have much predictive value for the number of memberships in associations (Hauser 2000). Data from the Wisconsin Longitudinal Study (WLS) reveal this pattern over a long period of time. Performance on an intelligence test in 1957 was positively associated with social participation some 35 years later, but this relationship disappeared completely when the level of education in 1975 was controlled. While volunteers typically perform better on cognitive tests than non-volunteers, this difference is often reduced when the level of education is controlled statistically (Bekkers and Ruiter 2008; Carabain and Bekkers 2011 2012). Intentions to volunteer in a scenario experiment conducted among a random population sample in the Netherlands were not correlated with performance on a vocabulary test when the level of education was controlled (Bekkers 2010).

The foregoing results do not necessarily mean that intelligence (cognitive performance) is unrelated to volunteering as a causal factor, while educational attainment is the causal factor. Intelligence likely affects how much education a person gets, especially in broad terms, such as high school degree versus college/university degree versus advanced degrees. In theory and substantially in practice, level of education and performance on cognitive tests measure the same aspects of a person's mind. Years of education also measure basic aspects of cognitive performance, including the knowledge and cognitive abilities underlying such performance. Insofar as volunteer roles require intelligence, people with higher intelligence will likely self-select themselves more into volunteering than people with low intelligence. The same is true for

levels of education. In sum, disentangling education from cognitive performance (intelligence) is important but rarely feasible in practice.

Studies of social participation programs for older adults have generally found higher cognitive performance among volunteers (Krueger et al. 2009; James et al. 2011). However, this finding does not prove that volunteering enhances cognitive performance, because the difference may well be a reflection of a higher level of education during entry into the program or intelligence during entry. Collapsing volunteer work with other forms of social participation, Aartsen et al. (2002) found no additive cognitive performance benefit of social participation.

Using data from the Fullerton Longitudinal Study, Reichard et al. (2011) found that intelligence measured by Wechsler Adult Intelligence Scale-Revised (WAIS-R) was positively correlated with non-work leadership positions, such as in a religious group, community service group, or sports organization, but this study did not include a measure of the level of education achieved.

5. Neurological correlates

From the *social brain hypothesis* (Dunbar 1998), it is likely that volunteering as a social activity is facilitated by the large cognitive capacity of humans and the human brain, viewing us as a species. Brain volume across species clearly determines the capacity to process information required to maintain social relationships, and this is true to a lesser extent across human individuals (Dunbar 1992). One study among 58 US adults found that the relative size of the amygdala (adjusted for total intracranial volume) is positively correlated with the size and complexity of social networks (Bickart et al. 2011a, 2011b). Another study on 40 US adults found that the size of the prefrontal cortex is positively correlated with the size and complexity of social networks (Powell et al. 2012). The prefrontal cortex is of particular importance for human sociality and consciousness (Dunbar 1998), in part because of its involvement in understanding the intentions of others (Lewis et al. 2011; Walter et al. 2004). The prefrontal cortex consists of two areas: the dorsal prefrontal cortex, which is involved in higher order cognitive functions such as planning, and orbital prefrontal cortex, which is involved in mood, affective behavior, and social cognition.

Thus far, no studies have specifically investigated brain activity in relation to volunteer work. Because of the heterogeneity of tasks that volunteers can perform, this would not make much sense. However, many studies have investigated brain activity involved in functions and conditions correlated with volunteering, such as social acceptance (Eisenberger et al. 2003) and empathy (Singer et al. 2008). A growing number of studies are using fMRI to investigate cognitive functioning in older adults recruited in volunteer programs (e.g., Carlson et al. 2009). These studies typically find enhanced cognitive functioning among volunteers.

While fMRI studies are not yet common in research on volunteering, several studies have found differential neural activation in reward areas when making charitable donations (Harbaugh et al 2007; James and Boyle 2014; Moll et al. 2006). Such studies could be conducted among volunteers – for instance, while they are thinking about their volunteer job versus a control activity, contrasting volunteers with different motives for volunteering.

Voluntary associations can differ markedly in the extent to which membership and participation requires greater education and higher cognitive performance/intelligence. For instance, social clubs and sports associations seem to make few such demands, while paramedic ambulance squads, groups of docent volunteers in museums, alumni associations, professional associations, and scholarly scientific societies make substantial demands. Unfortunately, no one has studied this issue so far, to our knowledge.

6. Neurochemicals

Dopamine is a neurotransmitter involved in the experience of pleasure. Originating in the midbrain, dopamine produces neurons that consecutively go to the nucleus accumbens and the prefrontal cortex (Eisler and Levine 2002). It is not specific for social experiences. It is involved in all kinds of positive moods, including those as a result of substance abuse and other addictive behaviors. The warm glow of giving (Andreoni 1990), often cited by volunteers as a motive for volunteering, may reflect that volunteering is a pleasurable experience leading to the production of more dopamine. Obviously, the finding that volunteers self-report warm glow does not show why volunteering is a pleasurable experience. Also it does not prove that volunteering produces warm glow. The warm glow may be specific to donors. In a study on the relationship between

blood donation and charitable giving, blood donors reported a stronger warm glow as they gave more to charity, but non-donors did not. This finding suggests that donating generates less of a warm glow to non-blood donors (Ferguson et al. 2012, Study 3).

7. Hormones

(a) Oxytocin

Oxytocin (OXT) is a neuropeptide that is released during childbirth, breastfeeding, and sexual activity, especially intercourse (Carter 1992, 1998; MacDonald and MacDonald 2010). It is also implicated in more general social interactions, trust, and in stress regulation (Heinrichs et al. 2003). For example, one experimental study found that nasally administered OXT (compared to a placebo) caused male participants to donate significantly more money to a charitable cause (Barraza et al. 2011). Many other studies have conceptually replicated these results (Zak and Barraza 2013; Zak et al. 2007). However, we know of no work that explicitly links OXT with volunteering behavior. Such research would be promising, as long as future researchers are aware that OXT is only linked with prosociality in certain groups of people and under certain contexts (Bartz et al. 2011).

(b) Vasopressin

Arginine vasopressin (AVP) is another neuropeptide implicated in social behavior. Compared to OXT, much less is known about its role in prosociality in humans. However, in rats, AVP injections are associated with prosocial tendencies, compared to placebo controls (Ramos et al. 2013). In humans, there are no known studies directly examining prosocial tendencies or volunteering specifically, yet studies on related processes are emerging. For example, experimentally administered doses of AVP in males produced a better recall of emotional faces (Guastella et al. 2010). But AVP gave inconsistent findings with respect to actually identifying the emotional expressions (impaired performance: Uzefovsky et al. 2012; no effects: Kenyon et al. 2013). Moreover, there may be sex-specific results of AVP effects, with one study finding

that after nasally administered AVP (compared to placebos) males see faces as more unfriendly, while females see them as friendlier (Thompson et al. 2006). This area is ripe for future research.

(c) Cortisol

Cortisol is a stress hormone that is associated with cardiovascular mortality risk (Kumari et al. 2011; Vogelzangs et al. 2010). Although there have been studies examining the effect of other prosocial behaviors on cortisol levels (e.g., Field et al 1998; Smith et al. 2009), there is only one known study examining cortisol in relation to volunteering. This experimental study found that a four-month volunteering program had no effect on adolescents' cortisol levels compared to a waitlist control condition (Schreier et al. 2013; Schreier 2012). More research is needed to examine the relationship between cortisol and volunteering.

(d) Testosterone

Testosterone is a male sex hormone, but it is also present to a lesser degree in women. There has been some research on testosterone and prosocial tendencies, but no study that we know of specifically examines testosterone and volunteering. Experimentally administered testosterone produces less facial mimicry of emotional facial expressions (Hermans et al. 2006), decreases the ability to recognize emotional facial expressions (i.e., cognitive empathy; Van Honk and Schutter 2007; Van Honk et al. 2011), and reduces trust in others, especially among highly trusting people (Bos et al. 2010). Several studies examine the effect of testosterone on generosity in economic games (e.g., the Ultimatum Game), with contradictory results. Two find that testosterone administration causes less generosity (Boksem et al. 2013; Zak et al. 2009), two find that testosterone administration causes more generosity (Eisenegger et al. 2010; Van Honk et al. 2012), and another finds null results (Zethraeus et al. 2009). One study finds that even as testosterone lowers initial generosity, it simultaneously increases reciprocal generosity – giving to others who first gave to the self (Boksem et al. 2013). Some contradictory results may be due to beliefs about how testosterone affects people (Eisenegger et al. 2010), and these need to be considered in all testosterone administration studies.

