

Original Paper

Reforming Sectarian Beliefs in Iraq: Winning the Peace

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Received: November 30, 2020 Accepted: December 14, 2020 Online Published: January 25, 2021

doi:10.22158/csm.v4n1p8

URL: <http://dx.doi.org/10.22158/csm.v4n1p8>

Abstract

Sectarian violence continues in Iraq affecting regional and world security. Neuroscience techniques are used to assess the mentalizing process and counter-arguing in response to videos designed to prevent extremist radicalization. Measurement of neural activity in brain Regions of Interest (ROI) assists identification of messages which can promote favorable behavior. Activation of the Medial Prefrontal Cortex (MPFC) is associated with message adoption and behavior change. Public Service Announcements (PSAs) have not been effective in reducing violence in Iraq. This study demonstrates that the four PSAs investigated in this study do not activate the MPFC. The RLPFC is a brain ROI associated with counter-arguing and message resistance. This study demonstrates that reduction in activity in the Right Lateral Prefrontal Cortex (RLPFC) is associated with decreased sectarianism. Engagement was measured and is associated with activity in the frontal pole regions.

We introduce Functional Near-infrared Spectroscopy (fNIRS) to measure the neural activity of highly sectarian Iraqis in response to these anti-sectarian messages. Neural activity was measured while viewing three PSAs and a fourth unpublished video. All four videos are intended to reduce sectarianism. A novel sectarianism scale is introduced to measure sectarian beliefs before and after the messages. This sectarian scale has high internal consistency as measured by Cronbach's alpha. Measured activation of brain ROIs are correlated with changes in the sectarian scale.

Twelve Sunni and twelve Shi'a Iraqis participated in the study. Subjects were shown the four videos in randomized order, while equipped with a fNIRS neural imaging device. All four videos produced significant engagement. None of the videos reduced sectarianism nor caused brain activation of

adoption. This is consistent with the widely held Iraqi public perception that the PSAs are ineffective. Only one video, which was un-published, caused reduced sectarian beliefs. This un-published fourth video was associated with decreased counter-arguing. Counter-arguing is associated with message resistance.

Keywords

counter-arguing, fNIRS, functional near infrared spectroscopy, influence, mentalize, message adoption, public service announcement, region of interest, resistance, sectarian

1. Introduction: Historical Background

Iraq is located in the cradle of civilization between the Tigris and Euphrates River. Successive empires invaded and controlled Iraq, including Sumeria, Babylonia, Assyria, Greece, Rome, the Mongols, and the Ottoman Turks. Baghdad was a center of culture, learning, and commerce for Islam in the Middle Ages until the Mongol invasion in 1258.

Iraq became a British mandate after the first World War, followed by an independent monarchy. This monarchy was followed by decades of violent upheaval, then Ba'ath Party control in 1968.

Most Iraqis are Muslim. There is sectarian conflict between Sunni and Shi'a Arabs, who both speak Arabic, and Kurds, who speak Kurdish. Iraq has been described as an "artificial" nation, comprised of geographically clustered sectarian strongholds. In World War I the Ottoman Empire sided with Germany, threatening British access to oil and other interests. Britain invaded Basra, then the rest of Iraq. After World War I, Britain created Iraq. The British mandate in Iraq involuntarily united diverse groups who were not cohesive and who had significant ties to outside entities. Iraq was held together by the overwhelming, brutal dictator, Saddam Hussein, his family, and Sunni Ba'ath Party.

