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Neuroscience of Influence

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Abstract

The science of influence is often counter-intuitive. This can lead to situations where likely successful information operations are not approved, in favor of those that create unintended negative consequences. Neuroscience offers additional insight into the neural correlates of influence. It provides a means to empirically test hypotheses at the biological level. This paper introduces a neurocognitive model of behavioral influence, intended to guide Department of Defense (DoD) policy makers and planners in designing more effective influence campaigns to support vital US foreign policy interests. It calls on the DoD to invest in a deeper understanding of cognitive influence as well as increased funding to basic fundamental research in neuroinfluence.

Introduction

The U.S. Military dominates the Air, Land, and Sea domains. Today, however, the bigger military challenge lies in the human and cognitive domains: influencing populations to overcome cultural bias and misinformation to align themselves with US vital interests. GEN Votel, commander of U.S. Central Command and former commander of U.S. Special Operations Command, has characterized these activities as operations in the "Gray Zone." These activities, whether unconventional warfare (UW), civil military operations (CMO), or military information support operations (MISO), all involve targeted influence at the cognitive level.

Influence is essential for maneuver in the human domain and to address critical national security challenges. Russia achieved success in the Ukraine, not through kinetic military power, but rather through "hybrid warfare," where they applied effective influence to persuade the population to reject their existing government in favor of Russian annexation. The Islamic State is using successful persuasion and influence to raise funds, recruit soldiers, and radicalize citizens in western countries. The US is also vulnerable to the spread of infectious disease emanating from populations that must be persuaded to take proper medical precautions. Influence is thus a critical component of national security.

Despite the growing importance of influence as an element of foreign policy and military power, the DoD still struggles to dominate in the human domain. Much of the problem is blamed on a lack of authorities or permissions. The author posits that perhaps the real issue is confidence and understanding. Senior policy and decision makers within the DoD rely on intuitive reasoning to make decisions regarding policy and authority. Influence is anything but intuitive. Decision makers need a simple model that they can use to evaluate proposed influence operations. Likewise, junior officers preparing military plans must also have a simple model they can use to develop viable influence operations or integrate influence effects within other military operations. These two communities must be able to communicate concepts efficiently with each other and have an objective means of assessing the success or failure of specific messaging goals.

Advances in neuroscience may provide solutions to some of these problems. Neuroscience allows hypothesis testing at the biological level. Certain brain regions are associated with various different cognitive responses to stimuli. These findings allow operators to test whether a desired cognitive response is present when presented with new stimuli in an influence operation. Neuroscience also provides insight into the anatomy of the brain and how certain brain regions are related, which helps form an improved understanding of how influence and decision making works. For example, decision-making is more strongly associated with emotion areas of the brain than logic areas (Damasio, 1994; Bechara et al, 2000). This counter-intuitive finding is supported by biological data and has profound implications for strategic information operations planning. Neuroscience provides objective data that can be used to inform an empirically supported understanding of influence that in turn may inform policy and planning.

This paper is organized in three remaining sections. The next section provides an overview of cognitive influence within the context of MISO, leveraging current science in persuasion. This overview provides a basic understanding of influence and while cast within the context of MISO, it finds similar application to other military operations such as UW, CMO, military deception (MILDEC), and a range of deterrence operations. The subsequent section integrates neuroscience into the discussion on persuasion. The final section outlines current ongoing research efforts in the area of neuroinfluence.

Cognitive Influence

"Military Information Support Operations (MISO), formally known as Psychological Operations (PSYOP), are planned operations to convey selected information and indicators to foreign audiences to influence their emotions, motives, objective reasoning, and ultimately the behavior of foreign governments, organizations, groups, and individuals. The purpose of MISO is to induce and reinforce foreign attitudes and behavior favorable to the originator's objectives." (Department of the Army, 2013)

Attitudes influence behavior when they are specific, personal, and relevant (Myers, 2011). In order for MISO officers to design effective specific, personal, and relevant messages that have the ability to change attitudes and behavior, they must understand how humans cognitively process information that they receive.

People do not form their understanding, beliefs, and world view from a rational and scientific study of their environment. Aristotle's approaches to persuasion, ethos (credibility), logos (logic), and pathos (emotion) are over 2 millennia old and uninformed by advances in cognitive psychology. Current US influence activities are either based in Aristotle's rhetoric or worse, rational choice. For example, individuals' behaviors such as suicide bombing cannot be reconciled with rational actor models of human behavior (Atran et al., 2007; Tetlock, 2003). We may want to believe that messaging an indigenous population with facts and evidence of adversary malign actions and intent will create an influence effect. This strategy is grossly naïve, unsupported in data, and is a major reason why the US is failing in the narrative space.

