Can virtue be measured using neuroimaging methods?

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These are unpublished conference papers for the 'Can Virtue Be Measured?, held by the Jubilee Centre for Character and Values at Oriel College, Thursday 9th – Saturday 11th January 2014. These papers are works in progress and should not be cited without author's prior permission.

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Abstract

This essay considers how neuroimaging methods can measure the development of moral virtue in individuals. The neuroimaging presents significant advantages over current methods for assessing moral development, such as self-reporting, which (1) do not give scientists insight into the substructures that process moral virtue and that underlie manifest behavior; and which (2) are biased by respondents' subjective reporting. Thus, such traditional methods are problematic for researchers in the field of virtue psychology. The neuroimaging methods can address these problems by giving researchers access to quantifiable data on inner events, allowing them to develop specific metrics to apply to moral virtue development in individuals. Thus, this essay demonstrates how to apply neuroimaging methods in practice. First, this essay reviews the brain connectivity analysis and suggests its application to the studies of virtue psychology. Virtue psychologists will be able to examine whether moral functions are properly integrated into selfhood with the brain connectivity analysis. Second, this essay introduces structural neuroimaging methods to examine the neural substrate of moral virtue. By comparing both the functional and structural characteristics of brains between moral exemplars and ordinary people, we will be able to gain insights about the measurement of moral virtue.

Introduction

Moral virtue has been an important issue in the fields of moral psychology and education. Moral psychologists and educators who aim to develop students' character tend to pay their attention to

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the concept of integrative moral virtue rather than individual moral function, such as moral cognition or affection (Lee & Taylor, 2013). To accurately diagnose the current developmental status and evaluate the effects of educational endeavors, scholars need a well-developed measurement of moral virtue. Then what are possible ways to measure the development of moral virtue? It seems to be difficult to properly measure this conceptual construct because we, human, cannot have a perfect insight into a subjects' mind with scientific methods; we can only have proxies to the mind, instead of "mind reading strategies," to conduct a scientific investigation of moral virtue. Aristotle gave us a hint about one possible proxy of moral virtue.

If a man once acquires reason, that makes a difference in action; and his state, while still like what it was, will then be virtue in the strict sense. (Aristotle, 2009)

Behavioral observation would be a possible way to assess whether a person possesses a certain moral virtue in his/her self, given the quote of Aristotle. In fact, this method has been frequently utilized by developmental psychologists, particularly who are interested in early childhood development (Woodhead & Paulkner, 2000). However, there are significant limitations in this method. First, a mere presence of moral behavior cannot prove that the actor of the behavior possesses moral virtue. According to Aristotle's account on the habituation of moral virtue and moral character, the repetition and consistency of the moral behavior are more important than a mere presence of the behavior (Aristotle, 2009). Thus, the observation of moral behavior in an empirical study, which is usually conducted during a short period, does not necessarily confirm that a participant has completely integrated moral virtue into his/her self. In addition, we should be aware of the possibility of social and desirability biases. Participants do not behave as they actually behave in their everyday lives because they want to show that they behave in a moral and socially desirable manner to observers (Adair, 1984). Because of these reasons, thus, the reliability and credibility of behavioral observation to measure moral virtue would be severely threatened.

This kind of limitations are also common to the questionnaire method, which is usually being utilized by moral psychologists and educators (Kristjánsson, 2013). The desirability bias is also an important issue in this case. For instance, if we ask our participants to rate the importance of keywords, which include both moral and non-moral ones, to them, they would naturally tend to rate moral keywords are important to them regardless of whether the moral values and virtues embedded in the keywords are really important to them, and integrated into their selfhood because they want to show that they are moral people. In addition, validity would not also be guaranteed; in other words, we are not sure about whether we can measure moral virtue, which is inevitably internal and covert, with a paper-and-pencil questionnaire. Does a quantified moral centrality or importance (e.g., Aquino & Reed, 2002) to a participant's self appropriately represents his/her internal psychological status, the habituation or integration of moral virtue into his/her self? It would be very hard to say "yes."

Therefore, we, moral philosophers and psychologists need a more direct approach to internal psychological processes that enables us to properly measure the development of moral virtue. Neuroimaging methods, which have been rapidly developed during last couple of decades, would address the problems of previous methods. The neuroimaging methods present significant advantages over current methods for assessing moral development such as self-reporting, which (1) do not give scientists insight into the substructures that process moral virtue and that underlie manifest behavior; and which (2) are biased by respondents' subjectivity (Ito & Cacioppo, 2007). Thus, I shall introduce newly invented neuroimaging methods that can be applied to our virtue studies, and suggest future directions.