Osama bin Laden founded the Sunni organization Al-Qeada. bin Laden led the Al-Qeada attack on the United States in 2001. In 2003, the United States attacked and occupied Iraq. After the United States invaded Iraq in 2003, the Coalition Provisional Authority disbanded the Iraqi Army and removed Ba'ath Party members from power. The failure to impose law and order allowed civil unrest and sectarian violence. Weakened states with unresolved ethnic and sectarian conflicts can become lawless, ungovernable, and havens for terrorists (Kirmanc, 2013), (Haddad, 2011). This fueled the uprising of Islamic State of Iraq and the Levant (ISIL). ISIL is also known as the Islamic State in Iraq and Syria (ISIS). In 2014, ISIS occupied substantial territory in Syria and Iraq. Civil conflict in Iraq persists. ISIS continues to be a potent terrorist threat. ISIS has been known to use social media to recruit supporters from throughout the world, including the United States and Great Britain. ISIS remains a worldwide threat in spite of territorial losses in Iraq (Haddad, 2011). Iran supports Shi'a militia insurgents in opposition to United States forces and policies. In 2004, the Iraqi occupation government launched anti-terror media campaigns. "Terror has no Religion" sought to counter Sunni-inspired Al-Qeada.

“Say No to Terror” followed. 350 videos and 60% of YouTube commentators responded negatively to “Say No to Terror”. Concerns were expressed regarding the format, agenda, and cultural and political barriers (al-Rawi, 2013). Former United States Chairman of the Joints Chiefs of Staff General Joseph Francis Dunford Jr. held a conference of Allied Defense Chiefs in 2018. Military progress has been made against violent extremism in Iraq. “The military can deal with the symptoms of terrorism, but it cannot solve the root cause (Dunford)”. General Dunford clarifies the need to “describe the nature of the challenges...in context...and craft more comprehensive solutions to deal with violent extremism (Dunford)”. The conference acknowledged concern that military interventions promote recruitment to terror groups (Garamone, 2018).

2. Neuroscience of Persuasion

Activation observed within certain brain regions of interest (ROI) can be predictive of future behaviors. Asymmetric activation, left greater than right, of ROI's in the frontal lobe poles indicates engagement. Activation of the ROI in the Medial Prefrontal Cortex (MPFC) indicates adoption of new behavior (Falk, 2010*), (Burns, 2018). Activation of the MPFC predicts behavior better than the self-reported intentions of subjects (Falk, 2010**). Activation of the ROI in the Right Lateral Prefrontal Cortex (RLPFC) indicates counter-arguing (Burns, 2018), (Schmidt, 2018). Counter-arguing is argument in opposition to a stated position. Counter-arguing is analogous to message resistance. The RLPFC communicates with and counter-balances the MPFC in normative, decision-making. This communication occurs below the level of consciousness. Messages selected on the basis of brain activity in focus groups can be generalized to whole populations (Falk, 2012), (Falk, 2013). This study measures brain activity by functional near infrared spectroscopy (fNIRS) (Ferrari, 2012). The prefrontal cortex recruits and organizes input and activity of large brain networks. Activation of the Medial Prefrontal Cortex (MPFC) indicates shifts in brain networks. Cooper reports shifts in brain networks predict behavior (Cooper, 2018). When a person changes one's mind that person is switching brain networks. The MPFC is a switch that shifts networks based on disparate input including stored memory, emotion, and active sensory input. The switching process occurs below conscious awareness. We are all subject to subconscious social influences. Social influences, including electronic media, can affect decision-making. Normal people can be prosyletized and radicalized.

3. Methods

Participants: Participants consisted of 24 male adults of Iraqi citizenship and ethnicity, planning to vote in the 2018 Iraqi election, and residing in Amman, Jordan (age $M = 23.52$ years, $SD = 3.07$). All were Arabic speakers and provided informed consent in Arabic to participate in this study. All participants were paid for their participation. Johns Hopkins University Institutional Review Board approved the

study. Of the 24 participants, 12 were Sunni Muslim and 12 were Shi'a Muslim. All subjects were assessed to hold high sectarian bias using the sectarianism scale described below. Participants were recruited by phone to participate in a video marketing study. The authors obtained permission to use the data for secondary analysis for the purpose of this paper. Sample size was determined based on the maximum number of participants that could conduct the study, given limited time, facilities, and resources. A priori power analysis using effect sizes in previous social neuroscience work with type I error of 5 percent and 80 percent power suggests a sample size of 14 participants.