People have to make sense of the world and will have difficulty in trusting any message or evidence that contradicts their current world-view. Modern persuasion research has demonstrated that persuasive messages inside one's latitude of acceptance lead to movement towards that position (i.e. assimilation) and persuasive messages outside one's latitude of acceptance lead to no persuasion or even movement away from that position (i.e. contrast) (Hovland, Harvey, & Sherif, 1957). For example, people who hold political views that are slightly more liberal or conservative than one's own are seen as reasonable and possible to engage, while views that are highly divergent are seen as unreasonable and

are rejected. In other words, a person assesses whether a new message can be integrated with one's current beliefs and self-concept.

When people encounter persuasive messaging that falls outside of their latitude of acceptance, the likely cognitive response is resistance and mistrust. Much of the research and understanding of influence is not conducted under conditions of resistance and is therefore not generalizable to many MISO or strategic influence applications. For example, advertising campaigns do not attempt to change behavior outside of a target's latitude of acceptance. If I am selling a new brand of toothpaste, I do not need to convince you that it is a good idea to brush your teeth. I need to offer an appeal, well within the target's latitude of acceptance, that my toothpaste brand may offer advantages over their current brand of choice. In this setting, Aristotle's ethos, pathos, logos, are likely to be effective. If, however, the goal is to create influence effects outside the latitude of acceptance, focused on polarizing issues, then cognitive resistance mechanisms must be considered.

The most common form of resistance thought to occur during persuasion attempts is *counterarguing*. This refers to the thoughts we generate that either identify weaknesses in the persuasive message itself or that bolster our existing beliefs to render them less vulnerable to such arguments (Festinger & Maccoby, 1964; Hovland, Lumsdaine, & Sheffield, 1949). Counterarguing is likely a central component that thwarts persuasive messaging relevant to the defense and intelligence communities.

Influence can be thought of like a military maneuver operation. If the goal was to conduct a deliberate attack, we would expect the adversary to establish defenses to turn, delay, or disrupt our attack. When developing a maneuver plan, much thought is devoted to understanding the terrain (target audience analysis), avenues of approach (lines of persuasion) and the decisive point is usually successful breach of the adversary's obstacle belt (breach cognitive resistance). Current MISO efforts devote varying levels of effort toward target audience analysis and lines of persuasion. They almost universally, however, demonstrate a complete lack of awareness of cognitive resistance.

There are several approaches to disarming cognitive resistance:

1) *Distraction* (Festinger & Maccoby, 1964). The rationale is that counterarguing takes effort. Distracting an audience with some stimuli appears to be an effective antidote to counterarguing and promotes acceptance of persuasive messages (Baron, Baron & Miller, 1973).

2) *Self-affirmation.* This involves thinking or writing about a highly valued aspect of the self, like one's social connections or moral beliefs. This process has led to reduced defensiveness in a variety of experimental domains from cognitive dissonance reduction (Steele & Liu, 1983) to negotiation (Cohen et al., 2007). It has also been shown to render people more open to identity-threatening information in a persuasion context.

3) *Narrative persuasion* uses stories, anecdotes, examples, or testimonials. Narratives tend to be more engrossing, which has several benefits. First, transportation into the narrative itself (i.e. *narrative immersion;* Green & Brock, 2000) allows deep processing of messages in a way that is not experienced as effortful. Additionally, narratives are often presented as entertainment rather than as attempts to persuade and thus they are less likely to trigger defensive measures like counterarguing (Slater & Rouner, 2002). Second, narrative immersion is often associated with identification with protagonists, which in turn may be associated with persuasion (Dal Cin et al, 2004). Degree of immersion has been associated with belief change and may function, in

part, like a form of distraction leaving a person less inclined or less able to devote the mental energy to generating counterarguments.

In contrast, *rhetorical persuasion* is presenting messages that are logical, statistical, or fact-based. These tend to promote counterarguing because they are overt in their intention to persuade (Brock, 1967). Effective messaging under conditions of resistance must carefully plan how they will disrupt counterarguing. Recent advances in neuroscience may offer new opportunities to support this objective.

