Cognitive Hints for Activating Socially Conforming Neural Responses

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ABSTRACT

Since the beginnings of societal frameworks, groups have been a method to spread cultural influence and impart a sense of belonging. As we move through the 21st century, many methods of simulating the benefits of group inclusion have been put forth. There are many technological means to simulate a group environment, from online chat rooms to fully immersive virtual environments. However, from a consumer perspective, many of these models miss the mark in terms of sparking human activity and engagement normally found in a group setting. With the onset and development of electroencephalogram (EEG) research, a unique perspective on brain activity in response and reaction to external events has been provided. Utilizing EEG data, here we will show a stimulus response correlation (SRC) that alludes to a pathway of neural activity in line with cognitive action found in group members. By studying the neural reactions of a wide array of participants, both within and outside of a group setting, this research hypothesizes that the architecture of group thinking can be activated within an individual outside of a group setting and provide insight into the environmental factors that influence group behavior within an individual.

1. INTRODUCTION

Group membership has been an integral part of human survival and evolution. It is thought that, "the human brain evolved in response to a specific set of problems associated with sizes of social groups," or more succinctly, how a group is able to address a given scenario as opposed to the individual (Van Vugt & Schaller, 2008). The dynamics of these social circles influence our individualistic behaviors and thought patterns, as well as lending us the ability to modify our interpretations of and responses to various stimuli in order to align them with the ideals and goals of a group. This feedback modality of influencing the group while also being influenced by the group can be thought of as group think. For the purpose of this research, this modulation of patterns to sync with those of the group will be referred to as "groupthink," which shares the definition put forth by James Brooks and Shinya Yamamoto as "the cognitive process of of forming mental representations at the level of groups, over and above their constituent members," (Brooks & Yamamoto, 2022). Through a combination of the "synergy effect" and "social loafing", it is thought that, "the total productivity of the group is greater than the sum of the productivity of its members," alluding to the idea that the group exists as something in tandem with its members and yet extraneous in its summations (Gençer, 2019). However, group membership not only enables the pursuit of a shared goal, it also reaffirms an individualist identity within each participant as, "dense networks of interaction probably broaden the participants' sense of self," (Putnam, 2012).

In modern parlance, the activation of a neural framework that serves the needs of the group over its own is referred to as social conformity. The conformity is driven by a hard-coded cognitive network that has evolved alongside us in order to retain the inherent group associative property. Differences in age, gender, and sex all come into play with regards to an individual's tolerance for conformity, particularly when it comes to adolescents. A fMRI study on risk taking by Chein et al, "adolescents took significantly more risks when observed by peers than when alone," which may be ascribed to the adolescent brain's development of, "the activity of neural systems underlying cognitive control, incentive processing, or both," (Chein et al., 2010). While risks may serve as a medium of acceptance in adolescence, developed adult brains have adapted to allow for a feedback structure that serves to hedge personal preference against the need for conformity through the means of social influence. fMRI imaging has been able to, "suggest that the orbitofrontal cortex (OFC) is causally involved in central components of social influence on value," allowing us to hone in on a direct spatial area that semantically determines the weights of conforming to group think and retaining individualist thought (Campbell-Meiklejohn et al., 2012). With regards to the idea of social conformity, a replication of the "Asch Study," where a participant was asked to answer a visually based question in the presence of compatriots who unanimously provided incorrect answers, " 62.5% [of participants] conformed to the incorrect answer on one or more trials," (Larsen, 1974). However, as groupthink affects the entire neural architecture, "other regions associated with the evaluation of social value such as the insula, cingulate gyrus, the temporal–parietal junction (TPJ) and medial prefrontal cortex have also been shown to discriminate between in-group and out-group members," (Andrews et al., 2018). In addition, the effects of social influence have manifested, "in the

striatum and ventromedial prefrontal cortex…and are believed to work in concert to encode subjective value," (Stallen & Sanfey, 2015). There is a wealth of knowledge in regards to the spatial locations within the brain that handle the paradigm of groupthink.