8. Genes

Genes have long been implied as biosocial causes of behavior. Turkheimer (2000) summarized the results of *many* thousands of studies in behavioral genetics in three laws, the first being that "everything is heritable." While this law may not be true in its extreme formulation, almost every aspect of usual human social behavior that has been studied with behavioral genetic data has indeed been found to have some genetic origins, including the size of social networks (Fowler et al. 2009; Freese 2008; McGue and Bouchard 1998), and even mobile phone use (Miller et al. 2012). Specific political party preference seems to be one of the few exceptions (Hatemi et al. 2009). Also, general prosocial tendencies and volunteering are subject to genetic effects (Ebstein et al. 2010). Before we discuss these findings, we go into the methodology used to obtain estimates of genetic effects.

(a) Biometric models

Behavioral genetic models, also called biometric models, decompose variance in human behavior by using samples of individuals with systematically different genetic similarity such as twins and siblings. Building on several assumptions, the variance in phenotypic traits can then be decomposed into effects of additive genetic factors (a^2), shared environmental (c^2) and unique environmental components (e^2). These models show that many traits have substantial genetic heritability (Turkheimer's first law), and that additive genetic factors typically explain more of the variance than shared environmental factors (the second law). On the other hand, however, there are few traits that have exclusively genetic origins. In fact, behavior genetics tells us how amazingly complex the interplay between nature and nurture is in determining human behavior. Most traits in humans are genetically complex, meaning that there is a complex of many genes associated with the trait. There are only a few traits that are determined by a single gene. An example is phenylketonuria (PKU), a disorder caused by a deficiency of the enzyme phenylalanine hydroxylase, giving rise to mental retardation and eczema. Thus far, the search for effects of specific genes on human behavior has been disappointing. Genome Wide Association Studies (GWAS) have failed to identify genes with substantial effects on specific human differences of interest to social scientists (Turkheimer 2012). Typically, all single nucleotide

polymorphisms (SNPs) combined explain less variance than is estimated in biometric models. The discrepancy between the sizable genetic heritability estimates from biometric models and the much smaller variance explained by all SNPs combined is called the "missing heritability problem" (for a discussion, see Turkheimer 2011).

Many studies have investigated altruism and related aggregate constructs of prosocial tendencies with biometric models, often including volunteering as well as informal forms of prosocial behavior and prosocial values and attitudes. While most studies have found genetic effects on prosocial tendencies (e.g., Rushton 2004; Rushton et al. 1986; Koenig et al. 2007; Gregory et al. 2009), some have not (Krueger et al. 2001; Bouchard and Loehlin 2001). More generally, estimates of genetic effects have varied widely from 0% up to 50%. Three studies have specifically investigated volunteering using behavioral genetic models. Son and Wilson (2010) used the MIDUS twins and siblings samples to estimate genetic variation in the number of volunteer hours. The best-fitting biometric models included no genetic effects for males and a relatively small genetic variance component (.30) for females. Gibson (2001) analyzed data from a small sample of New Zealand twins, finding that the higher educated twin of a monozygotic pair typically spent less time volunteering than the lower educated twin. This finding suggests that the relationship between education and volunteering in the general population is positive due to genetic effects. Recently, Bekkers (2014) also used the MIDUS twin sample to analyze religion and education as mediators of unique environmental effects on volunteering. The analysis was limited to monozygotic twin pairs to exclude genetic sources of variance. All differences within monozygotic twin pairs must be due to unique environmental factors. The study concluded that education did not explain any variance in volunteering among monozygotic twins. This finding implies that the relationship between education and volunteering, one of the most commonly found relationships in the literature (Smith 1994; Musick and Wilson 2008), is mostly due to genetic effects. The conclusion for religion, another common correlate of volunteering, was very different: the strength of religiosity was positively related to the number of hours volunteered, implying that genetic effects cannot explain the relationship.

Which genes are likely to be involved in volunteering? Several specific genes have been studied in detail as candidates that could play a role in prosocial behavior: DRD4 genes, OXTR

genes, AVPR genes, and serotonin transporter (5-HTTLPR) genes. No study thus far has specifically examined these genes in conjunction with volunteering, however.

(b) DRD4 genes

DRD4 genes enable the production of the D4 dopamine receptor protein, which is involved in the expression of emotions and for the stimulation of cognitive faculties (Schmidt et al. 2001). Song et al. (2011) found a weak negative relationship between DRD4 7R and paid-work job satisfaction. Future research could test whether this relationship holds for unpaid work as well. Jiang et al. (2013) provide a summary of papers investigating relationships between DRD4 variants and prosocial behaviors. Bacher-Melman et al. (2005) and Anacker et al. (2013) find negative relationships, that is, higher altruism scores in the absence of the dopamine receptor D4 7-repeat allele (DRD4 7R). Zhong et al. (2010) find an association with fairness in the ultimatum game. Knafo et al. (2011) did not find a relationship, but found a more complicated pattern: children with a DRD4 7R allele were more susceptible to positive parenting practices than children without this allele. One interpretation of this finding is that an environmental factor (positive parenting) is able to repair a lack of prosociality among children with a specific genetic risk factor (the DRD4 7R).

Several findings in studies of other social behaviors are consistent with the more general interpretation that individuals with the DRD4 7R are more susceptible to social influence. Using the AddHealth data, DeLisi et al. (2008) report an association between DRD4 polymorphisms and age of first criminal arrest among adolescents from low risk families, but not among high risk families. Settle et al. (2010) found that among participants in the NLSAH with the D4 7-repeat allele, the number of friendships in adolescence was significantly associated with liberal political ideology, while there was no such association among those without the gene variant. Sasaki et al. (2013) show that the influence of priming participants with religion positively affects the willingness to volunteer for environmental causes among those who carry the D4 2 or 7-repeat allele but not among those carrying other variants.

Reuter et al. (2011) examined another dopaminergic candidate polymorphism for altruistic behavior, the functional COMT Val158Met SNP, and found that the Val allele

(representing strong catabolism of dopamine) is positively related to charitable giving towards poor children in a developing country.

(c) OXTR genes

Oxytocin receptor (OXTR) genes are also implicated in prosocial traits and behaviors (for reviews, see Ebstein et al. 2012; Kumsta and Heinrichs 2013). For example, people with GG genotypes (in rs53576) are more sociable, empathic and trusting than A-allele carriers (Krueger et al. 2012; Rodrigues et al. 2009; Tost et al. 2010). They are also rated as more empathic by observers (Kogan et al 2011). Yet these effects are not found for all potential OXTR SNPs: only four out of ten SNPs in one study (rs2254298, rs2268491, rs237887, rs4686302: Wu et al. 2012), and only three out of 15 SNPs in another (rs1042778, rs2268490, rs237887: Israel et al. 2009). A meta-analysis of OXTR effects revealed weak relationships across the board (Bakermans-Kranenburg and Van IJzendoorn 2014). Clearly, the specific SNP within the OXTR gene is important. Behaviorally, OXTR GG genotypes are related to better emotion recognition performance (rs53576, rs2254298, and rs2228485: Lucht et al. 2013; Rodrigues et al. 2009; Wu and Su 2013) However, their effects on generosity within economic games (e.g. Dictator Game, Trust Game) are either limited (e.g. to three out of 15 possible OXTR SNPs: Israel et al. 2009) or non-existent (Apicella et al. 2010).

These inconsistent main effects might reflect underlying interactions with contextual variables. For example, although one study found no main effect of the OXTR SNP (rs53576) on prosocial behavior (including volunteering), there was an interaction between genotype and levels of environmental threat in predicting prosociality (Poulin et al. 2012). Another study found that the OXTR gene (rs2254298) interacted with volunteering status to predict mortality risk (Konrath 2014b). Specifically, the widely documented decline in mortality risk for volunteers was only found for OXTR A-allele carriers, and not GG carriers. Research is needed to better understand factors that may influence the relationship between OXTR genes, prosociality, and health. In addition, more cross-cultural research is needed, considering one study finding that the OXTR genotype had opposite effects in the US and Korea (Kim et al. 2011).

(d) AVPR genes

AVPR genes have also been implicated in prosocial traits and behaviors. Participants with longer versions of the AVPR1a RS3 gene scored higher on prosocial traits and allocated more money to others in the Dictator Game than those with short versions of this gene (Knafo et al. 2008). Similar to OXTR genes, AVPR genes may best predict prosocial behavior in concert with contextual factors (Poulin et al. 2012).

(e) 5-HTT genes

5-HTT genes regulate the function of the neurotransmitter serotonin. One common polymorphism in the promoter region of the gene (5-HTTLPR) has been linked not only to aggressive behavior (the short variant; Duman and Canli 2010), but also to voting (the long variant; Fowler and Dawes 2008). The 5-HTTLPR was one of the first to be discovered as interacting with environmental conditions (life stress) in depression (Caspi et al. 2003). Carriers of the short variant suffer more adverse consequences of childhood maltreatment (Karg et al. 2011). Song et al. (2011) found a weakly positive relationship between 5-HTTLPR and paid work job satisfaction. Whether this relationship holds for unpaid work as well remains to be seen in future research. Colzato et al. (2013) showed that intake of a tryptophan food supplement, containing an amino acid that is found in food such as fish, soybeans, eggs, and spinach, and a biochemical precursor of serotonin, increases trust in an economic game. Stoltenberg et al. (2013) found that the association between 5-HTTLPR triallelic genotype and helping behavior was mediated by anxiety in social situations. Students carrying the S' allele reported lower rates of helping others, partly as a result of higher levels of social avoidance.

