COMMENTARY

From fear recognition to kidney donation

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Valerie Maupin's best friend had a loved one who needed a kidney. In an act of extraordinary altruism, Maupin offered one of hers, but she was not a match. Then she wondered: If I'm willing to do this for someone I know, why not for someone else whose need is just as great? With that thought, Maupin, a 24-y-old nursing student and hair stylist living in San Diego, decided to do something even more extraordinary. She would donate one of her kidneys to a stranger. A few months later, her kidney was in Florida, filtering the blood of a grateful 50-y-old woman and fellow nurse named Christine Curti (1).

What makes someone give up a part of her body for a complete stranger? What might we learn about human nature from studying such extraordinary individuals? In PNAS, Marsh et al. describe the cognitive and neural characteristics of 19 extraordinary altruists who, like Valerie Maupin, gave their kidneys to strangers in need (2).

Marsh et al. find that these altruists, compared with a set of matched control subjects, have (on average) larger right amygdalae. (The amygdala is a structure within the temporal lobe known for its role in the evaluation of affectively salient stimuli.) (3) What's more, their right amygdalae are selectively more responsive to facial fear expressions. Finally, these individuals are better at recognizing fear expressions, although they show no advantage at recognizing expressions of anger.

Learning from the Extremes

This study and its findings are remarkable for several reasons. First, it took an extraordinary effort to assemble this group of altruistic donors, a feat accomplished through a national search aided by multiple organ transplant organizations. Second, this study stands out among the thousands of studies in cognitive neuroscience examining individuals with cognitive deficits. Although it makes sense to study deficits—both as basic science and for curing disease—research in psychology and neuroscience rarely considers individuals at the far positive end of the spectrum. An exception to this trend is the Positive Psychology movement (4), which aims, among other things, to glean scientific lessons from individuals with exceptionally high levels of function. Marsh et al.'s research, which was supported by the Templeton Foundation's Positive Neuroscience project, extends this strategy to the study of the human brain.

Third, this study hits the sweet spot for hypothesis-driven research, testing a theory that is strongly motivated by the extant literature and yet not at all obvious. This experiment, somewhat ironically, was motived by research on psychopaths. Individuals with psychopathic traits tend to have smaller amygdalae and reduced amygdala responses to fear-related stimuli (5–7). Such individuals are also relatively bad at recognizing fearful facial expressions (8, 9).

Marsh et al.'s bold and creative experiment has enriched our understanding of human altruism.

Following on these findings, Marsh et al. hypothesized that extreme altruists lie opposite psychopaths at the far positive end of a single antisocial/prosocial continuum. This hypothesis led to the specific predictions that extreme altruists would have larger-than-average amygdalae and exhibit greater neural and behavioral sensitivity to fear expressions.

As noted above, these hypotheses were confirmed, but this was by no means a foregone conclusion: having an enlarged thyroid gland may be bad for your health, but it does not follow from this that having an exceptionally small thyroid gland is particularly healthful. More generally, the mechanisms underlying exceptionally low function need not parallel the mechanisms underlying exceptionally high function. Nevertheless, the present results indicate that people who are exceptionally good to others are—at least some of the time and in some ways—the mirror images of people whose behavior is exceptionally bad. Here, the behavioral data are especially striking: it makes sense that psychopaths are relatively insensitive to facial expressions of fear, as they show little concern for the (often fearful) victims of their antisocial behavior. However, donating a kidney to a stranger is in no obvious way related to processing fear expressions. Thus, the finding that extraordinary altruists are better at recognizing fear suggests a deep connection between the cognitive underpinnings of antisocial and prosocial behavior.

The hypothesized connection between extreme altruism and psychopathy suggests an alternative interpretation that, if correct, would make these results a bit less exciting. According to this alternative account, the altruists' cognitive and neural characteristics are not, in fact, so different from those of the control group. By way of analogy, consider a hypothetical positive correlation between brain size and IQ. Stated thus, we're inclined to imagine an abundance of big-brained smart people. However, such a correlation might simply reflect the existence of diseases such as microcephaly, which involve both smaller brains and mental deficits (10). Along similar lines, one might wonder whether the correlations observed here are similarly misleading. Could it be that extreme altruists, rather than having big amygdalae (etc.), are simply less likely to have small amygdalae (etc.)? Marsh et al. carefully guard against this alternative explanation, showing that the distribution for the altruists is not just a reproduction of the upper half of the distribution for the control subjects. Instead, the altruists studied here exhibit a genuine positive shift, mirroring the negative shift previously observed in psychopaths.

This study raises important questions concerning the development of extraordinary altruism, and altruism more generally. Marsh et al. highlight evidence concerning genetic influences on altruism (11–13), but other evidence shows strong effects of cultural influences (14). One might take Marsh et al.'s finding that extreme altruists have larger amygdalae as evidence for genetic influences, but research shows that experience can alter the sizes of macroscopic neural structures. In a classic PNAS paper from the late 1990s

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(and one of the first neuroimaging experiments to study individuals with exceptionally high function), Maguire et al. found that London taxi drivers have larger posterior hippocampi than those of control subjects (15). Critically, they also found that time in the taxi correlated positively with posterior hippocampal volume. With this in mind, one might wonder about the developmental processes behind the present results: Are extreme altruists genetically predisposed to have larger amygdalae? Or do they have larger amygdalae because they, unlike others, have had amygdala-enlarging experiences? (Or both?).