Without getting too bogged down in the biological component, there are also a number of neuroimaging studies that support the behavioral aspect of individual responses within a group environment via EEG measurement. In a replication of the "Asch Study" conducted in a virtual group setting, Trautmann-Lengsfeld et al. found component data modeling social influence behavior exhibited as, "a significantly larger P1 response for when they adapted to the correct group opinion compared to when they adapted to the incorrect group opinion," (Trautmann-Lengsfeld & Herrmann, 2013). This breakthrough helps to establish the foundation of distinctive brain activity associated with social conformity and groupthink. Chen et al. discovered that contrary perceptions within an individual "elicited more negative-going medial frontal negativity (MFN), a component associated with processing expectancy violation," and providing yet another segment of the cognitive behavioral pathways that must be traversed when engaging stimulus through the lens of the group paradigm in an experiment that sought to examine individual resolve in the face of opposing group sentiment using EEG/ERP measurement.Again by EEG measurement in a setting that confounded the participants' decisions against the groups, Shestakova et al. utilized a two-way ANOVA model to show, "an interaction of conflict (large/small) × electrode, $F(18,252) = 2.18$, G–G adjusted $P = 0.108$," supported by EEG data that showed conflict produced a neural response in the frontal region (Shestakova et al., 2012).

While numerous studies have been put forth to define the magnetism that draws people together in groups, they focus on the real-time reactionary mechanisms social confluence imparts upon the brain. The aim of this research is to distinguish which elements are capable of triggering this cognitive shift from that of the individual to one that aligns with group think. The question is, if groups consist of two or more people, how can we remove the human element to allow for group identification within an individual without the group, allowing cognitive perception to pass through the multitude of secondary neural activations?In defining the underlying cues that can modulate individualistic brain patterns, further research may be able to unlock and utilize the key factors that determine one's identification with and allegiance to a group and work forward to align these patterns with favorable outcomes.

2. METHODS

2.1 Consideration

Minimizing ideals that are universally spread across all human groupings, this research will utilize laughter through a naturalistic medium to impart a point of focus that can generate a shared belief as the basis of a group. In order to decode the implications of group belonging within the individual, this research aims to present the shared belief in laughter as an auditory measure that serves as a, "cue[s] enabling group recognition," while also driving conformity towards group think (Brooks & Yamamoto, 2022).

2.2 Stimulus

To bring about a naturalistic response, a video segment highlighting human behavior will be used. Candid moments that allude to humorous situations are the main focus of the video given that, "laughter is a frequently occurring and socially potent nonverbal vocalization, which is frequently used to signal affiliation, reward, or cooperative intent, and often helps to maintain and strengthen social bonds" (Kamiloğlu et al., 2021). This video is inspired by the "If you laugh you lose" compilation series featured on YouTube. These videos range in length from 10 - 30 minutes, with a number of 5 - 20 second featurettes, each of which showcases a "funny" situation. Consideration is given to these videos as they originate from the social media platform Vine. This platform is geared toward a younger audience with a shorter attention span. In order to be more inclusive of a wider population and to suit the intentions of this research, there may be a need to generate a unique compilation that features shorts of varying time lengths (5 - 90 seconds) which provides a dynamic overview that should hint at the multiple humor and content preferences of the audience at large.

2.3 Participants

Groups are able to materialize through a milieu of social, cultural, and economic factors in support of a variety of collective goals. To this end, this research aims to cover a broad population base in both its control groups and the test participant population. Candidacy is prioritized for males and females aged 18 to 45. With consideration for differences in cultural values and inherent notions of humor, participants will be screened to identify those who are native to the United States or immigrated here at a young age. On the basis of cultural norms, this is done to ensure comprehension of the comedic situations presented in the video and forgo any social misunderstandings.

The first control group will consist of a population of 30 - 40 viewing the video together in a group setting. Each viewing will consist of an audience composed of a portion of the total population. This audience will be primed for response to the video by being told beforehand that they are to view a "funny video." A short time will be allotted for this group to

co-mingle and build a level of familiarization with each other to further build the foundation of the group. The key piece of information provided by this group will be the recording of the audience's auditory response to the stimulus. This "laugh track" will serve our test group as the simulated group dynamic. Within the audience, one participant will be chosen at random and fitted with EEG capture equipment. Their provided data will again serve the test group as a comparative baseline of responses to the stimulus within a group dynamic. Following the viewing, informal surveys will be provided to each audience member, asking for two subjective responses: first, a rating of funniness based on a 1-10 scale, and second, a personal opinion of the funniest vignette within the compilation. This survey provides a gauge as to the ability of the audio of the audience to induce a group mindset as well as hone in on specific time stamps for future evaluation. Overall, from this control group, we will be able to establish 3 "laugh tracks" and 3 baseline EEG models.