9. Discussion

We should be careful not to reify physiological differences (Dar-Nimrod and Heine 2011). An image of brain activity or a correlation between genetic polymorphisms and volunteering does not imply causality. The rules for causal inference also apply to physiological data: correlates may reflect a causal influence of physiological properties, but they may also be observed as a

result from social behavior influences on physiological functioning or selection on some third variable. Only studies that use random assignment of participants to treatment and control groups allow for easy causal inference on the effect of a specific cause (Shadish et al. 2002; Firebaugh 2008). However, brain activity or hormone levels are usually not manipulated. Primate studies in which group size was varied show that network size determines the grey matter volume and prefrontal cortex activity (Sallet et al. 2011). Thus the correct interpretation of a study showing a correlation between prefrontal cortex and network size is *not* that brains cause networks, as suggested in the causal model of one study (Figure 1 of Powell et al. 2012). The same study does acknowledge that the causal direction of the relationship between prefrontal cortex and network size may run in both ways. An adequate representation of the association between the volume of grey matter in the brain with the number of social contacts in online social networks is that "social network size is reflected in human brain structure" (Kanai et al. 2012). Lesion studies on patients with damage to specific parts of the brain (e.g., Shamay-Tsoory et al. 2009) show that specific cognitive and social functions are impaired. From such studies, however, we cannot conclude how individual differences in brain volume and activity among healthy individuals determine cognitive and social functioning.

Another shortcoming is that participants in fMRI studies are almost exclusively originating from Western countries (Chiao and Cheon 2010). The use of samples from WEIRD (Western, Educated, Industrialized, Rich and Democratic) countries reduces the potential for generalization of research findings to all of humanity (Henrich et al. 2010). Cross-cultural evidence on health correlates of prosociality (Calvo et al. 2012) is very important in this respect. Also within WEIRD countries, participants in studies that include physiological measurements are not random samples of the population. The Henrich, Heine and Norenzayan diagnosis warning echoes McNemar's (1946) warning that the practice in psychology to use students as research participants was creating a "science of the behavior of sophomores". Within this particular population, a volunteer bias is likely to occur such that individuals who are more sociable, less conventional, and more interested in the study will be more likely to participate (Rosenthal 1965; Rosnow and Rosenthal 1976). In longitudinal research on health, selective participation based on health status and deterioration is an additional problem. These problems reduce the potential for generalization of the findings to broader populations.

E. Usable knowledge

The fact that volunteers are in better health and ultimately live longer than non-volunteers demonstrates the potential relevance of physiological correlates of volunteering. If proven to be causal, the link between health and volunteering bears the promise of huge physical welfare (benefit) advantage of volunteering. Programs that encourage volunteering, specifically among the elderly and among those at risk for health problems, could improve health and promote longevity. The role of oxytocin in producing positive emotional feelings, even when those feelings result from spraying OXT into the nostrils, has practical applications. However, such applications are very manipulative, and clearly unethical if done without conscious choice by the recipient of the OXT.

F. Future trends and needed research

Our review suggests a considerable potential for discovery in future research on physiological correlates of volunteering. In our view, some of the findings we have reviewed are outright exciting. The current phase of biosocial research is one of discovery, mapping hitherto uncharted territory where “Here be dragons” used to be written. Just like the first maps drawn by cartographers were notoriously unreliable, new findings in biosocial science often fail to replicate in future studies (Freese 2011). The burgeoning literature in the biosocial sciences carries the risk of the “decline effect” (Lehrer 2010; Schooler 2011): promising discoveries of associations between physiological characteristics and prosocial behavior will prove to be more complicated than initially conceived, or worse still: they may not be replicated in other samples. Attempts to replicate often fail, as a recent replication effort of genes previously reported to be involved in intelligence shows (Chabris et al. 2012). We should thus be careful not to generalize from single genetic association studies. The results may be false positives as a result of a low statistical power (Davis-Stober and Dana 2013). Therefore, we encourage the use of meta-analytic methods to uncover reliable patterns and moderators of gene-behavior associations. Some of these problems are also inherent in fMRI studies (Vul et al. 2009). There is also abundant evidence that non-significant findings are disappearing from the universe of journal

publications in the social sciences (Fanelli 2012). Replication and open access publication of all relevant findings are therefore important to the advancement of knowledge in this area.

While the body of research on health correlates of volunteering is sizable, research on neurochemicals, hormones, and genes has often examined other forms of prosocial behavior such as charitable donations. Future research on these physiological correlates should focus specifically on volunteering. We should be careful not to conclude from correlational evidence that volunteering promotes health because reverse causation (health promotes volunteering) is often difficult to rule out as an explanation of the findings. Nevertheless, there is some promising experimental evidence that establishes volunteering as a causal factor in health promotion. Ideally, the effects of design features of such programs should be evaluated through randomized control trials.

Another aim for future research is to broaden the evidence base beyond samples from Western, educated, industrialized, rich, and democratic (WEIRD) countries. Both research from non-WEIRD countries and cross-national comparative research are required to obtain knowledge on physiological correlates of prosociality in human nature.

Finally, we encourage researchers to consider the wide variety of forms of volunteering. Collapsing all volunteers into one group masks differential associations between physiological characteristics and helping in-group versus out-group members, between volunteering for religious and non-religious groups, between intellectual and practical tasks, between volunteers with different motives, and between volunteering at different levels of intensity. Future research is much needed on various types of volunteering. Both formal and informal volunteering require future study, as does volunteering in volunteer service programs versus voluntary associations. Volunteers in different purposive and analytical types of associations (see Handbook Chapter 5) also need separate study.

G. Cross-references

Chapters 17, 34, 35, 37, 45.

H. References

Aartsen, Marja J., Carolien H. M. Smits, Theo Van Tilburg, Kees C. P. M. Knipscheer, and Dorly J. H. Deeg. 2002. "Activity in Older Adults: Cause or Consequence of Cognitive Functioning? A Longitudinal Study on Everyday Activities and Cognitive Performance in Older Adults." *Journal of Gerontology: Psychological Sciences* 57B:P153–P162.

Aknin, Lara B., Christopher P. Barrington-Leigh, Elizabeth W. Dunn, John F. Helliwell, Justine Burns, Robert Biswas-Diener, Imelda Kemeza, Paul Nyende, and Claire E. Ashton-James. 2013. "Prosocial Spending and Well-being: Cross-cultural Evidence for a Psychological Universal." *Journal of Personality and Social Psychology* 104:635–652.

Allen, Joseph P., Susan Philliber, Scott Herrling, and Gabriel P. Kuperminc. 1997. "Preventing Teen Pregnancy and Academic Failure: Experimental Evaluation of a Developmentally Based Approach." *Child Development* 68:729–742.

Almond, Douglas, and Janet Currie. 2011. "Killing Me Softly: The Fetal Origins Hypothesis." *Journal of Economic Perspectives* 25: 153–172.

Anacker, Kristin, Sören Enge, Andreas Reif, Klaus-Peter Lesch, and Alexander Strobel. 2013. "Dopamine D4 Receptor Gene Variation Impacts Self-reported Altruism." *Molecular Psychiatry* 18:402–403.

Andreoni, James (1990). "Impure Altruism and Donations to Public Goods: A Theory of Warm Glow Giving." *Economic Journal* 100:464–477.

Apicella, Coren L., David Cesarini, Magnus Johannesson, Christopher T. Dawes, Paul Lichtenstein, Björn Wallace, Jonathan Beauchamp, and Lars Westberg. 2010. "No Association Between Oxytocin Receptor (OXTR) Gene Polymorphisms and Experimentally Elicited Social Preferences." *PLoS ONE* 5:e11153.

Bacher-Melman, Rachel, Inga Gritsenko, Lubov Nemanov, Ada H. Zohar, Christian Dina, and Richard P. Ebstein. 2005. "Dopaminergic Polymorphisms Associated with Self-report Measures of Human Altruism: A Fresh Phenotype for the Dopamine D4 Receptor." *Molecular Psychiatry* 10:333–335.

Baerman, Peter. 2008. “Exploring Genetics and Social Structure: Introduction.” *American Journal of Sociology* 114:Sv–Sx.

Baird, Stephanie, and Sharon R. Jenkins. 2003. “Vicarious Traumatization, Secondary Traumatic Stress, and Burnout in Sexual Assault and Domestic Violence Agency Staff.” *Violence and Victims* 18:71–86.

*****Bakermans-Kranenburg, Marian J., and Marinus H. Van IJzendoorn. 2014. “A Sociability Gene? Meta-analysis of Oxytocin Receptor Genotype Effects in Humans.” *Psychiatric Genetics* 24:45–51.