Neuroimaging Methods to Measure Moral Virtue

Before I introduce each neuroimaging method, I shall suggest the overall direction of the neuroscientific investigation of moral virtue. The neuroscientific investigations of moral virtue can start by examining moral exemplars who are realizing moral virtue in their lives. Colby and Damon (1992) emphasized that empirical studies of moral exemplars can provide us with useful insights regarding the nature of human morality, which could not be completely examined by traditional moral psychological studies targeted at ordinary people. Because the moral exemplars are a paragon of moral virtue, it would be informative to investigate their developmental and psychological characteristics. In fact, this "reverse-engineering method" shows us how moral virtue works in reality through the real exemplars (Walker, 2013). Thus, comparing brains between moral exemplars that have already acquired moral virtue and ordinary people is a good starting point of our endeavors to measure the internal mechanism of moral virtue. I shall introduce and discuss two neuroimaging methods that can be used to examine the differences in virtue development between moral exemplars and ordinary people, and finally to illuminate the neural substrate of moral virtue based on this overall direction.

Functional Neuroimaging

First, the functional connectivity analysis would be useful at the functional level. Given the theoretical framework of virtue ethics and character psychology, the integration of moral virtue into a person's selfhood is an important goal in character development (Kristjánsson, 2007). Thus, it is reasonable to research the link between moral virtue to an individual's sense of "self" to examine the development of moral virtue. At the neural level, this research can be conducted by measuring the connectivity between brain regions associated with moral virtue and self-related processes, such as self-reflection and self-referencing (Buckner, Andrews-Hanna, & Schacter, 2008).

Before discussing how to utilize this neural connectivity analysis, it would be helpful to review previous studies of the neural substrate of selfhood and self-related processes. The neuroimaging studies of the default mode network (DMN), which is closely associated with psychological processes regarding the selfhood, self-referential and autobiographic processes (Immordino-Yang, Christodoulou, & Singh, 2012) are particularly informative for our research on the mechanisms of selfhood and self-related psychological processes at the neural level. In these DMN studies, scientists have reported that certain brain regions were deactivated while participants were consciously involved in cognitive tasks. On the contrary, these regions were activated when the participants were in resting state. This pattern significantly differed from the pattern usually reported in previous neuroimaging studies. The regions included the medial prefrontal cortex (MPFC), posterior cingulate cortex (PCC), precuneus, and inferior parietal lobule (IPL). The scientists named the network of these regions, which has only been activated during resting state, as the DMN; and they hypothesized that this network would be related to introspective self-related psychological processes, instead of goal-driven cognitive functions (Buckner et al., 2008).

As the scientists hypothesized, an interesting aspect of the DMN is that this network is extensively activated when participants are requested to do a sort of self-related tasks. For instance, the DMN was significantly more activated during the self-adjective association ask condition than other-adjective task association condition (Zhu, Zhang, Fan, & Han, 2007). In addition, when a part of this network, the precuneus, was disrupted by the transcraniel magnetic stimulation (TMS), the efficiency of the self-adjective association task declined and became identical to that of the other-adjective association task (Lou, Luber, Stanford, & Lisanby, 2010). Thus, given these findings, the DMN is the neural network extensively associated with the selfhood and its related psychological processes.

In fact, several recent neuroimaging studies that examined the neural substrate of admiration showed that the PCC and precuneus in the DMN were particularly activated under the moral virtue admiration condition compared with the physical excellence admiration condition (Englander, Haidt, & Morris, 2012; Immordino-Yang, McColl, Damasio, & Damasio, 2009). In addition, Moll et al. (2007) proposed that the ventromedial prefrontal cortex (VMPFC) and orbitofrontal cortex (OFC), which constitute the DMN, were significantly associated with prosocial and moral emotions. Given these findings, the DMN would be the core of moral self, and the region of interest in virtue ethics and character psychology. We will be able to quantify the degree of the development of moral virtue at the neural level, and to approach the inner psychological processes of virtue and character, which has not been completely investigated, by investigating the strength and robustness of the functional connectivity between these DMN regions and other regions associated with individual moral functions, such as moral compassion and moral indignation. Of course, this quantified connectivity cannot completely represent a person's moral character; however, it would provide us with some inner information, which previously could not be acquired but essential to investigate the psychology of moral virtue and character.

In short, we can examine the strength of the neural connectivity between brain regions associated with self-related processes and moral functions. The neural connectivity is calculated from the series of functional brain images that are acquired while participants are watching visual stimuli that induce moral emotional responses closely associated with moral virtue, or solving moral dilemmas. In addition to the brain connectivity under the task conditions, the connectivity measured during resting state is also informative as shown in previous DMN studies (e.g., Buckner et al., 2008). Finally, because it is usually expected that moral exemplars are successfully integrate moral virtue into their selfhood, their functional connectivity between brain regions dealing with moral and self-related functions would significantly differ from that among ordinary people.