4. Materials

Neural measurements were conducted with a NIRSport imaging unit, which is a Functional Near-infrared Spectroscopy (fNIRS) device manufactured by NIRx (nirx.net/nirsport). This device was selected because of its small size, portability, and greater ecological validity than other neural imaging alternatives. The NIRSport unit has eight light sources and eight light detectors configured to measure the prefrontal cortex over 23 channels of data. One drawback of the NIRSport is limited spatial coverage and the inability to measure activity in deep brain structures. Measurements include the medial prefrontal cortex, frontal poles, dorsal and lateral prefrontal cortex. These regions in the outer cortex and are several centimeters in size, within the measurement resolution of fNIRS of 1-3 cm. Four headcaps of different sizes were used to affix the light sources and detectors to participants. Spatial positioning was standardized using the 10-10 UI external positioning system. Light intensity was emitted at 760 nm and 850nm wavelengths with a 7.81Hz sampling rate. Four video commercials intended to reduce viewer sectarianism using different persuasion tactics were used a stimulus in this study.

Video One, labelled "Chess", is an animated chess game. Opposing pieces represent Al-Qaeda and Shi'a militia. The animated chess pieces from opposing sides fight each other with graphic violence. The video ends with the two militia leaders (Kings) walking off the board together. This video suggests participants in sectarian violence are being used as pawns in a chess game. This is meant to be a shocking and provocative appeal, motivating viewers to challenge their sectarian beliefs and seek more information. Video Two, labelled "Nice", shows two elementary school boys as friends. The boys pray together. Time is forwarded to show the friends grown as adults. It becomes apparent that one friend is Sunni and the other is Shi'a. This demonstrates the similarity between Sunni and Shi'a sects. This is intended as a positively framed message encouraging sectarian unity. Video Three, labelled "Grad", shows the graduation of a group of students. A young female graduate and her proud mother are portrayed. Then there is an explosion. The video switches to the graduate's mother crying over her deceased daughter. The video narrates "ISIL destroys families". This is meant as a shocking and provocative appeal. Video Four, labelled "Basheer", is a monologue by popular Iraqi comedian Ahmad

Al-Basheer. Basheer argues at length that Iraq should disband Shi'a militias and avoid sectarianism. This is meant to be a somber and conciliatory appeal, focusing on similarities and Iraqi national identity over sectarian identities.

5. Procedure

Prior to viewing any videos, all participants completed a survey measuring their level of sectarianism, defined as a bias toward their own sect, Sunni or Shi'a Islam, and a prejudice toward other sects. The survey consisted of eight questions, rated on a scale ranging from 0 (strongly disagree) to 10 (strongly agree). The eight questions consisted of the following: 1) I would not mind if a qualified [Sunni/Shi'a] was appointed as my boss; 2) I have often felt admiration for [Sunni/Shi'a]s living here; 3) Most politicians care too much about [Sunni/Shi'a] and not enough about the average Iraqi; 4) I would never marry a [Sunni/Shi'a]; 5) Sunnis and Shi'as are different in the way they practice Islam; 6) [Sunni/Shi'a] are different in the values they teach their children; 7) Sunnis and Shi'a are different in regards to their honesty/trustworthiness; 8) Sunnis and Shi'a can never be really comfortable with each other, even if they are close friends. Note that the [Sunni/Shia] in the above scale indicated the other sect, that was not the sect of the participant. Some of the items were reverse coded. The items were averaged to create a composite scale ranging from 0 to 10. Following the pre-video sectarian beliefs survey, participants watched the four anti-sectarian videos. Participants viewed baseline content for 30 seconds, consisting of a blank screen in a dark, quiet room. Following each video, the participant would view a blank screen again for 30 seconds. There were 24 different permutations of video ordering. Participants were randomly assigned to a permutation, constrained such that for all 6 permutations beginning with a given video, half would be viewed by a Sunni and half would be viewed by a Shi'a. Immediately following each video, participants were asked to self-report on level of identification, response efficacy, and perceived effectiveness. This was done using a single item, 5-point Likert scale. Two weeks following initial data collection, the same eight-question sectarianism survey was re-administered to assess change in sectarianism following video intervention.

