AN ABSTRACT OF THE THESIS OF

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Moral elevation, or elevation, is a prosocial emotional state elicited by witnessing displays of altruism or moral beauty. For this study, medial prefrontal cortex (mPFC) and autonomic physiology activity were monitored during elevation induction. We hypothesized that changes would occur in mPFC activity during elevation and that these would significantly relate to feelings, cognitions, and physiological changes that occur during elevation. Our data shows that deactivation of the mPFC is related to feelings and cognitions associated with elevation, including admiration and a desire to help others. Furthermore, participants who appeared more interested during elevation induction reported more sympathy/compassion and an increase in heart rate. In addition, physiological assessment found that appearing interested is significantly associated with an increase in parasympathetic activity. Altogether, these results add to the body of knowledge of the relationship between the body and the brain during elevation.

Key Words: Elevation, Autonomic Physiology, Medial Prefrontal Cortex, Respiratory Sinus Arrhythmia, Behavior, Psychology, Prosocial, Emotion

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Neural and Behavioral Components of Moral Elevation

By

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Introduction

Moral elevation, or *elevation*, is a prosocial emotional state elicited by witnessing or learning about acts of altruism or moral beauty (Haidt, 2003). This includes acts of charity, gratitude, fidelity, compassion, or any other act of particular moral excellence (Algoe & Haidt, 2009). Elevation possesses a distinguishing set of feelings, like admiration and affection for the moral exemplar, a characteristic feeling of warmth and expansion, and feelings of optimism about humanity (Algoe & Haidt, 2009; Freeman, Aquino, & McFerran, 2009; Schnall, Roper, & Fessler, 2010). Importantly, elevation motivates altruism, general helping behavior, and desires to behave more prosocially (Algoe & Haidt, 2009; Schnall, et al., 2010). In addition, it has been shown to bolster maternal caretaking behavior (Silvers & Haidt, 2008). Physical sensations associated with elevation include warmth in the chest, tears in the eyes, and chills on the skin (Schnall, et al., 2010; Silvers & Haidt, 2008). Experiencing this emotional state makes it more likely that one's outlook on life and the social world improve and is conducive to encouraging altruism and one's own sense of morality (Schnall & Roper, 2012).

Feelings and Cognitions

One of the most conspicuous consequences of elevation is the desire to help others. Researchers have found that individuals, after viewing an elevation-inducing television program segment, as opposed to those who watched a humorous or informative

television program segment, are more likely to agree to participate in another, unpaid study. Participants in this study were not merely engaging in modeling behavior, for the altruistic acts performed in the elevation-inducing clip (mentoring underprivileged youth) is not the same as the helping tasks performed in the laboratory setting (agreeing to participate in another study or completing a math questionnaire). Thus, elevation prompts general altruism, not helping behavior of a specific kind (Schnall, et al., 2010).

It has been demonstrated that a result of elevation is the attenuation of social dominance orientation (SDO), a measurement of how likely one is to support a group-based hierarchy wherein "superior" groups dominate "inferior" groups. SDO beliefs are associated with generosity levels to outgroups and levels of prosocial behavior upon moral elevation. Higher levels of SDO beliefs are associated with higher levels of ethnocentrism and, consequently, Whites being less willing to donate to Black-oriented charities. White individuals, as part of a study, were asked to read a story about morally virtuous act. The effects of strong SDO beliefs among individuals were neutralized upon elevation induction, resulting in these participants being more likely to donate to a Black-oriented charity. Elevation stimulates desire for proximity with others, regardless of ingroup/outgroup status (Freeman, Aquino, & McFerran, 2009).

Elevation is regarded as belonging to a family of other-praising emotions, namely gratitude and admiration (Algoe & Haidt, 2009). These emotions are brought forth by others' laudable actions (Haidt, 2003). Gratitude is generally considered to be produced by the perception that one is benefitting from another's intentionally produced act of kindness. Its "characteristic expression" tends to be the recipient having a desire to repay

the benefactor for the assistance. Admiration, in contrast, is an emotional response to non-moral excellence, elicited when one witnesses displays of exceptional skill, talent, or achievement. It can be regarded as freely-conferred deference, coupled with a desire to form a closer relationship with the exemplar. Gratitude and elevation both create a drive to perform benevolent actions, although the source of the motivation and target for both are different. Like elevation, admiration can inspire one to produce accomplishments, but of different natures. Elevation motivates one to perform a morally commendable action for another, while admiration inspires one to work toward personal goals. Despite their differences, each of the other-praising emotions focuses individuals' attention on others, as opposed to themselves (Algoe & Haidt, 2009).