Barraza, Jorge A., Michael E. McCullough, Sheila Ahmadi, and Paul J. Zak. 2011. “Oxytocin Infusion Increases Charitable Donations Regardless of Monetary Resources.” *Hormones and Behavior* 60:148–151.

*Bartz, Jennifer A., Jamil Zaki, Niall Bolger, and Kevin N. Ochsner. 2011. “Social Effects of Oxytocin in Humans: Context and Person Matter.” *Trends in Cognitive Sciences* 15:301–309.

Bekkers, René. 2004. *Giving and Volunteering in the Netherlands: Sociological and Psychological Perspectives*. Dissertation Utrecht University.

Bekkers, René. 2010. “Who Gives What and When? A Scenario Study of Intentions to Give Time and Money.” *Social Science Research* 39:369–381.

Bekkers, René. 2014. “Religion Nurtures Some Forms of Prosociality, Education Does Not. Paper Presented at the CESifo Conference on Social Economics, Munich, 22 March 2014.” Retrieved from http://www.cesifo-group.de/link/se14_Bekkers.pdf

Bekkers, René, and Stijn Ruiter. 2008. “Education and Voluntary Association Participation: Evidence for Selection and Causation.” Paper Presented at the 103d ASA Annual Meeting, Boston, 2 August 2008.

Benson, Peter L., E. Gil Clary, and P. Scales. 2007. “Altruism and Health: Is There a Link During Adolescence?” in *Altruism and health: Perspectives from Empirical Research*, edited by S. Post. New York: Oxford University Press.

Benton, Ted (1991). “Biology and Social Science: Why the Return of the Repressed Should be Given a (Cautious) Welcome.” *Sociology* 25:1–29.

Bickart, Kevin C., Christopher I. Wright, Rebecca J. Dautoff, Bradford C. Dickerson, and Lisa F. Barrett. 2011a. "Intrinsic Amygdala–Cortical Functional Connectivity Predicts Social Network Size in Humans." *Journal of Neuroscience* 32:14729–14741.

Bickart, Kevin C., Christopher I. Wright, Rebecca J. Dautoff, Bradford C. Dickerson, and Lisa F. Barrett. (2011b). "Amygdala Volume and Social Network Size in Humans." *Nature Neuroscience* 14:163–164.

Black, Sandra E., Paul J. Devereux and Kjell G. Salvanes. 2007. "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes." *Quarterly Journal of Economics* 122: 409–439.

Boksem, Maarten A. S., Pranjal H. Mehta, Bram Van den Bergh, Veerle van Son, Stefan T. Trautmann, Karin Roelofs, Ale Smidts, and Alan G. Sanfey. 2013. "Testosterone Inhibits Trust But Promotes Reciprocity." *Psychological Science* 24:2306–2314.

Boisvert, Daniëlle, and Jamie Vaske. 2011. "Genes, Twin Studies, and Antisocial Behavior." *Research in Biopolitics* 9:159–183.

Bos, Peter A., David Terburg, and Jack Van Honk. 2010. "Testosterone Decreases Trust in Socially Naive Humans." *Proceedings of the National Academy of Sciences* 107:9991–9995.

Bouchard, Thomas J., and John C. Loehlin. 2001. "Genes, Evolution, and Personality." *Behavior Genetics* 31:243–273.

Bowles, Samuel and Herbert Gintis. 2001. "Economic Status, Inheritance of: Education, Class, and Genetics." International Encyclopedia of the Social and Behavioral Sciences: Genetics, Behavior and Society, 6: 4132–4141.

Burr, Jeffrey A., Jane Tavares, and Jan E. Mutchler. 2011. "Volunteering and Hypertension Risk in Later Life." *Journal of Aging and Health* 23:24–51.

*Calvo, Rocío, Yuhui Zheng, Santosh Kumar, Analia Olgiati, and Lisa Berkman. 2012. "Well-being and Social Capital on Planet Earth: Cross-national Evidence from 142 Countries." *PLOS ONE* 7:e42793.

Carabain, Christine L., and René Bekkers. 2011. “Religious and Secular Volunteering: A Comparison Between Immigrants and Non-immigrants in the Netherlands.” *Voluntary Sector Review* 2:23–41.

Carabain, Christine L. and René Bekkers. 2012. “Explaining Differences in Philanthropic Behavior between Christians, Muslims, and Hindus in the Netherlands.” *Review of Religious Research* 53:419–440.

Carlson, Michelle C., Kirk I. Erickson, Arthur F. Kramer, Michelle W. Voss, Natalie Bolea, Michelle Mielke, Sylvia McGill, George W. Rebok, Teresa Seeman, and Linda P. Fried. 2009. “Evidence for Neurocognitive Plasticity in at-risk Older Adults: The Experience Corps Program.” *Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 64:1275–1282.

Carp, Frances M. 1968. “Differences Among Older Workers, Volunteers, and Persons Who are Neither.” *Journal of Gerontology* 23:497–501.

Carter, C. Sue. 1992. “Oxytocin and Sexual Behavior.” *Neuroscience and Biobehavioral Review* 16:131–144.

Carter, C. Sue. 1998. “Neuroendocrine Perspectives on Social Attachment and Love.” *Psychoneuroendocrinology* 23:779–818.

Caspi, Avshalom, Karen Sugden, Terry E. Moffitt, Alan Taylor, Ian W. Craig, HonaLee Harrington, Joseph McClay, Jonathan Mill, Judy Martin, Antony Braithwaite, and Richie Poulton. 2003. “Influence of Life Stress on Depression: Moderation by a Polymorphism in the 5-HTT Gene.” *Science* 301:386–389.

Chabris, Christopher F., Benjamin M. Hebert, Daniel J. Benjamin, Jonathan Beauchamp, David Cesarini, Matthijs Van der Loos, Magnus Johannesson, Patrik K. E. Magnusson, Paul Lichtenstein, Craig S. Atwood, Jeremy Freese, Taissa S. Hauser, Robert M. Hauser, Nicholas Christakis, and David Laibson. 2012. “Most Reported Genetic Associations with General Intelligence are Probably False Positives.” *Psychological Science* 23:1314–1323.

Chiao, Joan Y., and Bobby K. Cheon. 2010. “The Weirdest Brains in the World. Commentary on Henrich, Heine, and Norenzayan: The Weirdest People in the World?” *Behavioral and Brain Sciences* 33:28–30.

Chobanian, Aram V., George L. Bakris, Henry R. Black, William C. Cushman, Lee A. Green, Joseph L. Izzo Jr, Daniel Jones, Barry Materson, Suzanne Oparil, and Jackson T. Wright Jr. 2003. "The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report." *JAMA* 28919:2560–2571.

Choi, Eunhee, and Fengyan Tang. 2014. "*Relationship Between Older People's Functional Health and Volunteering, Full-Time, and Part-Time Employment: Longitudinal Latent Growth Curve Model*." Paper Presented at the The Society for Social Work and Research, San Antonio, TX.

Colzato, Lorenza C., Laura Steenbergen, Erik W. De Kwaadsteniet, Roberta Sellaro, Roman Liepelt, and Bernard Hommel. 2013. "Tryptophan Promotes Interpersonal Trust." *Psychological Science* 24:2575–2577.

Dar-Nimrod, Ilan, and Steven J. Heine. 2011. "Genetic Essentialism: On the Deceptive Determinism of DNA." *Psychological Bulletin* 137:800–818.

Davis-Stober, Clintin, and Jason Dana. 2013. "A New Measure of Replicability." Available at www.sas.upenn.edu/~danajd/vstat.pdf

DeLisi, Matt, Kevin M. Beaver, John P. Wright, and Michael G. Vaughn. 2008. "The Etiology of Criminal Onset: The Enduring Salience of Nature and Nurture." *Journal of Criminal Justice* 36:217–223.

D'Onofrio, Brian M., and Benjamin B. Lahey. 2010. "Biosocial Influences on the Family: A Decade Review." *Journal of Marriage and Family* 72:762–782.

Duman, Elif A., and Turhan Canli. 2010. "Social Behavior and Serotonin." Pp. 449–456 in *Handbook of Behavioral Neurology of Serotonin Volume 21*, edited by C. Müller and B. Jacobs. London: Academic Press.

Dunbar, Robin I. M. (1992). "Neocortex Size as a Constraint on Group Size in Primates." *Journal of Human Evolution* 22:469–493.

Dunbar, Robin I. M. 1998. "The Social Brain Hypothesis." *Evolutionary Anthropology* 6:178–190.

Durkheim, Emile. 1897. *Le Suicide*. Paris: PUF.

*Ebstein, Richard P., Salomon Israel, Soo Hong Chew, Songfa Zhong, and Ariel Knafo. 2010. "Genetics of Human Social Behavior." *Neuron* 65:831–844.