The second control group consists of 5 - 10 participants, each of whom will view the stimulus in a solo setting. The methodology behind this group is to gather individual baseline data free from group influence. EEG data will be collected from each participant while viewing the stimulus. In addition, while this group is small, it may serve to develop an inter-subject correlation (ISC) model that can inform the research of segments within the stimulus that evoke the greatest response within a participant.

The final test group is where the previously collected data and hypothesis behind the cognitive effects of a group will be put into action. Here 10 participants will again view the original stimulus in a solo environment. In order to induce a simulated group environment, participants will watch the video compilation, which will be modulated by an overlay of the audience reaction audio. Again, we will prime the participants based on the surveys collected from the audience group, namely how funny the video is perceived to be and which segment is considered the funniest. This will create an anticipatory state within the participant not only for the visual but, more importantly, for the group audio. Lastly an exit survey will be given to each participant of the test group. The survey will be based upon a domain-specific risk-attitude scale (DOSPERT) as proposed by Webber et. al. Whereas "perceived-risk attitude refers to the positive or negative weight assigned to the perceived riskiness of the option", we will inversely extrapolate the intentions of this scale along the lines of our own paradigm, where a risk averse attitude indicates behavioral tendencies that lean towards conformity (Weber et al., 2002).

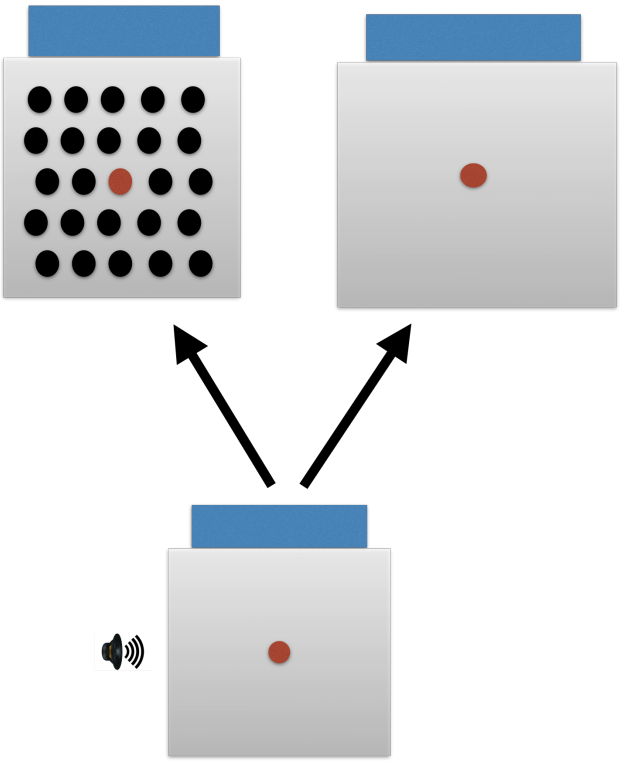

Figure 1. A model dictating the the audience control group (upper left), the solo control group (upper right) and the test group (lower)

3. Analysis

The EEG data provided by the two test groups should meet a time-resolved criterion during analysis. We are most interested in the event related potentials (ERPs) of the "punch line" moments, and will work to encode a mathematical weight to emphasize the data recorded during these segments. While control group one only provides a partial view of the audience, the solo control group provides several EEG data sets that can be used for other purposes. In the analysis of the most intense RCA, we should find a trend that lends itself to brain activity indicative of a visual stimulus response. With the RCAs, we should be able to develop an inter-subject correlation (ISC) model dependent on time-locked responses, which will serve as a comparative tool in analysis of the test group dataset.

To emphasize the hypothesis that a group paradigm of neural responses is possible without a group, the key piece of data we look to build upon is the regional cognitive activity of the test group: does the test group's neural activity relay that the visual stimulus (individual) or audio modulation (group) as the driving factor?

First a comparative analysis can be made between the test group and the solo control group, both in RCA identification and ISC comparison. By comparing each test participant against the control group ISC, there will be While there are lessons to be learned here, this only answers half our question. Variance in both the most

prominent RCA and ISC comparisons is sure to allude to individual differences.