6. Neural Data Processing

fNIRS data was pre-processed using NIRXLab. Event markers captured the beginning and end of each video and baseline period. The length of each video is known, so reliable start/stop times for each baseline and video stimuli are recorded. Discontinuities in neural signals were removed. Several of the relevant channels were over-saturated. Four of these were repaired by interpolating over no more than 15 frames (approximately 2 seconds). The others were discarded from analysis. This resulted in the exclusion of 2 participant's data, leaving usable data for 22 participants. Band pass filtering was applied to all signals with a low cutoff frequency of 0.01 Hz and a high cutoff frequency of 0.2 Hz.

This effectively removed biometric noise in the neural signal data. A Principal Component Analysis (PCA) algorithm was used to identify and remove motion artifacts from the data. Light intensity was converted into a percentage change in oxygenated hemoglobin concentration relative to baseline using the modified Beer-Lambert law. The first and last 7 seconds of each video stimulus was truncated to account for delayed response due to the participant's hemodynamic response function. Data for each channel were exported to a text file for statistical analysis using R. R is a free, popular, and open source statistical computing and graphics language and environment. Since fNIRS measures a relative frequency, an absolute activity measure was estimated by scaling the neural signal for each frontal pole between zero and one by subtracting the minimum value from the beginning of the baseline period through video completion, then dividing by the range in maximum to minimum over the same time period. For each frame (data point) the left value was divided by the right value and this value was then divided by the sum of the two values. The log of the resulting value was used for calculations.