*Ebstein, Richard P., Ariel Knafo, David Mankuta, Soo Hong Chew, and Poh San Lai. 2012. "The Contributions of Oxytocin and Vasopressin Pathway Genes to Human Behavior." *Hormones and Behavior* 61:359–379.

Eisenberger, Naomi I., Matthew D. Lieberman, and Kipling D. Williams. 2003. "Does Rejection Hurt? An fMRI Study of Social Exclusion." *Science* 302:290–292.

Eisenegger, Christoph, Michael Naef, Romana Snozzi, Markus Heinrichs, and Ernst Fehr. 2010. "Prejudice and Truth About the Effect of Testosterone on Human Bargaining Hehaviour." *Nature* 463:356–359.

Eisler, Riane and Daniel S. Levine. 2002. "Nature, Nurture, and Caring: We Are Not Prisoners of Our Genes." *Brain and Mind* 3: 9–52.

Fanelli, Daniele. 2012. "Negative Results are Disappearing from Most Disciplines and Countries." *Scientometrics* 90:891–904.

Ferguson, Eamonn, Femke Atsma, Wim De Kort, and Ingrid Veldhuizen. 2012. "Exploring the Pattern of Blood Donor Beliefs in First-time, Novice, and Experienced Donors: Differentiating Reluctant Altruism, Pure Altruism, Impure Altruism, and Warm Glow." *Transfusion* 52:343–355.

Ferguson, Eamonn, Kathleen Farrell, and Claire Lawrence. 2008. "Blood Donation is an Act of Benevolence Rather than Altruism." *Health Psychology* 27:327–336.

Field, Tiffany M., Maria Hernandez-Reif, Olga Quintino, Saul Schanberg, and Cynthia Kuhn. 1998. "Elder Retired Volunteers Benefit from Giving Massage Therapy to Infants." *Journal of Applied Gerontology* 17:229–239.

Firebaugh, Glenn. 2008. *Seven Rules for Social Research*. Princeton, NJ: Princeton University Press.

Fowler, James H. 2006. "Altruism and Turnout." *Journal of Politics* 68:647–683.

Fowler, James H., and Christopher T. Dawes. 2008. “Two Genes Predict Voter Turnout.” *Journal of Politics* 70:579–594.

Fowler, James H., and Christopher T. Dawes. 2013. “In Defense of Genopolitics.” *American Political Science Review* 107:362–374.

Fowler, James H., Christopher T. Dawes, and Nicholas A. Christakis. 2009. “Model of Genetic Variation in Human Social Networks.” *PNAS* 106:1720–1724.

*Freese, Jeremy. 2008. “Genetics and the Social Science Explanation of Individual Outcomes.” *American Journal of Sociology* 114:S1–S35.

Freese, Jeremy. 2011. “Integrating Genomic Data and Social Science.” *Politics and the Life Sciences* 30:88–92.

Freese, Jeremy, Jui-Chung A. Li, and Lisa D. Wade. 2003. “The Potential Relevances of Biology to Social Inquiry.” *Annual Review of Sociology* 29:233–256.

*Fried, Linda P., Michelle C. Carlson, Marc Freedman, Kevin D. Frick, Thomas A. Glass, Joel Hill, Sylvia McGill, George W. Rebok, Teresa Seeman, James Tielsch, Barbara A. Wasik, and Scott Zeger. 2004. “A Social Model for Health Promotion for an Aging Population: Initial Evidence on the Experience Corps Model.” *Journal of Urban Health* 81:64–78.

*Fried, Linda P., Michelle C. Carlson, Sylvia McGill, Teresa Seeman, Quan-Li Xue Xue, Kevin D. Frick, Erwin Tan, Elizabeth K. Tanner, Jeremy Barron, and Constantine Frangakis. 2013. “Experience Corps: A Dual Trial to Promote the Health of Older Adults and Children’s Academic Success.” *Contemporary Clinical Trials* 36(1):1–13.

*Gibson, John. 2001. “Unobservable Family Effects and the Apparent External Benefits of Education.” *Economics of Education Review* 20:225–233.

Gillum, Richard F., Diane M. Makuc, and Jacob J. Feldman. 1991. “Pulse Rate, Coronary Heart Disease, and Death: The NHANES I Epidemiologic Follow-up Study.” *American Heart Journal* 121:172–177.

Gregory, Alice M., Jade H. Light-Häusermann, Frühling Rijsdijk, and Thalia C. Eley. 2009. “Behavioral Genetic Analyses of Prosocial Behavior in Adolescents.” *Developmental Science* 12:165–174.

Guastella, Adam J., Amanda R. Kenyon, Gail A. Alvares, Dean S. Carson, and Ian B. Hickie. 2010. "Intranasal Arginine Vasopressin Enhances the Encoding of Happy and Angry Faces in Humans." *Biological Psychiatry* 67:1220–1222.

Gyurak, Anett, Claudia M. Haase, Jocelyn Sze, Madeleine S. Goodkind, Giovanni Coppola, Jessica Lane, Bruce M. Miller, and Robert W. Levenson. 2013. "The Effect of the Serotonin Transporter Polymorphism on Empathic and Self-Conscious Emotional Reactivity." *Emotion* 13:25–35.

Halaby, Charles N. 2004. "Panel Models in Sociological Research: Theory into Practice." *Annual Review of Sociology* 30:507–544.

Handy, Femida, and Ram A. Cnaan. 2007. "The Role of Social Anxiety in Volunteering." *Nonprofit Management and Leadership* 18:41–58.

*Harbaugh, William T., Ullrich Mayr, and Daniel R. Burghart. 2007. "Neural Responses to Taxation and Voluntary Giving Reveal Motives for Charitable Donations." *Science* 316:1622–1624.

*Harris, Alex H. S., and Carl E. Thoresen. 2005. "Volunteering is Associated with Delayed Mortality in Older People: Analysis of the Longitudinal Study of Aging." *Journal of Health Psychology* 10:739–752.

Hatemi, Peter K., John R. Alford, Nicholas G. Hibbing, Martin, and Linden J. Eaves. 2009. "Is There a 'Party' in Your Genes?" *Political Research Quarterly* 62:584–600

Hauser, Seth M. 2000. "Education, Ability, and Civic Engagement in the Contemporary United States." *Social Science Research* 29:556–558.

Heinrichs, Markus, Thomas Baumgartner, Clemens Kirschbaum, and Ulrike Ehlert. 2003. "Social Support and Oxytocin Interact to Suppress Cortisol and Subjective Responses to Psychosocial Stress." *Biological Psychiatry* 54:1389–1398.

*Henrich, Joseph, Steven J. Heine, and Area Norenzayan. 2010. "The Weirdest People in the World?" *Behavioral and Brain Sciences* 33:61–83.

Hermans, Erno J., Peter Putman, and Jack Van Honk. 2006. “Testosterone Administration Reduces Empathetic Behavior: A Facial Mimicry Study.” *Psychoneuroendocrinology* 31(7):859–866.

Hong, Song-iee, and Nancy Morrow-Howell. 2010. “Health Outcomes of Experience Corps®: A High-commitment Volunteer Program.” *Social Science and Medicine* 71(2):414–420.

Hunter, Kathleen I., and Margaret W. Linn. 1980. “Psychosocial Differences Between Elderly Volunteers and Non-Volunteers.” *International Journal of Aging and Human Development* 12(3):205–213.

Idler, Ellen L., and Yael Benyamini. 1997. “Self-rated Health and Mortality: A Review of Twenty-seven Community Studies.” *Journal of Health and Social Behavior* 21–37.

Ishikawa, Sharon S., and Adrian Raine. 2002. “Behavioral Genetics and Crime.” Pp. 81–110 in *The Neurobiology of Criminal Behavior*, edited by J. Glicksohn. Kluwer Academic Publishers.

*Israel, Salomon, Elad Lerer, Idan Shalev, Florina Uzefovsky, Mathias Riebold, Efrat Laiba, Rachel Bachner-Melman, Anat Maril, Gary Bornstein, Ariel Knafo, and Richard P. Ebstein. 2009. “The Oxytocin Receptor (OXTR) Contributes to Prosocial Fund Allocations in the Dictator Game and the Social Value Orientations Task.” *PLOS ONE* 4:e5535.

*James, Bryan D., Robert S. Wilson, Lisa L. Barnes, and David A. Bennett. 2011. “Late-Life Social Activity and Cognitive Decline in Old Age.” *Journal of the International Neuropsychological Society* 17:998–1005.

James, Russell N. III and Michael W. O’Boyle. 2014. Charitable Estate Planning as Visualized Autobiography: An fMRI Study of Its Neural Correlates. *Nonprofit and Voluntary Sector Quarterly* 43: 355-373.Jiang, Yushi, Soo H. Chew, and Richard P. Ebstein. 2013. “The Role of D4 Receptor Gene Exon III Polymorphisms in Shaping Human Altruism and Prosocial Behavior.” *Frontiers in Human Neuroscience* 71–77.