Structural Neuroimaging

In addition to the functional neuroimaging method, we can investigate the difference in brains between exemplars and ordinary people at the structural level. In fact, several structural neuroimaging studies have shown that various trainings including both physical and cognitive skill trainings induced significant changes in brains at the structural level (e.g., Scholz, Klein, Behrens, & Johansen-Berg, 2009; Takeuchi et al., 2010). For instance, long-term trained players of the game of "Baduk (Go)," an Asian board game, showed a significantly different brain anatomy in the frontal, cinglulum, and striato-thalamic areas dealing with attentional control, working memory, executive regulation, and problem-solving, compared with non-experts (Lee et al., 2010). Thus, given this fact, we can expect that moral exemplars that have successfully habituated and internalized moral virtue would show significantly different structural characteristics in brain regions associated with moral and self-related functions compared with ordinary people.

Then, what kind of structural investigation methods can be used? First, we can utilize the gray matter thickness measurement. It measures the thickness of gray matters in the region of interest using high-resolution structural brain images, and enables researchers to investigate developmental or pathological changes from the quantified thickness (Fischl & Dale, 2000). For instance, O'Donnell, Noseworthy, Levine, and Denis (2005) examined the developmental changes in the frontopolar area, which is associated with cognitive function, from childhood to adolescence using this method. Given the findings of previous studies using this method, the structural characteristics of gray matters were continuously affected by both internal (e.g., aging), and external (e.g., environment and training) factors (Lazar et al., 2005; O'Donnell et al., 2005). In addition, the diffusion-tensor imaging (DTI) can also be used to examine changes in brain regions. This method quantifies diffusion anisotropy effects in white matters, and investigates the microstructure of the human brain (Assaf & Pasternak, 2008). The DTI method has also been applied to investigate the influences of both internal and external factors on the brain structure (e.g., Lee et al., 2010; Molinuevo et al., 2012; Scholz et al., 2009; Takeuchi et al., 2010).

Particularly, we shall concentrate on the structural changes in brain regions associated with moral function and the DMN to examine character development at the level of brain structure. In addition, we will be able to discover other brain regions that would be related to moral virtue, which have not been yet reported by previous studies, through the comparison in the brain anatomy between exemplars and ordinary people. In fact, structural changes were usually observed in a brain region that is directly associated with a function of interest in the previous studies of the brain structure (e.g., Lazar et al., 2005; Lee et al., 2010), so brain regions associated with moral virtue would show significantly different brain structures between moral exemplars and ordinary people. Again, we can expect that the habituation and internalization of moral virtue, which are the most important characteristics of moral exemplars, would be reflected in the structural feature of the regions.

Conclusion

In sum, neuroimaging methods have some potential benefits in measuring the development of moral virtue. Thanks to the rapid development of neuroimaging techniques as the result of research in the fields of electronic engineering and radiology, neuroimaging methods will provide more reliable and direct measurements of moral virtue. Although several scientific studies have attempted to investigate moral function, their contributions would be limited because they did not carefully look at the "self" and did not seriously consider virtue theory. These limitations should be addressed by future studies in the field of neuroimaging, with the guidance of virtue philosophy. The ideas presented in this essay will guide the future studies to measure moral virtue with neuroscientific methods.

Acknowledgements

I would like to thank William Damon, Anne Colby, William B. Hurlbut, Heather Malin, Indrawati Liauw, and Gary H. Glover for their comments on an earlier version of this essay.

References

Adair, J. G. (1984). The Hawthorne effect: A reconsideration of the methodological artifact. *Journal of Applied Psychology*. doi:10.1037/0021-9010.69.2.334

Aquino, K., & Reed, A. (2002). The self-importance of moral identity. *Journal of personality and social psychology*, *83*(6), 1423–1440. Retrieved from <Go to ISI>://000179661800013

Aristotle. (2009). *Nicomachean Ethics* (Vol. 2013). Retrieved from http://classics.mit.edu/Aristotle/nicomachaen.html

Assaf, Y., & Pasternak, O. (2008). Diffusion tensor imaging (DTI)-based white matter mapping in brain research: A review. *Journal of Molecular Neuroscience*, *34*, 51–61. doi:10.1007/s12031-007-0029-0

Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network. *Annals of the New York Academy of Sciences*, *1124*(1), 1–38.

Colby, A., & Damon, W. (1992). *Some do care : contemporary lives of moral commitment*. New York, NY: Free Press.

Englander, Z. A., Haidt, J., & Morris, J. P. (2012). Neural Basis of Moral Elevation Demonstrated through Inter-Subject Synchronization of Cortical Activity during Free-Viewing. *Plos One*, *7*(6), e39384.

