Our Genes Want Us to Be Altruists

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“Birds do it. Bees do it. Even educated fleas do it. Let’s do it. Let’s…” Be altruists?

While it may not be what Cole Porter had in mind, animals from bees to rats to chimpanzees (though perhaps not fleas) incur costs to their own immediate well-being for the benefit of members of their own species — one reasonable definition of altruism. Humans, of course, are no exception. Many of our daily activities and important life decisions involve setting aside self-interest on behalf of others.

Over the past several decades, behavioral scientists have made tremendous strides toward understanding when and why altruism occurs. Notably, across species, it seems to be the case that self-sacrifice is much more likely to occur on behalf of genetically related individuals, which is in line with the predictions of W. D. Hamilton’s (1964) kin selection theory. That’s not to say that altruism toward unrelated others (and even other species) doesn’t occur. Thanks to Robert Trivers’ (1971) theory of reciprocal altruism, we also know that self-sacrifice is more likely toward individuals who could reasonably be expected to reciprocate one day.

These theoretical models of altruistic behavior provide useful rules for when altruism should occur. The problem is humans don’t always play by the rules. Anecdotes from everyday life as well as data from social psychology and experimental economics suggest that people are biased toward generosity, even on behalf of non-kin members and even when they have no reasonable expectation of reciprocity. To be sure, this may arise from concern with our reputations and self-esteem, especially when our altruistic acts can be observed by others. However, the rule-bending nature of human altruism has been demonstrated compellingly in studies showing that people behave altruistically when they are merely asked to think about the feelings of a person in need, even when they believe they will not be observed (e.g., Batson, 1991; Cialdini, Brown, Lewis, Luce, & Neuberg, 1997). These findings raise the question

of whether the complexity of human altruism fits with current theoretical models or whether newer models of altruism, such as multilevel selection (Sober & Wilson, 1998), may hold more promise.

That's where genes for oxytocin and vasopressin come in.

Neurohormones and Social Behavior

Oxytocin and vasopressin are not especially impressive molecules. Composed of nine amino acids each, they are nearly identical, and both serve as hormones. Vasopressin is known as the anti-diuretic hormone because one of its primary functions is to facilitate water retention in the kidneys. Oxytocin stimulates uterine contractions during childbirth and the letdown of milk during nursing.

In addition to their peripheral effects, oxytocin and vasopressin have effects in the brain. In fact, because they not only act in the brain but are released by neurons in the brain, they merit the term *neurohormone*. Research on non-human mammals indicates that neurohormones profoundly influence social behavior (Carter, 1998). For example, in rodents, oxytocin is not only associated with the physiological side of motherhood — labor, nursing — but also with maternal behavior, including responding to infants' cries and protective aggression against intruders. Also in rodents, vasopressin is associated with pair bonding between mates and aggression by males on behalf of their mates.

Broadly speaking then, in non-human mammals, oxytocin and vasopressin predict costly actions on behalf of reproductively significant others — mates and offspring. How does this relate to human social behavior? The evidence, especially in the case of oxytocin, indicates that these neurohormones facilitate human altruism toward a wide variety of targets, including strangers as well as mates and offspring. Much of this research consists of studies in which oxytocin is administered to subjects as a drug — specifically, as a nasal spray. Studies of nasally administered oxytocin show that those who receive oxytocin donate more money in economic games, communicate better with romantic partners, and are better at reading others' emotions compared with people who receive a placebo spray (see Campbell, 2010, for a review).

The limitation of studies in which oxytocin (or, more rarely, vasopressin) is administered as a drug is that they don't reveal how these neurohormones naturally function to facilitate human altruism. Research in non-human animals can block the effects of these neurohormones, but this strategy is impractical in humans. Neuroimaging studies could help in this regard, but the neural circuits in which oxytocin and vasopressin are active are not completely understood. Moreover, only a limited range of altruistic behaviors can be observed while subjects are in a scanner.