Given that we establish a framework in which prominent neural activity in the occipital region is indicative of a more individualistic response to the stimulus, while frontal activation alludes to an anticipatory state of the audience's audio response, signaling a cognitive framework in line with group think, there exists the need to discriminate between the two components. To accomplish this, the analysis framework will closely mimic Dmochiski et al. in extracting multidimensional stimulus-response correlations (SRC). Firstly, by extracting significant features from both the video and audio stimuli, we can encode applicable weights to each. Secondly, we can decode EEG data based on spatial activation. The intersection of these two pieces of information should provide an SRC value that "correlates spatial response components with temporal stimulus components," allowing us to establish a determination in line with the proposed hypothesis (Dmochowski et al., 2018). Furthermore, ANOVA analysis should allow for the separation of mean magnitudes for the visual and auditory components, indicating a preference for an anticipatory state of social influence or pure stimuli engagement.

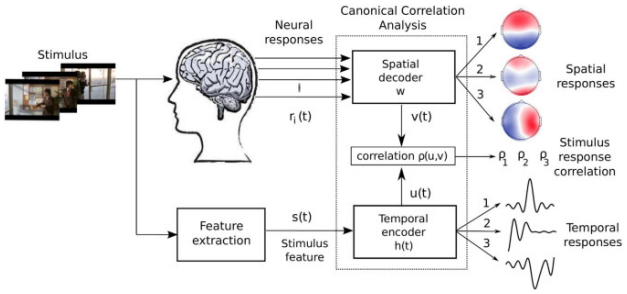

Figure 2. Dmochowski et al. (2018) illustrate the method of stimulus feature encoding and spatial response decoding to arrive at a Stimulus response correlation value.

4. Expected Results

Our hypothesis is based upon the notion that a model of group influenced neural responses can be evoked within an individual via a simulated element of group participation, which for the purpose of this research is based upon auditory feedback.

It is expected that during the peak moments of activity during the video stimulus, the "punch line" moments, there will be higher levels of brain activity across all participant groups caused by an underlying increase of engagement with the media. In addition, it is to be expected that there will be a variance in components and their strengths between the audience and solo control groups.

The result that will serve to best reinforce the hypothesis is the determination of SRC components between the video and audio for the control group. Test group participants are expected to return higher RCA values in comparison to the solo test group's ISC valuation. This research expects that during the "punchline" moments, auditory spatial components will overshadow visual ones, indicating a paradigm of cognitive activity based upon inherent social influence and conformity.

5. Discussion

Should this research provide results that support the hypothesis, it can be said that the testing here has created a model of simulated behavioral conformity that drives group neural patterns in an individual. Higher responses experienced due to the group narrative drive home an inherent need for belonging and patterns of brain activity along the lines of a shared group idea (the video stimulus is funny). The human need to conform to the group archetype modulates interpretation and responses to external stimuli in order to more readily align with group sentiment, even if the group is an artificial construct.

If results confirm the null hypothesis, then it can be surmised that environmental components that simulate group participation are not enough to evoke group thought within an individual. There remains an uncaptured human element of interaction within a group setting that drives cognitive interpretation and responses. While it may be possible to replicate this human element, it is not something conveyed via auditory feedback. Further research may need to be carried out through differentiating mediums in order to garner insight into a definitive factor causing cognitive conformity.

6. Further Development

If this study is successful in proving the hypothesis, it will reveal the categorization of the ability to influence group pattern behavior within the individual. Needless to say, the opportunity to impart a group ideology to a broad population, at least through thought patterns, will open new possibilities in terms of providing for the basic human need to belong. Future research could build upon this idea in studying other emotional bases such as anger or sadness. Being able to modulate an individual's thought pattern will provide flexibility to the psychological field and may aid in addressing behavioral disabilities. Furthermore, this research may provide insight into the cognitive responses associated with the breadth of psychological research associated with group behavior and empower future research endeavors along those lines. This research may help generate methods that serve to relieve the symptoms of trauma victims by creating a simulated state of familiarity that provides empathy and comfort to the victim by simulating a group ideal that drives an individual to conform to and align with.

7. Conclusion

With the deep pool of knowledge that links neurological phenomena with the underlying psychological patterns of group behavior, a key missing link is to understand exactly what situations, circumstances, environments and

stimuli trigger these behaviors. The EEG data compiled into Stimulus-related correlation values, this research aims to develop an insight into the underpinning cognitive facets of group conformity within a social paradigm.

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