Neuroscience and Persuasion

Through the use of functional magnetic resonance imaging (fMRI) and over a decade of empirical research, we understand that activity in different areas of the brain can signal certain cognitive processes. One of the benefits of fMRI is that multiple processes can be interrogated simultaneously and the interactions between these processes can be assessed as well. Here, a neurocognitive model for persuasion-induced changes in belief and behavior is presented. As seen in the figure below, each aspect of the persuasion process that we have discussed is represented along with the hypothesized relationships between regions. Arrows connecting boxes illustrate the direction of putative causal effects, with unbroken lines representing facilitation and dashed lines representing inhibition.

The model focuses on four psychological processes that are color coded both in the model (right) and in the brain images highlighting the neuroanatomical systems (left). Successful persuasion, at least as observed in prior studies, has been associated with activity in medial prefrontal cortex (MPFC) and posterior cingulate cortex (PCC), through a process we tentatively characterize as *self-integration* (i.e. increased activity for messages and cues that are successfully integrated with one's self-concept). This network is shown in green in the model. *Counterarguing* in our pilot data was associated with right lateral prefrontal cortex (LPFC) and is shown in orange in the model. *Self-affirmation* in our pilot data was associated with ventral striatum (VS). With more statistical power we also expect to see orbitofrontal cortex (OFC). This system is shown in red in the model. Finally, *Narrative immersion* is hypothesized to rely on mentalizing regions including dorsomedial prefrontal cortex (DMPFC) and tempoparietal junction (TPJ) and is shown in blue in the model.

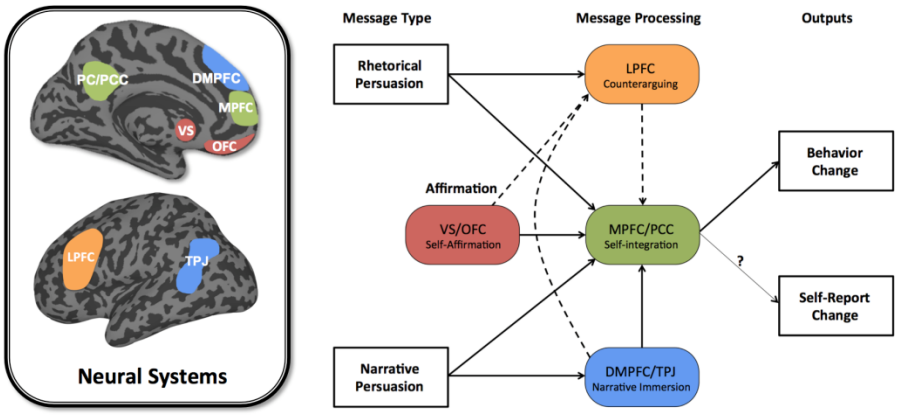

Figure 5. Neurocognitive Persuasion Model (MPFC=medial prefrontal cortex; PC/PCC=posterior cingulate cortex & precuneus; DMPFC=dorsomedial prefrontal cortex; TPJ=tempoparietal junction; LPFC=lateral prefrontal cortex; VS=ventral striatum; OFC=orbital frontal cortex).

Inputs to persuasion are shown on the left side of the model. I hypothesize that Rhetorical persuasion (i.e. persuasion based on logic, facts, and statistics) will induce both attempts at self-integration and counterarguing. Messages that are relatively innocuous and inside one's latitude of acceptance should promote more self-integration and less counterarguing. Messages that are outside of one's latitude of acceptance should promote less self-integration and more counterarguing. In contrast, narrative persuasion should induce both narrative immersion and self-integration. Self-affirmation is also viewed as an input process that moderates the neurocognitive response to the messages themselves. Specifically, to the extent that self- affirmation increases VS/OFC activity, we expect to see decreased counterarguing (both self-reported and as indicated by LPFC activity) and increased self-integration via MPFC/PCC (see preliminary research below).

During message processing, I hypothesize that three processes interact to increase or decrease the resulting changes in belief and behavior. To the extent that counterarguments are generated, self-integration will be diminished. In contrast, to the extent that narrative immersion occurs, self-integration will be facilitated. I also hypothesize that narrative immersion will lead to reduced counterarguing. Counterarguing and narrative immersion will both have their impact on outputs via self-integration, rather than having direct effects. Thus, correlations between counterarguing or narrative immersion and belief and behavior change are mediated by MPFC/PCC activity associated with self-integration (i.e. the successful integration of an idea into one's self-concept). There is evidence that MPFC/PCC activity is related to subsequent behavior change (Falk et al, 2015). The link to self-reported intentions is less clear and will hopefully be examined in future research.