Fortunately, there is another way to infer the actions of oxytocin and vasopressin in the human brain. Neurohormone activity depends on the interaction between the neurohormone and a cell molecule called a receptor. By investigating behavioral differences in individuals with different receptor genes, researchers can investigate how neurohormone activity is connected to human behavior.

The Role of Receptors

To understand how researchers go about doing this, it helps to know a tiny bit about the oxytocin and vasopressin receptors. There is one oxytocin receptor (OXTR), and it is distributed throughout the

tissues on which it exerts its effects. Vasopressin is somewhat more complex, because there are several vasopressin receptors, but one type — the 1a receptor (AVPR1a) — is strongly linked to social behavior.

Variation in the genes for OXTR and AVPR1a may affect the quantity or structure of the receptor in ways that enhance or reduce the function of oxytocin or vasopressin. Most of the research on OXTR has examined places in the genetic code where one nucleotide, or "letter" of DNA, can differ among individuals. These locations, called *single nucleotide polymorphisms* (or SNPs, pronounced "snips"), get unglamorous but precise-sounding names such as rs53576. By contrast, most of the research on AVPR1a has examined long strings of letters in the genetic code that can repeat themselves various times among different individuals. Examples of these strings, called *repeat sequences* or *microsatellite regions*, include RS1 and RS3.

While it is still unclear exactly what the OXTR SNPs and AVPR1a microsatellites *do* to their respective receptors — though there is some evidence that longer forms of AVPR1a, RS1, and RS3 lead to the manufacture of more AVPR1a receptors (Knafo et al., 2008) — these genetic variants have been linked to altruistic behavior in ways that parallel the known effects of their respective neurohormones. Let's start with OXTR. Much of the research on this gene and prosocial behavior has focused on the SNP rs53576, a place in the genetic code where a person can have an A (for adenine) or G (for guanine). It turns out that having G instead of A in this location is associated with many of the same behaviors affected by oxytocin administration, including reading others' emotions, engaging in more supportive behavior, maternal responses to children, and higher levels of self-reported prosocial temperament (Bakermans-Kranenburg & van Ijzendoorn, 2008; Donaldson & Young, 2008; Israel et al., 2008; Kogan et al., 2011; Saslow, Garcia, John, & Keltner, 2009; Tost et al., 2010).

A similar pattern exists for AVPR1a microsatellites RS1 and RS3. In general, longer versus shorter versions of RS3 predict greater generosity in economic games, altruism in preschoolers, male pair-bonding, and self-reported endorsement of benevolent values (Avinun et al., 2011; Donaldson & Young, 2008; Israel et al., 2008; Knafo et al., 2008; Walum et al., 2008). There is less research on RS1, but at least one study indicated that both RS1 and RS3 were associated with a desire to get along with others and specifically with getting along with siblings (Bachner-Melman et al., 2005).

Genes and Reciprocity

The fact that genes predict altruistic behavior is inherently interesting, but as social psychologists, my colleagues and I are interested in the cognitive and affective mechanisms that might explain why they do so. Along with my colleague Alison Holman and PhD student Anneke Buffone, I recently conducted a study to address this question in the context of public altruism — charitable involvement and commitment to civic duties, such as paying taxes or serving on a jury (Poulin, Holman & Buffone, 2012). In thinking about the ways in which OXTR and AVPR1a could influence such altruism toward strangers, we were intrigued by the fact that in non-human mammals oxytocin and vasopressin are most closely linked to altruism on behalf of mates and offspring. This result suggested the interesting possibility that these neurohormones actually lead people to treat strangers like kin. If so, we speculated that OXTR and AVPR1a variation linked to altruism could reduce people's concerns about the unspoken rules for being generous toward non-kin, such as whether strangers are trustworthy and likely to reciprocate.

To test these ideas, we examined data from a sample of 348 US residents who had completed surveys on

charitable involvement and commitment to civic duty, as well as their views about whether other people are generally kind and generous (benevolent) or unkind and selfish (malevolent). Via mail, we had these individuals donate saliva samples for DNA analysis, from which we obtained genetic data on OXTR and AVPR1a. We predicted that, as a general rule, viewing others as more malevolent would be associated with less altruism in the form of charity and civic duty. However, we hypothesized that variants of the OXTR and AVPR1a genes previously linked to altruism (G versus A on the OXTR rs53576 SNP and longer versions of the AVPR1a microsatellites RS1 and RS3) would weaken this association — that is, make people less concerned about the benevolence or malevolence of other people.