*Kahana, Eva, Tirth Bhatta, Loren D. Lovegreen, Boaz Kahana, and Elizabeth Midlarsky. 2013. “Altruism, Helping, and Volunteering Pathways to Well-Being in Late Life.” *Journal of Aging and Health* 25:159–187.

Kanai, Ryota, Bahador Bahrami, R. Roylance, and Geraint Rees. 2012. “Online Social Network Size is Reflected in Human Brain Structure.” *Proceedings of the Royal Society B* 279:1327–1334.

Kenyon, Amanda R., Gail A. Alvares, Ian B. Hickie, and Adam J. Guastella. 2013. “The Effects of Acute Arginine Vasopressin Administration on Social Cognition in Healthy Males.” *Journal of Hormones* 386–306. Retrieved from http://dx.doi.org/10.1155/2013/386306 2013.

Kim, E., and Sara Konrath. 2014. “Volunteering is Prospectively Associated with Healthcare Utilization Among Older Adults.” *under review*.

Kim, Heejung S., David K. Sherman, Taraneh Mojaverian, Joni Y. Sasaki, Jinyoung Park, Eunkook M. Suh, and Shelley E. Taylor. 2011. “Gene-Culture Interaction: Oxytocin Receptor Polymorphism (OXTR) and Emotion Regulation.” *Social Psychological and Personality Science* 2:665–672.

Knafo, Ariel, Salomon Israel, Ariel Darvasi, Rachel Bachner-Melman, Florina Uzefovsky, Lior Cohen, Esti Feldman, Elad Lerer, Efrat Laiba, Yael Raz, Lubov Nemanov, Inga Gritsenko, Christian Dina, Galila Agam, Brian Dean, Gary Bornstein, and Richard P. Ebstein. 2008. “Individual Differences in Allocation of Funds in the Dictator Game Associated with Length of the Arginine Vasopressin 1a Receptor RS3 Promoter Region and Correlation Between RS3 Length and Hippocampal mRNA.” *Genes, Brain and Behavior* 7:266–275.

Knafo, Ariel, Salomon Israel, and Richard P. Ebstein. 2011. “Heritability of Children’s Prosocial Behavior and Differential Susceptibility to Parenting by Variation in the Dopamine Receptor D4 Gene.” *Development and Psychopathology* 23:53–67.

Koenig, Laura, Matt McGue, Robert F. Krueger, and Thomas Bouchard. 2007. “Religiousness, Antisocial Behavior, and Altruism: Genetic and Environmental Mediation.” *Journal of Personality* 75:265–290.

Kogan, Aleksandr, Laura R. Saslow, Emily A. Impett, Christopher Oveis, Dacher Keltner, and Sarina R. Saturn. 2011. Thin-slicing Study of the Oxytocin Receptor (OXTR) Gene and the Evaluation and Expression of the Prosocial Disposition. *Proceedings of the National Academy of Sciences* 108:19189–19192.

Konrath, Sara. 2013. "*Older Adults Who Volunteer Have Lower Cardiovascular Risk Factors*. Paper Presented at the ARNOVA Conference, Hartford, CT.

*Konrath, Sara. 2014a. "The Power of Philanthropy and Volunteering." Pp. 387–426 in *Interventions and Policies to Enhance Wellbeing: A Complete Reference Guide*, Volume VI, edited by F. A. Huppert and C. L. Cooper. DOI: 10.1002/9781118539415.wbwell11

Konrath, Sara. 2014b. "Oxytocin Receptor Genes (OXTR) Moderate the Relationship Between Prosociality and Mortality." *Under review*.

Konrath, Sara, and Stephanie L. Brown. 2012. "The Effects of Giving on Givers." in *Handbook of Health and Social Relationships*, edited by N. Roberts and M. Newman. American Psychological Association.

*Konrath, Sara, Andrea Fuhrel-Forbis, Alina Lou, and Stephanie L. Brown. 2012. "Motives for Volunteering Are Associated with Mortality Risk in Older Adults." *Health Psychology* 31:87–96.

Krueger, Frank, Raja Parasuraman, Vijeth Iyengar, Matthew Thornburg, Jaap Weel, Mingkuan Lin, Ellen Clarke, Kevin McCabe, and Robert H. Lipsky. 2012. "Oxytocin Receptor Genetic Variation Promotes Human Trust Behavior." *Frontiers in Human Neuroscience* 6:1–9.

Krueger, Kristin R., Robert S. Wilson, Julia M. Kamenetsky, Lisa L. Barnes, Julia L. Bienias, and David A. Bennett. 2009. "Social Engagement and Cognitive Function in Old Age." *Experimental Aging Research* 35:45–60.

Krueger, Robert F., Brian M. Hicks, and Matt McGue. 2001. "Altruism and Antisocial Behaviour: Independent Tendencies, Unique Personality Correlates, Distinct Etiologies." *Psychological Science* 12:397–402.

Kumar, Santosh, Rocio Calvo, Mauticio Avendano, Kavita Sivaramakrishnan, and Lisa F. Berkman. 2012. "Social Support, Volunteering and Health Around the World: Cross-national Evidence from 139 Countries." *Social Science and Medicine* 74:696–706.

Kumari, Meena, Martin Shipley, Mai Stafford, and Mika Kivimaki. 2011. "Association of Diurnal Patterns in Salivary Cortisol with all-cause and Cardiovascular Mortality: Findings from the Whitehall II Study." *The Journal of Clinical Endocrinology and Metabolism* 96:1478–1485.

*Kumsta, Robert, and Markus Heinrichs. 2013. “Oxytocin, Stress and Social Behavior: Neurogenetics of the Human Oxytocin System.” *Current Opinion in Neurobiology* 23:11–16.

Lakens, Daniël. 2013. “Using a Smartphone to Measure Heart Rate Changes During Relived Happiness and Anger.” *IEEE Transactions on Affective Computing* 4:238–241.

Lee, Lichang, Jane A. Piliavin, and Vaughn R. A. Call. 1999. “Giving Time, Money, and Blood: Similarities and Differences.” *Social Psychology Quarterly* 62:276–290.

Lehrer, Jonah. 2010. “The Truth Wears Off.” *The New Yorker*, 13 December:52–57.

Lewis, Penelope A., Roozbeh Rezaie, Rachel Brown, Neil Roberts, R. I. M. Dunbar. 2011. “Ventromedial Prefrontal Volume Predicts Understanding of Others and Social Network Size.” *Neuroimage* 57:1624–1629.

*Li, Yunqing, and Kenneth F. Ferraro. 2005. “Volunteering and Depression in Later Life: Social Benefit or Selection Processes?” *Journal of Health and Social Behavior* 46:68–84.

Loewen, Peter J., and Christopher T. Dawes. 2012. “Heritability of Duty and Voter Turnout.” *Political Psychology* 33:363–373.

Lucht, Michael J., Sven Barnow, Christine Sonnenfeld, Ines Ulrich, Hans J. Grabe, Winnie Schroeder, Henry Volzke, Harald Freyberger, Ulrich John, Falko H. Herrmann, Heyo Kroemer, and Dieter Rosskopf. 2013. “Associations Between the Oxytocin Receptor Gene (OXTR) and ‘mind-reading’ in Humans-an Exploratory Study.” *Nordic Journal of Psychiatry* 67:15–21.

*Lum, Terry Y., and Elizabeth Lightfoot. 2005. “The Effects of Volunteering on the Physical and Mental Health of Older People.” *Research on Aging* 27:31–55.

*Luoh, Ming-Ching, and A. Regula Herzog. 2002. “Individual Consequences of Volunteer and Paid Work in Old Age: Health and Mortality.” *Journal of Health and Social Behavior* 43:490–509.

MacDonald, Kai, and Tina M. MacDonald. 2010. “The Peptide that Binds: A Systematic Review of Oxytocin and its Prosocial Effects in Humans.” *Harvard Review of Psychiatry* 1:1–21.

Massey, Douglas S. 2002. “A Brief History of Human Society, the Origin and Role of Emotion in Social Life.” *American Sociological Review* 67:1–29.

McDougle, Lindsey, Femida Handy, Sara Konrath, and Marlene Walk. 2014. "Health Outcomes and Volunteering: The Moderating Role of Religiosity." *Social Indicators Research* 117: 337–351. DOI: 10.1007/s11205-013-0336-5.

McGue, M., and T. Bouchard. 1998. "Genetic and Environmental Influences on Human Behavioural Differences." *Annual Review of Neuroscience* 21:1–24.

McNemar, Quinn. 1946. "Opinion-attitude Methodology." *Psychological Bulletin* 43:289–374.

Midlarsky, Elizabeth, and Eva Kahana. 1994. "Helping and Volunteering in Late Life: The Results of an Experimental Intervention." Pp. 189–220 in *Altruism in Later Life*, edited by E. Midlarsky and E. Kahana. Thousand Oaks, CA: Sage Publications, Inc.