The recent US-based research on neural correlates of influence demonstrates that neuroscience may be significantly more effective than traditional focus groups for understanding behavior change (Lieberman and Falk, 2014; Falk, 2015). In these studies, neural response was better correlated with behavior change than self-reported findings. Figure 2 shows the results of a study where three smoking cessation ads were shown to subjects and their brain activity was measured by a functional magnetic resonance imaging (fMRI) device. The subjects were asked to self-report on the effectiveness of the ads. The ads were aired at different times and the effectiveness of the ads were measured based on the call volume to a hotline to help people quit smoking. The neural response was better correlated with behavior change as measured by call volume to the toll free number at the end of the video after it was aired in Los Angeles.

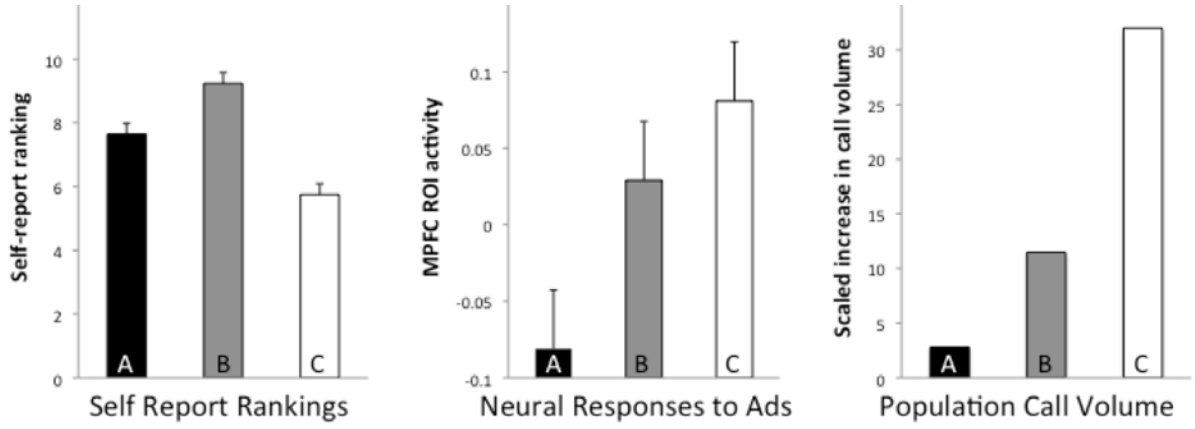

Figure 6. fMRI Results Evaluating Neural Response to Three Smoking Cessation Ads.

The important insight from this research is that current methods for product testing influence campaigns involve focus groups and surveys, which are known to be suboptimal approaches (Lieberman and Falk, 2014; Falk, 2015). Improved methods of product testing influence are required.

Conclusion

This paper provides a brief introduction to cognitive influence and presents a neurocognitive persuasion model. This model has important design considerations for influence messaging. Results from neurocognitive models are more predictive of behavioral outcomes than focus groups or other traditional approaches.

In order to capitalize on this research for military planning efforts, senior leaders and planners must develop basic understanding of influence as outlined in this paper. CMO, MILDEC, MISO, UW, and other military operations must be evaluated in the context of this model. The DoD must invest in useful mixed methods research to collect relevant data to inform influence planning and then use that data to inform data driven operations and not "CONOP by good idea." Military planners must understand influence; understand strategic goals; and develop their polls like any other reconnaissance and surveillance plan. Where is my adversary (ethnographic/in-depth interviews to identify polarizing issues and context)? Where is the location of obstacles (polling to understand latitude of acceptance)? Identify influence avenues of approach and mobility options (cultural domain analysis to understand self-affirming values and narrative analysis to understand culturally known stories that will resonate with and immerse the target audience). Breach the obstacle (design products based on neurocognitive model). Identify the establishment of successful breach lanes (product test concepts, story boards, products using brain imaging). Exploit the breach (deliver products and use polling and social media analysis to assess effect). Consolidate and perform actions on the objective (be prepared with a set of alternatives to the adversary that will allow indigenous populations to have dignity and feel success). Prepare for follow-on operations.