In a nutshell, we found what we predicted. While OXTR and AVPR1a seemed relevant for different outcomes — OXTR for charitable involvement, AVPR1a for commitment to civic duty — both moderated the association between viewing others as malevolent and altruistic behavior. These results suggest that OXTR and AVPR1a diminish concerns over reciprocity and may reflect the fact that oxytocin and vasopressin serve to make even strangers feel like kin.

Prosocial Genes and Human Society

While our findings and those of other researchers focus on individual differences in OXTR and AVPR1a genes, the implications of these findings go well beyond identifying reasons some individuals may be nicer or more altruistic than others. For one thing, naturally occurring variability in OXTR and AVPR1a may serve to highlight universal characteristics of humanity. For instance, while it may be the case that individuals with some versions of these genes have a *greater* propensity to overlook reciprocity concerns and possibly extend kinship to strangers, this may be a general human capacity and may even help explain the altruism-generating effects of merely thinking about the feelings of a person in need.

Another way in which individual differences in OXTR and AVPR1a may have broad implications for human social behavior is by shaping the behavior of groups. It is plausible that the distributions of these genetic variants have differed across groups over time and that groups containing a greater proportion of individuals with more “altruistic” forms of these genes had a competitive advantage over other groups. This phenomenon, an example of multilevel selection, could result in interesting patterns of gene-culture co-evolution. For example, groups with a high ratio of OXTR rs53576 G to A or AVPR1a RS1/RS3 long to short may engage in and value altruism without expectations of reciprocity, while groups with lower ratios of these genetic variants may place greater emphasis on trustworthiness and reciprocity. This prediction, while admittedly highly speculative, may be consistent with fascinating work by Heejung Kim and colleagues showing that rs53576 G is more prevalent among European Americans (among whom our data was collected) than among individuals from East Asian cultures (e.g., Kim et al., 2010). Perhaps the development of these cultures as relatively individualist versus relatively collectivist was shaped in part by OXTR- and AVPR1a-facilitated tendencies toward different patterns of altruistic behavior. If so, these genes are likely to be only one piece of the puzzle, but they may make a unique contribution.

Prosocial Genes: The Future

These are still the early days in research on genetic influences on behavior. Future research will undoubtedly go beyond the gene-behavior association and the gene-by-environment interaction studies noted here to include research on combinations of genes that may interact to predict behavior and

epigenetic studies on how life experiences alter the effects of genes on behavior.

However, there is still a great deal to be learned from studies that take much the same approach as those described here. For example, upcoming research should explore whether genetic variations in the receptors OXTR and AVPR1a influence the behavior of groups as well as individuals. In addition, incorporating assessments of these genes into traditional experimental approaches to studying altruism could help shed light on the mechanisms that drive altruistic behavior.

Indeed, one of the greatest advantages to using genetic techniques to examine potential biological contributions to psychological phenomena is how easy it is to integrate this data collection into a research project. While collection and analysis of genetic data are not cheap, they are rapidly getting less expensive, and they are very easy to do, with the help of a partnering lab. Best of all, the collection process need not interfere with any other data collection procedures you might have in place. Genes are (highly!) non-reactive, so they will not be affected by your protocol and can be collected at any point during a study. While I've focused here on the implications of OXTR and AVPR1a for altruism, research on these genes has exploded in many different areas of research, including autism and other social deficits, social behavior across cultures, health, and even musical ability (Chen et al., 2011; Donaldson & Young, 2008; Israel et al., 2008). Given the similar growth in research on other genes, it is very likely that you could discover a role for genetic data in your own research.

In short, genetic research shows promise for psychological science in general, and in research on oxytocin, vasopressin, and altruism specifically. In coming years, I expect this work to further clarify why and how humans are "the social animal."