Miller, Geoffrey, Gu Zhu, Margaret J. Wright, Narelle K. Hansell, and Nicholas G. Martin. 2012. "The Heritability and Genetic Correlates of Mobile Phone Use: A Twin Study of Consumer Behavior." *Twin Research and Human Genetics* 15:97–106.

*Moen, Phyllis, Donna Dempster-McClain, and Robin M. Williams. 1989. "Social Integration and Longevity: An Event History Analysis of Women's Roles and Resilience." *American Sociological Review* 54:635–647.

Moll, Jorge, Frank Krueger, Roland Zahn, Matteo Pardini, Ricardo De Oliveira-Souza, and Jordan Grafman. 2006. "Human Frontomesolimbic Networks Guide Decisions About Charitable Donation." *Proceedings of the National Academy of Sciences* 103:15623–15628.

Morrow-Howell, Nancy, Jim Hinterlong, Philip A. Rozario, and Fengyan Tang. 2003. "Effects of Volunteering on the Well-being of Older Adults." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 58:S137–S145.

Murphey, David A., Kelly H. Lamonda, Jan K. Carney, and Paula Duncan. 2004. "Relationships of a Brief Measure of Youth Assets to Health-promoting and Risk Behaviors." *Journal of Adolescent Health* 34:184–191.

*Musick, Marc A., A. Regula Herzog, and James S. House. 1999. "Volunteering and Mortality Among Older Adults: Findings From a National Sample." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 54B:S173–S180.

Musick, Marc A. and John Wilson. 2008. *Volunteers: A Social Profile*. Bloomington, Indiana University Press.

Nathanielsz, Peter W., Graham Liggins, and Paula DiSanto Bensadoun. 1996. *Life Before Birth: The Challenges of Fetal Development*. New York, WH Freeman.

*Okun, Morris A., Ellen W. Yeung, and Stephanie Brown. 2013. "Volunteering by Older Adults and Risk of Mortality: A Meta-Analysis." *Psychology and Aging* 28:564–577.

*Oman, Doug, Carl E. Thoresen, and Kay Mcmahon. 1999. "Volunteerism and Mortality Among the Community-dwelling Elderly." *Journal of Health Psychology* 4:301–316.

Ottoni-Wilhelm, Mark and René Bekkers. 2010. "Helping Behavior, Dispositional Empathic Concern, and the Principle of Care." *Social Psychology Quarterly* 73: 11–32.

*Piliavin, Jane A., and Erica Siegl. 2007. "Health Benefits of Volunteering in the Wisconsin Longitudinal Study." *Journal of Health and Social Behavior* 48:450–464.

Plagnol, Anke, and Felicia Huppert. 2010. "Happy to Help? Exploring the Factors Associated with Variations in Rates of Volunteering Across Europe." *Social Indicators Research* 97:157–176.

Poulin, Michael J., E. Alison Holman, and Anneke Buffone. 2012. "The Neurogenetics of Nice Receptor Genes for Oxytocin and Vasopressin Interact with Threat to Predict Prosocial Behavior." *Psychological Science* 23:446–452.

Powell, Joanne, Penelope A. Lewis, Neil Roberts, Marta García-Fiñana, and R. I. M. Dunbar. 2012. "Orbital Prefrontal Cortex Volume Predicts Social Network Size: An Imaging Study of Individual Differences in Humans." *Proceedings of the Royal Society B* 292:2157–2162.

Putnam, Robert D. 2000. *Bowling Alone: The Collapse and Revival of American Community.* New York: Simon and Schuster.

Ramos, Linnet, Callum Hicks, Richard Kevin, Alex Caminer, Rajeshwar Narlawar, Michael Kassiou, and Iain S. McGregor. 2013. "Acute Prosocial Effects of Oxytocin and Vasopressin When Given Alone or in Combination with 3, 4-Methylenedioxymethamphetamine in Rats: Involvement of the V1A Receptor." *Neuropsychopharmacology* 38:2249–2259.

Reichard, Rebecca J., Ronald E. Riggio, Diana Wright D. W. Guerin, Pamella H. Oliver, Allen W. Gottfried, and Adele E. Gottfried. 2011. "A Longitudinal Analysis of Relationships Between Adolescent Personality and Intelligence with Adult Leader Emergence and Transformational Leadership." *Leadership Quarterly* 22:471–481.

Reuter, Martin, Clemens Frenzel, Nora T. Walter, Sebastian Markett, and Christian Montag. 2011. Investigating the genetic basis of altruism: the role of the COMT Val158Met polymorphism. *Scan* 6: 662–668.

Rodrigues, Sarina M., Laura R. Saslow, Natalia Garcia, Olivier P. John, and Dacher Keltner. 2009. "Oxytocin Receptor Genetic Variation Relates to Empathy and Stress Reactivity in Humans." *Proceedings of the National Academy of Sciences* 106:21437–21441.

Rosenthal, Robert. 1965. "The Volunteer Subject." *Human Relations* 18:389–406.

Rosnow, Ralph L., and Robert Rosenthal. 1976. "The Volunteer Subject Revisited." *Australian Journal of Psychology* 28:97–108.

Rushton, J. Philippe. 2004. "Genetic and Environmental Contributions to Pro-social Attitudes: A Twin Study of Social Responsibility." *Proceedings of the Royal Society London* 271:2583–2585.

*Rushton, J. Philippe, David W. Fulker, Michael C. Neale, David K. B. Nias, and Hans J. Eysenck. 1986. "Altruism and Aggression: The Heritability of Individual Differences." *Journal of Personality and Social Psychology* 50:1192–1198.

Ryff, Carol D. 1989. "Happiness is Everything, or is it? Explorations on the Meaning of Psychological Well-being." *Journal of Personality and Social Psychology* 57:1068–1081.

Sallet, Jerome, Rogier B. Mars, MaryAnn P. Noonan, Jesper L. Andersson, Jill X. O. O'Reilly, Saad Jbabdi, Paula L. Croxson, Mark Jenkinson, Karla L. Miller, and Matthew F. S. Rushworth. 2011. "Social Network Size Affects Neural Circuits in Macaques." *Science* 334:697–700.

Sasaki, Joni Y., Heejung S. Kim, Taraneh Mojaverian, Lauren D. S. Kelley, In Y. Park, and Skirmantas Janusonis. 2013. "Religion Priming Differentially Increases Prosocial Behavior Among Variants of the Dopamine D4 Receptor (DRD4) Gene." *Social Cognitive and Affective Neuroscience* 8:209–215.

Schmidt, Louis A., Nathan A. Fox, Koraly Perez-Edgar, Stella Hu, and Dean H. Hamer. 2001. "Association of DRD4 with Attention Problems in Normal Childhood Development." *Psychiatric Genetics* 11:25−29.

Schooler, Jonathan. 2011. "Unpublished Results Hide the Decline Effect." *Nature* 470:437.

Schreier, Hannah M. C. 2012. *Physiological Benefits of Volunteering Among Young Adults and Adolescents.* Dissertation, University of British Columbia.

*Schreier, Hannah M. C., Kimberly A. Schonert-Reichl, and Edith Chen. 2013. "Effect of Volunteering on Risk Factors for Cardiovascular Disease in Adolescents: A Randomized Controlled Trial." *JAMA Pediatrics* 167:327–332.

Schwingel, Andiara, Mathew M. Niti, Catherine Tang, and Tze P. Ng. 2009. "Continued Work Employment and Volunteerism and Mental Well-being of Older Adults: Singapore Longitudinal Ageing Studies." *Age and Ageing* 38:531–537.

Settle, Jaime E., Christopher T. Dawes, Nicholas A. Christakis, and James H. Fowler. 2010. "Friendships Moderate an Association Between a Dopamine Gene Variant and Political Ideology." *The Journal of Politics* 72:1189–1198.

Shadish, William R., Thomas D. Cook, and Donald T. Campbell. 2002. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. Boston/New York: Houghton Mifflin Company.

Shamay-Tsoory, Simone G., Judith Aharon-Peretz, and Daniella Perry. 2009. "Two Systems for Empathy: A Double Dissociation Between Emotional and Cognitive Empathy in Inferior Frontal Gyrus Versus Ventromedial Prefrontal Lesions." *Brain* 132:617–627.

Shmotkin, Dov, Tzvia Blumstein, and Baruch Modan. 2003. "Beyond Keeping Active: Concomitants of Being a Volunteer in Old-old Age." *Psychology and Aging* 18:602.

Singer, Tania, Romana Snozzi, Geoffrey Bird, Predrag Petrovic, Giorgia Silani, Markus Heinrichs, and Ramond J. Dolan. 2008. "Effects of Oxytocin and Prosocial Behavior on Brain Responses to Direct and Vicariously Experienced Pain." *Emotion* 8:781–791.

Smith, Ashley M., Timothy J. Loving, Erin E. Crockett, and Lorne Campbell. 2009. “What’s Closeness Got to Do with it? Men’s and Women’s Cortisol Responses When Providing and Receiving Support.” *Psychosomatic Medicine* 71:843–851.