The DoD should fund additional research in neuroscience as applied to influence and radicalization. While neural imaging has been demonstrated to provide an effective means to measure engagement and target audience resonance with messages in recent OSD Minerva effort, this research has not been extended to social media engagement. The DoD needs to understand what aspects of social media capture the attention of target audience members at the cognitive/neurological level. They also need a method to test the effectiveness of media interventions/engagements prior to full development and employment of influence activities. Their solutions must be field portable and demonstrate effectiveness. The miniaturization and availability of functional near infrared spectroscopy (fNIRS) offers an attractive option.

fNIRS is an optical approach that approximates functional Magnetic Resonance Imaging (fMRI) at much lower cost and greater portability. Oxygenated and de-oxygenated tissue absorbs light of different wavelengths. By modulating light at different wavelengths, emitting the light on the skin-exposed areas of the cranium and detecting that light, fNIRS measures the blood oxygenation level dependent (BOLD) signal as does fMRI. fNIRS has recently been used to successfully measure characteristic neural responses to anti-smoking and anti-obesity public health video advertisements in the U.S. under Air Force Office of Scientific Research (AFOSR) funding. This research promises to equip military operators with a cost effective means to design, test, and develop much more effective influence operations to meet current challenges in the Gray Zone.

General Votel stated, "Our ability to operate in the Gray Zone is dependent on our ability to understand the human domain." The "Gray Zone" refers to conflicts, which fall in between peaceful

interstate competition and war. He continued to emphasize the importance of understanding influence in order to meet current and future national security challenges. Russia has already demonstrated the danger of overlooking influence in Eastern Europe. "The role of [cognitive influence] for achieving political and strategic goals has grown, and in many cases, they have exceeded the power of force of weapons in their effectiveness…" (General Valery Gerasimov, Chief of Staff of the Armed Forces of Russia). Recently, the Joint Staff J39 Strategic Multilayer Assessment (SMA) has taken particular interest in neuroscience approaches for understanding influence and the "Gray Zone." This is an important step forward. DoD must now advance fundamental basic research that directly supports this critical national security challenge.

References

Atran, S., Axelrod, R., & Davis, R. (2007). Sacred barriers to conflict resolution. *Science-New York Then Washington-*, *317*(5841), 1039.

Baron, R. S., Baron, P. H., & Miller, N. (1973). The relation between distraction and persuasion. *Psychological Bulletin*, *80*(4), 310.

Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral cortex*, *10*(3), 295-307.

Brock, T. C. (1967). Communication discrepancy and intent to persuade as determinants of counterargument production. *Journal of Experimental Social Psychology*, *3*(3), 296-309.

Cohen, G. L., Sherman, D. K., Bastardi, A., Hsu, L., McGoey, M., & Ross, L. (2007). Bridging the partisan divide: Self-affirmation reduces ideological closed-mindedness and inflexibility in negotiation. *Journal of personality and social psychology*, *93*(3), 415.

Dal Cin, S., Zanna, M. P., & Fong, G. T. (2004). Narrative persuasion and overcoming resistance. *Resistance and persuasion*, 175-191.

Damasio AR (1994) Decartes' error: emotion, reason, and the human brain. New York: Grosset/Putnam.

Department of the Army. (2013). *Field Manual (FM) 3-53*, *Military information support operations*. Washington, DC: U.S. Government Printing Office.

Falk, E.B., Berkman, E., Mann, T. Harrison, B., & Lieberman, M.D. (2010). Predicting persuasion-induced behavior change from the brain. *Journal of Neuroscience*, 30, 8421-8424.

Falk, E. B., O'Donnell, M. B., Tompson, S., Gonzalez, R., Dal Cin, S., Strecher, V., Cummings, K.M., An, L. (2015). Functional brain imaging predicts public health campaign success. *Social Cognitive and Affective Neuroscience*, 11(2), 204-214.

Festinger & Maccoby, 1964; Hovland, Lumsdaine, & Sheffield, 1949

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of personality and social psychology*, *79*(5), 701.

Hovland, C. I., Harvey, O. J., & Sherif, M. (1957). Assimilation and contrast effects in reactions to communication and attitude change. *The Journal of Abnormal and Social Psychology*, *55*(2), 244.

Myers, L. B., & Goodwin, R. (2011). Determinants of adults' intention to vaccinate against pandemic swine flu. *BMC Public Health*, *11*(1), 1.

Slater, M. D., & Rouner, D. (2002). Entertainment—education and elaboration likelihood: Understanding the processing of narrative persuasion. *Communication Theory*, *12*(2), 173-191.

Steele, C. M., & Liu, T. J. (1983). Dissonance processes as self-affirmation. *Journal of personality and social psychology*, *45*(1), 5.

Tetlock, P. E. (2003). Thinking the unthinkable: Sacred values and taboo cognitions. *Trends in cognitive sciences*, *7*(7), 320-324.