The Neurobiology of Health Communication

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ABSTRACT

This issue of *Psychosomatic Medicine* describes findings from an innovative study by Kang et al that used neuroimaging methods to quantify neural responses to health communications. Findings indicated that sedentary individuals who hold self-transcendent values show attenuated limbic threat responses to communications about the benefits of physical activity. Furthermore, participants who were instructed to articulate such values showed some evidence of additional blunting of the same neural response. In this editorial, we provide context for the interpretation of these findings within the existing research using the brain-as-predictor approach, and other recent trends within biobehavioral medicine involving the use of neuroscience methods in the service of health behavior change.

Key words: fMRI, health communication, neuroscience, brain, amygdala.

Health communications can have a variety of objectives, ranging from simple information provision to motivating behavior change. Yet none of these objectives are likely to be realized if the communication process has been circumvented. Perceived personal relevance and attention to the communication contents may be two necessary ingredients, but even these may not be influential if the communication process is shut down early as a consequence of neurobehavioral threat reactions that drive avoidance. As such, threat responses could be crucial determinants of the relative success of health communications.

Threat responses can exist on the level of conscious perception, but neural activity in threat-sensitive regions of the brain itself may be more crucial indicators of pending changes in overt behavior. The limbic system, and specifically the amygdala, has long been understood as a key player in the neurobiology of threat detection/response (1) and therefore represents an intuitive place to look for neural responses to health communications that might indicate a shutting down of the information exchange process. Yet, there has been little in the way of empirical examination of threat responses as part of the mediating mechanism linking communications to outcomes.

TRANSCENDENCE IN THE HEALTH COMMUNICATION PROCESS

Transcendence can be conceptualized as a dispositional or statelike tendency to expand awareness to something superordinate to the self, normally involving prosocial values and consideration of universal aspects of the human condition. Transcendence of one's personal wants and desires in favor of nonselfish considerations is central to many religious orientations, altruistic behaviors, as well as spiritual practices such as meditation. The many positive health benefits of such beliefs, behaviors, and practices attests to the potential for transcendence to foster an approach to life that results in less interpersonal, and perhaps more importantly, intrapersonal, friction. Transcendent tendencies (and strategies) may circumvent defensiveness and allow for less censoring of incoming information, a process that may enable one to be more responsive to messages that are of self-relevance. What has not been tested is whether brain imaging techniques can tell us something about the capacity of transcendence to open the gates of self-awareness and to enhance the effectiveness of important messaging regarding health behaviors.

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The study by Kang et al (2) in this issue of *Psychosomatic Medicine* is representative of a new frontier of health communication research involving the use of neuroimaging to examine brain responses to health communications. The investigators tested the extent to which self-transcendence might mitigate threat responses to health communications that could be perceived defensively (i.e., as threats); in this case, communications about sedentary behavior to those who are inactive. Their findings revealed that sedentary individuals who held self-transcendent values tended to show less activity in brain systems implicated in threat processing in response to potentially threatening communications about the risks of inactivity, compared to those sedentary individuals who held less self-transcendent values. Furthermore, those who were instructed to articulate such values (using a "self-affirmation task") showed some further attenuation of these so-called neural threat responses. These neural threat responses were not markedly influenced by level of social connection, and were specific to health-related messaging about the self (and not generic self-relevant information). A novel aspect of the study is the use of neuroimaging techniques to gauge the processing of health communications at a neurobiological level, with a focus on brain structures previously implicated in threat perception, such as the amygdala and the anterior insula, which may link health message processing to behavior change.

The Kang et al study (2) is significant in part because of its connection to the larger literature involving the brain-as-predictor approach within communication neuroscience. Three prior studies from the same laboratory involving functional magnetic resonance

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imaging (fMRI) methods are exemplary. In the first study, Falk et al (3) demonstrated that when compared to self-reported impressions of efficacy, brain responses to three alternative smoking cessation television campaigns among a small group of current smokers were better predictors of smoking cessation hotline usage rates when the three competing campaigns were actually released on a population level. Self-reported evaluations of the same campaigns got the rank ordering wrong when attempting to predict real-world quit line uptake; neural responses, however, correctly predicted the rank ordering of real-world efficacy. A second study, again involving smokers with a different behavioral outcome, affirmed the importance of self-related processing in the medial prefrontal cortex (mPFC) for improving responsiveness to messaging about health risks of smoking (4).