Elevation has been shown to be a unique emotional state, distinct from sheer positive mood (Schnall, et al., 2010). Nevertheless, it has traits in common with other positive emotions, namely admiration and awe (Algoe & Haidt, 2009; Keltner & Haidt, 2003). Considering these similarities, it is useful to clarify what distinguishes the former from the latter. The awe-family of feeling states, of which elevation is considered a member (Keltner & Haidt, 2003), is generally considered an aid in the integration of vast and uncommon experiences into one's understanding of existence. These experiences may be phenomena like natural and man-made objects and charismatic political leaders. Awe has various elicitors, like threat, exceptional skill, virtue, and supernatural encounters. Elevation, however, does not need a vast stimulus and is only elicited by an individual displaying virtue (Haidt, 2003).

Physiology

Inclination to nurture has been shown to increase upon elevation induction. Nursing mothers exposed to an elevation-inducing video, compared to nursing mothers who watched a humorous video, secreted more milk and were more prone to hug their children. Mothers in the elevation condition were also more likely to report feeling more inspired, tingling on the skin, and crying. Because an increase in milk letdown and nurturing behaviors followed an induction of elevation, it is speculated that oxytocin plays a role in elevation. Oxytocin is a hormone synthesized in hypothalamic nuclei and organs located in the chest, like the heart and the thymus. It follows that higher rates of circulating oxytocin can be identified with the feelings of warmth and expansion in the chest, with which elevation is identified. Moreover, it is associated with receiving signals of trust and of being more willing to trust in return. In accord with these facts, oxytocin release may be regarded as a physiological component of elevation (Silvers & Haidt, 2008).

The autonomic nervous system (ANS) is the part of the peripheral nervous system that controls visceral functions that are normally outside of conscious control and is comprised of the sympathetic and the parasympathetic nervous systems (SNS and PNS, respectively). Distinct autonomic physiological states accompany different emotional states. The SNS is in control of what is commonly known as the fight-or-flight response, preparing the body for physical action in a potentially threatening environment. An aspect of this physiological response is an increase in heart rate (HR), among others, like increased skin conductance (Christie & Freedman, 2004). The PNS takes over when there

is no environmental threat present, and is often referred to as the rest-and-digest response. A marker of increased PNS function is increased respiratory sinus arrhythmia (RSA). RSA is the naturally occurring variability in heart rate during the breathing cycle and an index of the vagus nerve brake on the heart (Porges, 2007). The character of ANS activation as a whole can be taken as an indicator of how, physiologically, an individual is responding to the environment.

Specific brain regions are identified with particular cognitions, feelings, and functions. The medial prefrontal cortex (mPFC) is associated with emotional and social cognition, affect regulation, and ego-driven self-evaluation (Amodio & Frith, 2006; Thayer, Åhs, Fredrickson, Sollers III, & Wager, 2012).

Behavior

The behavioral displays during moral elevation have never been analyzed before. To approach this, we devised a coding scheme based on previous work by the Principal Investigator looking at prosocial cues (Kogan et al., 2012) and the feelings often self-reported during elevation induction, such as interest, sadness, sympathy, and compassion (Haidt, 2003).

Current Study

The current study sought to expand the knowledge of the effects of elevation on the body and the brain. Past research has examined what specific feelings and cognitions are correlated with elevation and whether performing or expressing intent to perform prosocial actions can arise from this emotional state. The present study examined how cognitions and feelings associated with elevation relate to changes in activity occurring in

the medial prefrontal cortex and the autonomic nervous system. Behavior, especially facial expression, associated with feelings and cognitions identified with elevation were also investigated. It was hypothesized that activity in the mPFC and in the autonomic physiological system would correlate significantly to feelings and cognitions identified with elevation. It was additionally hypothesized that the feelings, cognitions, and physiological changes that occur during elevation would be reflected through behavior.

Methods

Participants

One hundred and four participants took part in this study. Participants' ages ranged from 18 to 38 and the mean age was 20.61 (*SD* = 3.35) and 65 were female. Those who took part in the study were Oregon State University students recruited through an online registration system available for students enrolled in a psychology course. They were reimbursed with three credit hours of extra credit for their psychology course.