Fischl, B., & Dale, A. M. (2000). Measuring the thickness of the human cerebral cortex from magnetic resonance images. *Proceedings of the National Academy of Sciences of the United States of America*, *97*, 11050–11055. doi:10.1073/pnas.200033797

Immordino-Yang, M. H., Christodoulou, J. A., & Singh, V. (2012). Rest Is Not Idleness Implications of the Brain's Default Mode for Human Development and Education. *Perspectives on Psychological Science*, *7*(4), 352–364.

Immordino-Yang, M. H., McColl, A., Damasio, H., & Damasio, A. (2009). Neural correlates of admiration and compassion. *Proceedings of the National Academy of Sciences*, *106*(19), 8021–8026. doi:10.1073/pnas.0810363106

Ito, T. A., & Cacioppo, J. T. (2007). Attitudes as Mental and Neural States of Readiness: Using Physiological Measures to Study Implicit Attitudes. In B. W. N. Schwarz (Ed.), *Implicit measures of attitudes* (pp. 125–158). New York, NY, US: Guilford Press.

Kristjánsson, K. (2007). Measuring self-respect. *Journal for the Theory of Social Behaviour*, *37*(3), 225–242.

Kristjánsson, K. (2013). *Virtues and Vices in Positive Psychology: A Philosophical Critique*. New York, NY: Cambridge University Press.

Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., … Fischl, B. (2005). Meditation experience is associated with increased cortical thickness. *Neuroreport*, *16*, 1893–1897. doi:10.1097/01.wnr.0000186598.66243.19

Lee, B., Park, J.-Y., Jung, W. H., Kim, H. S., Oh, J. S., Choi, C.-H., … Kwon, J. S. (2010). White matter neuroplastic changes in long-term trained players of the game of "Baduk" (GO): a voxel-based diffusion-tensor imaging study. *NeuroImage*, *52*, 9–19. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20394826

Lee, C., & Taylor, M. J. (2013). Moral education trends over 40 years: A content analysis of the Journal of Moral Education (1971–2011). *Journal of Moral Education*, *42*(4), 399–429.

Lou, H. C., Luber, B., Stanford, A., & Lisanby, S. H. (2010). Self-specific processing in the default network: a single-pulse TMS study. *Experimental brain research*, *207*, 27–38. doi:10.1007/s00221-012-3249-7

Molinuevo, J. L., Bargalló, N., Junqué, C., Solé-Padullés, C., Bartrés-Faz, D., Arenaza-Urquijo, E. M., … Peña-Gómez, C. (2012). Multiple DTI index analysis in normal aging, amnestic MCI and AD. Relationship with neuropsychological performance. *Neurobiology of Aging*. doi:10.1016/j.neurobiolaging.2010.02.004

Moll, J., De Oliveira-Souza, R., Garrido, G. J., Bramati, I. E., Caparelli-Daquer, E. M. A., Paiva, M. L. M. F., … Grafman, J. (2007). The self as a moral agent: linking the neural bases of social agency and moral sensitivity. *Social Neuroscience*, *2*, 336–352.

O'Donnell, S., Noseworthy, M. D., Levine, B., & Dennis, M. (2005). Cortical thickness of the frontopolar area in typically developing children and adolescents. *Neuroimage*, *24*, 948–954. doi:S1053-8119(04)00610-X [pii]\r10.1016/j.neuroimage.2004.10.014

Scholz, J., Klein, M. C., Behrens, T. E. J., & Johansen-Berg, H. (2009). Training induces changes in white-matter architecture. *Nature Neuroscience*, *12*, 1370–1371. Retrieved from http://discovery.ucl.ac.uk/55987/

Takeuchi, H., Sekiguchi, A., Taki, Y., Yokoyama, S., Yomogida, Y., Komuro, N., … Kawashima, R. (2010). Training of working memory impacts structural connectivity. *The Journal of neuroscience : the official journal of the Society for Neuroscience*, *30*, 3297–3303. doi:10.1523/JNEUROSCI.4611-09.2010

Walker, L. J. (2013). Moral Motivation through the Perspective of Exemplarity. In K. Heinrichs, F. Oser, & T. Lovat (Eds.), *Handbook of Moral Motivation: Theories, Models, Applications* (pp. 197–214). Rotterdam, The Netherlands: Sense Publishers.

Woodhead, M., & Paulkner, D. (2000). Subjects, Objects or Participants? Dilemmas of Psychological Research with Children. In P. Christensen & A. James (Eds.), *Research with Children: Perspectives and Practices* (2nd ed., pp. 10–39). New York, NY: Routledge.

Zhu, Y., Zhang, L., Fan, J., & Han, S. H. (2007). Neural basis of cultural influence on self-representation. *Neuroimage*, *34*(3), 1310–1316.