A final study involved using the brain to examine the role of self-affirmation in facilitating behavioral change via health communications (5). This was an analysis of the same data set (and manipulation) from the authors but in this case, tracking the effects of communications on the mPFC, as an indicator of self-relevant processing. It was hypothesized that this articulating of self-relevant values might overcome defensiveness and, on a neural level, result in stronger message-driven activation of the mPFC (i.e., suggesting that the message had indeed made its way through the gates of awareness and perceived as personally relevant). Importantly, over the follow-up interval of the study, those who were self-affirmed went on to be less sedentary (i.e., a positive response to the communication about inactivity) than those who were not self-affirmed.

These study findings shed some light on what the central nervous system can tell us about the path to effective health communication, when effectiveness is defined as that which is most likely to result in a message received, and behavior adjusted in line with one's own interests. These insights would not have been possible just a few decades ago, and without creative blending of neuroimaging methods, population health concepts and behavioral paradigms.

NEUROSCIENCE METHODS IN BIOBEHAVIORAL MEDICINE

The aforementioned studies represent an important new approach to understanding the process of health communication, but should they be categorized as belonging to the field of biobehavioral medicine? The use of neuroscience methods within the field of biobehavioral medicine has been of interest for some time, but seems to be subject to a revival with the advent of modern neuroimaging and neuromodulation techniques (6–11).

For example, in a series of recent studies from the field of exercise neuroscience, fMRI has been used to examine the effects of exercise interventions and cardiorespiratory fitness on brain outcomes in older adults with and without mild cognitive impairment (12–14). These results have led to a better understanding of the mechanisms underlying the cognitive benefits of exercise and the ways in which exercise could be used to mitigate age-related cognitive losses. In addition, these methods have allowed for a better understanding of the limitations of some therapeutic approaches. For example, using fMRI and similar neuroimaging techniques, it has been found that the effects of exercise on the brain may be most pronounced in hippocampal and prefrontal regions (15,16). Thus, behaviors that are less supported by these brain areas may show limited benefit from engaging in exercise. Results like these demonstrate how fMRI and related approaches can help guide biobehavioral medicine, therapies, health communication, and new scientific discoveries.

Brain imaging has also been used to characterize the cortical and subcortical neural systems that are responsive to behavioral medicine interventions (e.g., mindfulness-based stress reduction (17), as well as neural systems that are involved in regulating negative emotions (18) and peripheral physiological stress responses (e.g., stressor-evoked cardiovascular reactions) that may confer risk for chronic illnesses, such as coronary heart disease (19). These and other applications of brain imaging to the study of intervention effects, emotion, and stress physiology in the context of risk for physical illness illustrate the recent extension of a long tradition of focus on the central nervous system within biobehavioral and psychosomatic medicine (8,20).

Beyond neuroimaging, recent advances in noninvasive brain stimulation (NIBS) have led to increased interest in neuromodulation as both an experimental technique and as a therapeutic modality. For example, experimental studies have revealed the causal significance of the dorsolateral prefrontal cortex in relation to the modulation of dietary cravings and possibly consumption, using several variants of NIBS techniques, including repetitive transcranial magnetic stimulation (10,21). Applications of NIBS techniques to the treatment of affective disorders and addictions is well underway (22,23), and there seems to be promise in the area of pain management (23,24). As the field of biobehavioral medicine grows to more fully exploit NIBS techniques in experimental and clinical settings, our understanding of causal influences of cortical structures on human behavior and disease outcomes will grow.

Frohlich (25) provides accessible overviews of neuroimaging and neuromodulation methods of potential interest to biobehavioral researchers.

SUMMARY AND CONCLUSIONS

Kang et al present a compelling use of fMRI not as a way of assessing outcomes but of examining brain responses, which in turn might be expected to have behavioral consequences. This is an interesting application of neuroimaging methods that broadens its scope beyond brain-as-outcome approaches that are more familiar in biobehavioral medicine. The finding that neural threat responses are mitigated among those who have a tendency toward transcendence reinforces the importance of considering individual differences in transcendent tendencies, whereas the enhancing effect of a momentary manipulation reminds us of the malleability of transcendence. The findings begin to help provide a plausible mechanism by which elusive phenomena such as spirituality and interpersonal connection may influence health outcomes.

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