Video Stimuli

Emotional videos and record manipulation check responses were administered using E-Prime 2.0 software (Psychology Software Tools, Inc., Sharpsburg, PA). The software was programmed to deliver the participants surveys on their current emotions, an emotionally neutral baseline video, emotional videos, and manipulation check items meant to measure emotional experiences elicited by the latter two videos. After their current emotions were assessed, participants were shown a five-minute long *How It's Made* segment concerning the processes involved in manufacturing factory-made hammers. This video served as the baseline control segment with neutral emotional valence.

Those in the elevation condition watched a seven-minute long segment from an episode of *The Oprah Winfrey Show*. The segment dealt with a man who grew up impoverished in Chicago. During his adolescence, a music professor gave him a scholarship and mentored him through college. Becoming a music teacher later in life, his

students came on the show to express their gratitude. This segment has been used in past studies on elevation induction (Schnall, et al., 2010; Silvers & Haidt, 2008).

Participants in the amusement condition watched a four-and-a-half minute long group of segments from the BBC One show "Funny Talking Animals – Walk on the Wild Side." This video contains footage of animals interacting with human voices telling jokes dubbed over it. Amusement has been used as a control condition in past research on elevation to separate the effects of elevation from those of general positive valence (Algoe & Haidt, 2009; Schnall, et al., 2010; Silvers & Haidt, 2008).

Manipulation Check Items

Following emotion induction, participants responded to Likert-type six-point scale items with regards to the feelings, cognitions, and physical sensations they experienced during the emotional videos. The self-report items, some of which are "hope," "more curious about the world," and "warm or expansive feelings in chest," are provided in Table 1. Manipulation check items for amusement included "amused" and "laughter."

Physiological Measures

Analyses of physiological measures were taken from a two-minute baseline period and a two-minute emotion induction period. The former was appropriated from the last two minutes of the neutral video, while the latter from the initial two minutes of the elevation and amusement videos. A group of laboratory research assistants (n=5) rated the emotional-induction content throughout each video and determined that the affective content of each of these two-minute periods is representative of each video as a whole.

Functional near-infrared spectroscopy (fNIR; fNIR Devices LLC., Potomac, MD) was used to measure blood-oxygenation level-dependent (BOLD) signal. The fNIR device recording apparatus is a band comprised of four light-emitting diodes and ten light detectors. Temporal means of oxygenation were calculated for each channel. For this study, oxygenated hemoglobin concentration from the center four channels were averaged to serve as a measure of mPFC activity, the region of interest. Its signal was refined with fNIRsoft (Ayaz, 2010), specialized data analysis software. It was wrapped around the participants' foreheads and secured in place.

RSA data was collected using electrocardiogram (ECG) leads that were placed on the participants' left arm and right collarbone, with the ground lead placed on the lower right abdomen. ECG recordings were collected at 1000 Hz with the MP150 Data Acquisition System and Acqknowledge 4.2 software (Biopac Systems Inc., Santa Barbara, CA). The Acqknowledge software located R-peaks for interbeat interval analysis, which was conducted using CardioEdit/CardioBatch software (Brain-Body Center, University of Illinois-Chicago, Chicago, IL) by evaluating the time between heartbeats. RSA was averaged over the baseline and emotion induction periods to use for statistical tests.

Behavioral Coding

Participants' faces were video recorded while they were presented with the video stimuli and manipulation check items. The first two minutes of the elevation condition recording were extracted and five research assistants analyzed participants' behavior. The

coding scheme is included in the Appendix. Inter-rater reliability was determined with Krippendorff's α coefficient ($\alpha = 0.76$).

Procedure

Recruitment of participants took place through Oregon State University's online Psychology Experiment Sign-Up System. Upon arrival at the laboratory, an informed consent process explained the procedures. Participants were sorted into either the elevation or amusement condition upon arrival to the laboratory where they had ECG leads and the fNIR headband placed on them. Participants viewed the videos and completed the manipulation check items while being video recorded. The ECG leads and fNIR headband were removed, the participants were debriefed, and they were dismissed.

Results

Mann-Whitney U tests set to $\alpha=0.05$ revealed significant differences in 18 of 22 post-elevation self-report items. The elevation group reported more warmth; inspiration; admiration; hope; tenderness; uplifted; awe; sympathy/compassion; optimism about humanity; wanting to help others; more open and loving towards people in general; eyes watering/tearing up; lump in throat/choked up; warm or expansive feelings in chest; heart beating faster; and chills, goose bumps, or tingling on skin. Means, standard deviations, and *p*-values are listed in Table 1.

Table 1: *Post-Elevation Self-Report Items and Significant Differences between Conditions*
Possible values range from 1 (*did not feel at all*) to 6 (*felt very strongly*).