Feeling and Thinking

In considering the significance of Marsh et al.'s findings, it is important to note that the observed differences between altruists and controls are matters of degree and not stark categorical differences. Many of the control subjects have larger amygdalae than many of the altruists and likewise for the other characteristics measured. As Marsh et al. note, donating kidneys to strangers is extremely rare—not to be found in a typical control group. Thus, although having a larger, more sensitive right amygdala may make one more likely to become an extraordinary altruist, the factors that are most determinative of extraordinary altruism remain to be identified. (Either that, or, most of the factors that are determinative of extraordinary remain to be identified.) What are these unknown factors? The words of extreme altruists such as Valerie Maupin may provide a clue.

Why, Maupin asked, should I offer my kidney to someone I know, but not to an equally desperate stranger? Philosophers in the utilitarian tradition, such as Peter Singer (16, 17), have asked similar questions about the limited scope of our altruistic tendencies. Singer observes that it would be monstrous to allow a child to drown in a shallow pond simply because one is worried about ruining one's expensive clothes. Why, Singer asks, is it wrong to allow a nearby child to drown, but morally acceptable to allow a faraway child to starve or die of a preventable disease when, for the cost of an expensive set of clothes, one can save such a child's life? Singer and Maupin are both arguing for an expansion of our moral circles. On a psychological level, it could be that both are simply providing rationalizations for their emotionally driven altruistic tendencies (18), but the evidence suggests otherwise (19, 20). Could it be that extraordinary altruists such as Maupin and the 19 individuals studied by Marsh et al. are special, not only because of how they feel when they see people in distress, but because of how they think?

Marsh et al.'s bold and creative experiment has enriched our understanding of human altruism, linking low-level perceptual abilities and coarse-grained neural features to rare and profound acts of kindness. We still do not know why extraordinary altruists tend to have these traits or how these traits are related to more familiar forms of generosity. However, thanks to the path-breaking work of Marsh et al., we are poised to find out.

1 Garske M (2013) San Diego woman donates kidney to stranger. Available at www.nbcsandiego.com/news/local/San-Diego-Woman-Donates-Kidney-to-Stranger-233159411.html. Accessed September 25, 2014.

2 Marsh AA, et al. (2014) Neural and cognitive characteristics of extraordinary altruists. *Proc Natl Acad Sci USA* 111: 15036–15041.

3 Pessoa L, Adolphs R (2010) Emotion processing and the amygdala: from a 'low road' to 'many roads' of evaluating biological significance. *Nat Rev Neurosci* 11(11):773–783.

4 Seligman ME, Csikszentmihalyi M (2000) Positive psychology: An introduction. *Am Psychol* 55(1):5–14.

5 Marsh AA, et al. (2008) Reduced amygdala response to fearful expressions in children and adolescents with callous-unemotional traits and disruptive behavior disorders. *Am J Psychiatry* 165(6):712–720.

6 Viding E, et al. (2012) Amygdala response to preattentive masked fear in children with conduct problems: The role of callous-unemotional traits. *Am J Psychiatry* 169(10):1109–1116.

7 Pardini DA, Raine A, Erickson K, Loeber R (2014) Lower amygdala volume in men is associated with childhood aggression, early psychopathic traits, and future violence. *Biol Psychiatry* 75(1):73–80.

8 Dawel A, O'Kearney R, McKone E, Palermo R (2012) Not just fear and sadness: Meta-analytic evidence of pervasive emotion recognition deficits for facial and vocal expressions in psychopathy. *Neurosci Biobehav Rev* 36(10):2288–2304.

9 Marsh AA, Blair RJR (2008) Deficits in facial affect recognition among antisocial populations: A meta-analysis. *Neurosci Biobehav Rev* 32(3):454–465.

10 Martin HP (1970) Microcephaly and mental retardation. *Am J Dis Child* 119(2):128–131.

11 Anacker K, Enge S, Reif A, Lesch KP, Strobel A (2013) Dopamine D4 receptor gene variation impacts self-reported altruism. *Mol Psychiatry* 18(4):402–403.

12 Thompson GJ, Hurd PL, Crespi BJ (2013) Genes underlying altruism. *Biol Lett* 9(6):20130395.

13 Rushton JP, Fulker DW, Neale MC, Nias DK, Eysenck HJ (1986) Altruism and aggression: The heritability of individual differences. *J Pers Soc Psychol* 50(6):1192–1198.

14 Henrich J, et al. (2010) Markets, religion, community size, and the evolution of fairness and punishment. *Science* 327(5972): 1480–1484.

15 Maguire EA, et al. (2000) Navigation-related structural change in the hippocampi of taxi drivers. *Proc Natl Acad Sci USA* 97(8): 4398–4403.

16 Singer P (1972) Famine, affluence, and morality. *Philos Public Aff* 1(1):229–243.

17 Singer P (2009) *The Life You Can Save: Acting Now to End World Poverty* (Random House, New York).

18 Haidt J (2001) The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychol Rev* 108(4): 814–834.

19 Paxton JM, Ungar L, Greene JD (2012) Reflection and reasoning in moral judgment. *Cogn Sci* 36(1):163–177.

20 Greene J (2013) *Moral Tribes: Emotion, Reason, and the Gap Between Us and Them* (Penguin Press, New York).