Smith, David H. 1994. “Determinants of Voluntary Association Participation and Volunteering: A Literature Review.” *Nonprofit and Voluntary Sector Quarterly* 23:243–263.

Smith, David H. 2014. “Overview of S-Theory (Synanthrometrics): A Comprehensive, Quantitative, Interdisciplinary, and Consilient Theory of Human Behavior Proposed as a New Standard Human Science Model.” Unpublished paper.

Smith, Kevin B., John R. Alford, Peter K. Hatemi, Lindon J. Eaves, Carolyn Funk, and John R. Hibbing. 2012. “Biology, Ideology and Epistemology: How Do We Know Political Attitudes Are Inherited and Why Should We Care?” *American Journal of Political Science* 56:17–33.

Son, Joonmo, and John Wilson. 2010. “Genetic Variation in Volunteerism.” *The Sociological Quarterly* 51:46–64.

Song, Zhaoli, Wendong Li, and Richard D. Arvey. 2011. “Associations Between Dopamine and Serotonin Genes and Job Satisfaction: Preliminary Evidence From the Add Health Study.” *Journal of Applied Psychology* 96:1223–1233.

*Stoltenberg, Scott F., Christa C. Christ, and Gustavo Carlo. 2013. “Afraid to Help: Social Anxiety Partially Mediates the Association Between 5-HTTLPR Triallelic Genotype and Prosocial Behavior.” *Social Neuroscience* 8:400–406.

*Switzer, Galen E., Roberta G. Simmons, Mary A. Dew, Jeanne M. Regalski, and Chi-Hsein Wang. 1995. “The Effect of a School-Based Helper Program on Adolescent Self-Image, Attitudes, and Behavior.” *The Journal of Early Adolescence* 15:429–455.

Tan, Erwin J., George W. Rebok, Qilu Yu, Constantine E. Frangakis, Michelle C. Carlson, Tao Wang, Michelle Ricks, Elizabeth Tanner, Sylvia McGill, and Linda P. Fried. 2009. “The Long-Term Relationship Between High-Intensity Volunteering and Physical Activity in Older African American Women.” *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 64B:304–311.

Thoits, Peggy, and Lyndi Hewitt. 2001. “Volunteer Work and Well-being.” *Journal of Health and Social Behavior* 42:115–131.

Thompson, Richmond R., Kate George, James C. Walton, Scott P. Orr, and Christopher J. Benson. 2006. “Sex-specific Influences of Vasopressin on Human Social Communication.” *Proceedings of the National Academy of Sciences* 103:7889–7894.

Tost, Heike, Bhaskar Kolachana, Shabnam Hakimi, Herve Lemaitre, Beth A. Verchinski, Venkata S. Mattay, Daniel Weinberger, and Andreas Meyer–Lindenberg. 2010. “A Common Allele in the Oxytocin Receptor Gene (OXTR) Impacts Prosocial Temperament and Human Hypothalamic-limbic Structure and Function.” *Proceedings of the National Academy of Sciences* 107:13936–13941.

*Turkheimer, Eric. 2000. “Three Laws of Behavior Genetics and What they Mean.” *Current Directions in Psychological Science* 9:160–164.

Turkheimer, Eric. 2011. “Still Missing.” *Research in Human Development* 8:227–241.

Turkheimer, Eric. 2012. “Genome Wide Association Studies of Behavior are Social Science.” Pp. 43–64 in *Philosophy of Behavioral Biology*, edited by K. S. Plaisance and T. A. C. Reydon. Springer Netherlands: Boston Studies in the Philosophy of Science 282, DOI 10.1007/978-94-007-1951-4_3.

Udry, J.Richard (1995). “Policy and Ethical Implications of Biosocial Research.” *Population Research and Policy Review* 14:347–357.

Uggen, Christopher, and Jennifer Janikula. 1999. “Volunteerism and Arrest in the Transition to Adulthood.” *Social Forces* 78:331–362.

Uzefovsky, Florina, Idan Shalev, Salomon Israel, Ariel Knafo, and Richard P. Ebstein. 2012. “Vasopressin Selectively Impairs Emotion Recognition in Men.” *Psychoneuroendocrinology* 37:576–580.

Van den Berghe, Pierre L. 1990. “Why Most Sociologists Don’t – and Won’t! Think Evolutionarily.” *Sociological Forum* 5:173–185.

Van Honk, Jack, Estrella R. Montoya, Peter A. Bos, Mark van Vugt, and David Terburg. 2012. “New Evidence on Testosterone and Cooperation.” *Nature* 485:E4–E5.

Van Honk, Jack, and Dennis J. Schutter. 2007. “Testosterone Reduces Conscious Detection of Signals Serving Social Correction Implications for Antisocial Behavior.” *Psychological Science* 18:663–667.

Van Honk, Jack, Dennis J. Schutter, Peter A. Bos, Anne-Wil Kruijt, Eef G. Lentjes, and Simon Baron-Cohen. 2011. “Testosterone Administration Impairs Cognitive Empathy in Women Depending on Second-to-fourth Digit Ratio.” *Proceedings of the National Academy of Sciences* 108:3448–3452.

Van Lente, Frederick. 2000. “Markers of Inflammation as Predictors in Cardiovascular Disease.” *Clinica Chimica Acta* 293:31–52.

*Van Willigen, Marieke. 2000. “Differential Benefits of Volunteering Across the Life Course.” *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 55:S308–S318.

Vogelzangs, Nicole, Aartjan T. Beekman, Yuri Milaneschi, Stefania Bandinelli, Luigi Ferrucci, and Brenda W. J. A. Penninx. 2010. “Urinary Cortisol and Six-year Risk of all-cause and Cardiovascular Mortality.” *Journal of Clinical Endocrinology and Metabolism* 95:4959–4964.

Von Scheve, Christian. 2011. “Sociology of Neuroscience or Neurosociology?” *Advances in Medical Sociology* 13:255–278.

Vul, Ed, C. Harris, Pjotr Winkielman, and Harold Pashler. 2009. “Puzzlingly High Correlations in fMRI Studies of Emotion, Personality, and Social Cognition.” *Perspectives on Psychological Science* 4:274–290.

Wagner, Shannon L., and Melanie O’Neill. 2012. “Mental Health Implications of Volunteer Fire Service Membership.” *Disaster Prevention and Management* 21:310–319.

Walter, Hendrik, Mauro Adenzato, Angela Ciaramidaro, Ivan Enrici, Lorenzo Pia, and Bruno G. Bara. 2004. “Understanding Intentions in Social Interaction: The Role of the Anterior Paracingulate Cortex.” *Journal of Cognitive Neuroscience* 16:1854–1863.

*Wheeler, Judith A., Kevin M. Gorey, and Bernard Greenblatt. 1998. “The Beneficial Effects of Volunteering for Older Volunteers and the People they Serve: A Meta-analysis.” *International Journal of Aging and Human Development* 47:69–79.

Wilson, John. 2000. “Volunteering.” *Annual Review of Sociology* 26:215–240.

Wilson, John. 2012. “Volunteerism Research: A Review Essay.” *Nonprofit and Voluntary Sector Quarterly* 41: 176–212.

Wu, Nan, Z. Li, and Yanjie Su. 2012. “The Association Between Oxytocin Receptor Gene Polymorphism (OXTR) and Trait Empathy.” *Journal of Affective Disorders* 138:468–472.

Wu, Nan, and Yanjie Su. 2015. “Oxytocin Receptor Gene Relates to Theory of Mind and Prosocial Behavior in Children.” *Journal of Cognition and Development* 16: 302-313. *Zak, Paul J., and Jorge A. Barraza. 2013. “The Neurobiology of Collective Action.” *Frontiers in Neuroscience* 7:1–9.

Zak, Paul J., Robert Kurzban, Sheila Ahmadi, Ronald S. Swerdloff, Jang Park, Levan Efremidze, Karen Redwine, Karla Morgan, and William Matzner. 2009. “Testosterone Administration Decreases Generosity in the Ultimatum Game.” *PLoS ONE* 4:e8330.

Zak, Paul. J., Angela A. Stanton, and Sheila Ahmadi. 2007. “Oxytocin Increases Generosity in Humans.” *PLoS ONE* 2:e1128.

Zethraeus, Niklas, Ljiljana Kocoska-Maras, Tore Ellingsen, Bo von Schoultz, Angelica L. Hirschberg, and Magnus Johannesson. 2009. “A Randomized Trial of the Effect of Estrogen and Testosterone on Economic Behavior.” *Proceedings of the National Academy of Sciences* 106:6535–6538.

Zhong, Songfa, Salomon Israel, Idan Shalev, Hong Xue, Richard P. Ebstein, and Soo H. Chew. 2010. “Dopamine D4 Receptor Gene Associated with Fairness Preference in Ultimatum Game.” *PLOS ONE* 5:e13765.