Manipulation check item	**Mean (SE) in elevation (N = 50)**	**Mean (SE) in amusement (N = 48)**
Happiness/joy	4.08 (0.19)	3.94 (0.17)
Warmth**	4.30 (0.17)	3.44 (0.19)
Inspiration**	4.64 (0.14)	2.92 (0.19)
Admiration**	4.60 (0.16)	2.83 (0.20)
Hope**	4.38 (0.18)	2.94 (0.19)
Tenderness**	4.08 (0.20)	3.02 (0.18)
Uplifted**	4.24 (0.21)	3.27 (0.21)
Awe**	3.72 (0.19)	2.98 (0.21)
Amused	3.36 (0.19)	4.27 (0.22)
Sympathy/compassion**	4.44 (0.21)	2.79 (0.19)
Optimistic about humanity**	4.48 (0.20)	3.08 (0.22)
Wanted to help others**	4.50 (0.20)	2.69 (0.17)
More open and loving towards people in general**	4.22 (0.22)	2.79 (0.19)
More curious about the world	3.62 (0.22)	3.65 (0.22)
Eyes watering/tearing up**	3.55 (0.21)	1.33 (0.12)
Lump in throat/choked up**	2.76 (0.21)	1.31 (0.12)
Warm or expansive feelings in chest**	3.56 (0.22)	2.52 (0.22)
Nausea	1.36 (0.10)	1.27 (0.11)
Heart beating faster*	2.52 (0.18)	1.94 (0.17)
Change in breathing	2.88 (0.21)	2.35 (0.20)
Chills, goose bumps, or tingling on skin**	2.80 (0.24)	1.38 (0.11)
Laughter	2.22 (0.17)	3.81 (0.21)

*$p<0.05$
**$p<0.005$

Paired t-tests were performed to check for significant fluctuations in BOLD signal for the two-minute period from the end of baseline to the beginning of elevation induction. mPFC activity showed greater deactivation in elevation (M=-0.51, SE=0.13) than in amusement (M=0.36, SE=0.29), t(41.3)=-2.74, p=.009, Cohen's d=-0.69.

Spearman correlations were performed to assess the relationship between manipulation check items and mPFC activity. Significant relationships were found between sympathy/compassion, wanting to help others, inspiration, admiration, and hope and a decrease in mPFC activity. Results are reported in Table 2.

Table 2: *Post-Elevation Self-Report Items and mPFC Activity*

Manipulation check item		**mPFC activity**
Sympathy/compassion	r	-0.304*
	r^2	0.09
	p	0.014
	N	65
Wanting to help others	r	-0.297*
	r^2	0.09
	p	0.016
	N	65
Inspiration	r	-0.258*
	r^2	0.07
	p	0.038
	N	65
Admiration	r	-0.346**
	r^2	0.12
	p	0.005
	N	65
Hope	r	-0.249*
	r^2	0.06
	p	0.046
	N	65

*Significant at the 0.05 level (2-tailed).
**Significant at the 0.01 level (2-tailed).

Spearman correlations were performed to assess the relationship between RSA and behavior. A significant relationship was found between RSA and how interested a participant appeared $r(39)=0.402$. Spearman correlations were also performed to assess the relationship between manipulation check items and behavior. Significant relationships were found between sympathy/compassion and appearing interested, $r(38)=0.397$, and an increase in heart rate and appearing interested, $r(38)=0.375$. All $ps<0.05$.

Discussion

The current study examined the associations between the feelings and cognitions identified with elevation and mPFC and autonomic physiological activity. Significant associations were found between elevation and a decrease in activity of the mPFC. Nominally, there was a significant correlation between a decrease in BOLD signal and reporting feeling inspiration, admiration, hope, sympathy/compassion, and wanting to help others.

The reported feelings and cognitions associated with elevation induction in this study fall in line with past research on the feelings and cognitions that comprise elevation (Freeman, et al., 2009; Schnall, et al., 2010). This provides support to the concept of elevation as an emotion whose components are positive and prosocial in nature. Reduced activity in the mPFC may be related to an absence of social-evaluative threats. One of the mPFC's functions is contributing to the planning out of present- and actual-irrelevant actions, so it may be concluded that desiring to help others and feeling sympathy or compassion would increase mPFC activity. It is possible that, despite these cognitions, the individual experiencing elevation is not planning out prosocial actions in actuality, but merely has such a desire. The mPFC is associated with planning out non-temporally related actions, as opposed to focusing attention on that which is "in the here and now" (Farb, et al., 2007). The mPFC is also related to self-awareness, so it can be inferred that a reduction in BOLD signal during elevation may be due to thinking more about others and less about the self. The effect sizes were found to be modest, with the self-report item "admiration" having the strongest correlation to reduced BOLD signal.

Additionally, a relationship between the feelings and cognitions of elevation and behavior was discovered. Reporting feeling sympathy/compassion and an increase in heart rate correlated significantly with appearing interested. An increase in heart rate is a portion of the array of physiological responses initiated by the SNS. Elevation has been speculated to have some underlying physiological responses in common with stress responses due to witnessing others in a distressing situation. This finding makes sense in the light of past research that has found that females, when confronted by a stressful, SNS activating condition, will engage in a "tend-and-befriend" response in lieu of a "fight-or-flight" response (Silvers & Haidt, 2008; Taylor, et al., 2000). Although the current study did not investigate differences among the sexes in terms of responses to elevation induction in the current study, it is possible that males may have a response similar to "tend-and-befriend" during elevation.

The current study investigated how the physiological consequences of elevation are related to its behavioral outcomes. It was revealed that there is a correlation between an increase in RSA and appearing interested during elevation. RSA increases when the PNS is activated, which occurs when engaged in social situations. Considering this, an increase in RSA during elevation suggests that the body is preparing for social interaction (Porges, 2011). This is in accord with the prosocial and optimistic feelings about humanity elicited by elevation.

The increase in RSA and reported increase in heart rate suggests a dual activation of the SNS and PNS. This is an exciting implication, as dual activation only occurs during certain circumstances, like crying (Trimble, 2012), interacting with infants

(Kenkel, et al., 2013), and sexual activity (Carter 1992). In these scenarios, the SNS is activated to prepare one to protect infants or assist a distressed individual. Activation of the PNS in these situations may serve to reduce stress reactivity and prepare one for social interaction. Elevation inducing dual activation is further bolstered by extant research, as elevation may be linked to oxytocin release (Silvers & Haidt, 2008) and dual activation of the SNS and PNS may mark oxytocin release (Kenkel, et al., 2013). Because appearing interested has been found to be associated with a marker of SNS activation and a marker of PNS activation, it could signal to proximal individuals, or bolster their similar response, that an appropriate response to a distressing situation involving other people would be one of assisting the affected individual or individuals in a friendly manner. Further studies can aim their attention at the hormonal and behavioral outcomes of elevation.

Studies examining brain activity patterns have found them to be highly consistent across experiencers (Englander, Haidt, & Morris, 2012; Immordino-Yang, McColl, Damasio, & Damasio, 2009). It would be useful for future studies to use a more capable neural imaging device to investigate neural activation during elevation. Using functional magnetic resonance imaging would yield recordings of neural activation in deeper structures than what an fNIR device is capable of reading (Logothetis, 2003); an fNIR device can only detect activation near the surface of the prefrontal cortex (Chance, et al., 1998).

Future studies can focus on people from different cultures and age groups. Despite the relative logistical difficulties it may produce, it would be interesting to

investigate the differences, if any, between the minutiae of elevation produced by a live-action instance of moral beauty and a videotaped event. A future, longitudinal study could look at the long-term effects of repeated exposure to elevation inducing episodes.

Altogether, the research presented here adds to the body of knowledge on elevation and, more broadly, the relationship between the body and brain. It was shown that deactivation of the mPFC is coupled with reports of feelings and cognitions that have been previously shown to be associated with elevation. An effect of elevation is behaving in a manner that suggests that one is more interested, which can affect others' responses to the situation. Additional support has been provided to the thesis that there occurs a dual activation of the SNS and PNS during elevation. The present study provides support for recent research on that which is internally experienced during elevation, at both the mental and physical levels.

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APPENDIX

Elevation Coding:

Intensity and Duration of Specific Emotions and Behaviors

0 = none

1 = slight and short, 2 = slight and long

3 = moderate and short, 4 = moderate and long

5 = strong and short, 6 = strong and long

Elevation

tearing up, choked up (lump in throat, swallowing), smiling, looking inspired

Distress/Fear

shaking, cringing, muscle tension, twitches, flinches, eye widening, mouth corners to the side and down, brow up and in, head moved away from screen, obscure vision (hand to the eyes)

Sadness

downturn of mouth, upturn of inner brow, head forward, closed body posture, turning face away, widened nostrils

Interest

eyes widened, fixed gaze, leans forward