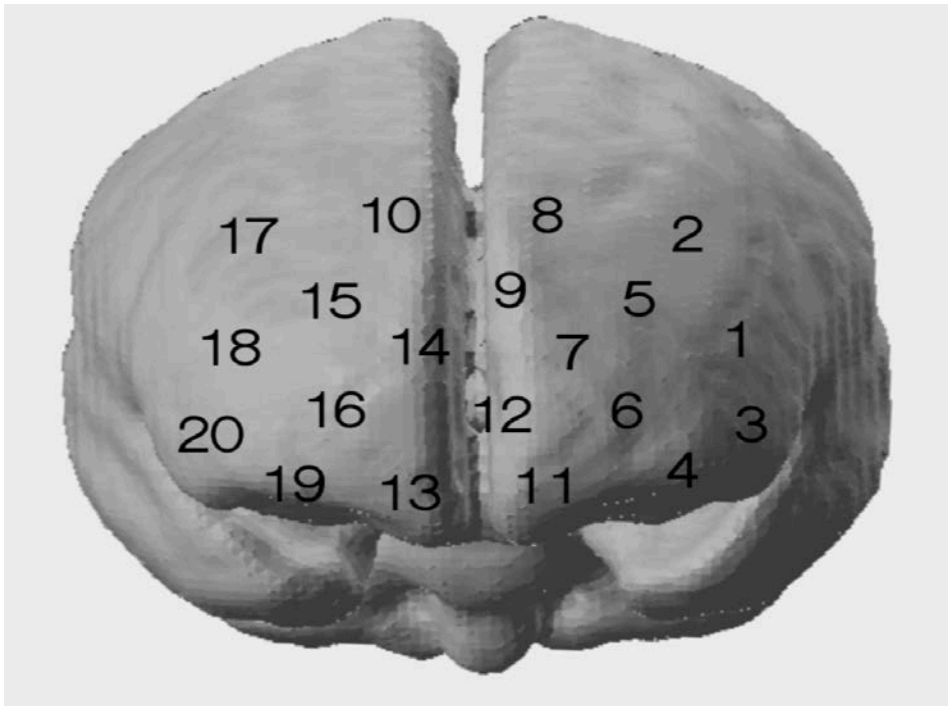


Figure 1. fNIRS Channels Measuring A Priori Brain Regions of Interest

We focus measurement in three key brain regions of interest. The level of engagement or disgust toward video content was estimated by asymmetry in the frontal poles. People with greater left than right activity experience engagement with stimuli, while people with greater right than left frontal pole activity experience disgust. We use the formula $(L/R)/(L+R)$, where L and R refers to the brain activity in neural channels 11 and 13 respectively as indicated in Figure 1. Message adoption was estimated by

activity in the medial prefrontal cortex observed in channel 12. Counter-arguing toward stimulus was estimated by activity in the right lateral prefrontal cortex observed in channel 18.

Four research questions are investigated in this experiment:

R1: Are the videos cognitively engaging? We hypothesize that all four videos will cause cognitive engagement in participants as observed by a significant increase in left greater than right frontal pole activation (Channels 11 and 13) during the video compared to the blank screen viewed immediately prior.

R2: Do the videos increase adoption of the message? We hypothesize that the published videos will not increase adoption. Increased adoption will result in decreased sectarianism. Lack of adoption will not reduce sectarianism. Adoption is shown by activity in the medial prefrontal cortex (channel 12).

R3: Do the shocking, provocative videos affect counter-arguing? We hypothesize that the provocative videos, Video 1, the Chess video, and Video 3, the Grad video, will exhibit higher levels of counter-arguing. The un-provocative, pleasant videos, Video 2, the Nice video, and Video 4, the Basheer video, will not exhibit counter-arguing. Counter-arguing is shown by activity in the right lateral prefrontal cortex (Channel 18).

R4: Does decreased counter-arguing (Channel 18) increase message integration and adoption (Channel 12)? We hypothesize that videos with high cognitive engagement and low counter-arguing will exhibit higher activity in the medial prefrontal cortex.

Behavior is not limited to individual regions of interest, but is more reflected in changes in larger circuits. Overall, a pattern of increased engagement, decreased counter-arguing, and increased adoption will likely correlate with decreased sectarianism. The decrease in sectarianism will be measured between the pre-video survey and the two week post-video survey. All statistical tests will apply the student T-test to compare the block average of neural signals while participants viewed stimulus material against those while they viewed blank screens prior to stimulus. The t-test will be corrected for heteroskedasticity.

7. Results: Summary of Key Findings

Reduced sectarianism is the intended effect of all four videos in this study. The sectarian survey has high Cronbach's alpha equalling 0.78, indicating high internal consistency. There is no observed difference in sectarian score between Sunni and Shi'a. All four videos were engaging (Table 1). There was no effect of engagement on sectarianism (Table 2). None of the videos shows increased neural activity associated with adoption of new behavior (Table 3). Video 2 shows decreased neural activity association with adoption (Table 4). None of the videos show an effect of adoption on sectarianism (Table 5). None of the videos show increased neural activity associated with counter-arguing (Table 6). Videos 2 and 4 show decreased neural activity associated with counter-arguing (Table 7). Only video 4,

the Basheer video, showed decreased sectarianism. None of the published videos, Videos 1, 2, and 3, had any effect in reducing sectarianism. This confirms Iraqi public opinion that public service announcements against sectarian violence are not effective. Video 4, the Basheer video, has not been published. The Basheer video shows decreased sectarianism as a function of decreased counter-arguing (Table 8). We believe this indicates decreased resistance to the message.

8. Findings

Asymmetric activation of the frontal poles, left greater than right, measured in Channels 11 and 13, indicates engagement. All four videos show significant increase in engagement according to two-sample t-tests comparing baseline and stimulus block-average:

Table 1. Increased Engagement

Video	p-value
Chess	0.0007
Nice	0.0010
Grad	0.0170
Basheer	0.0009

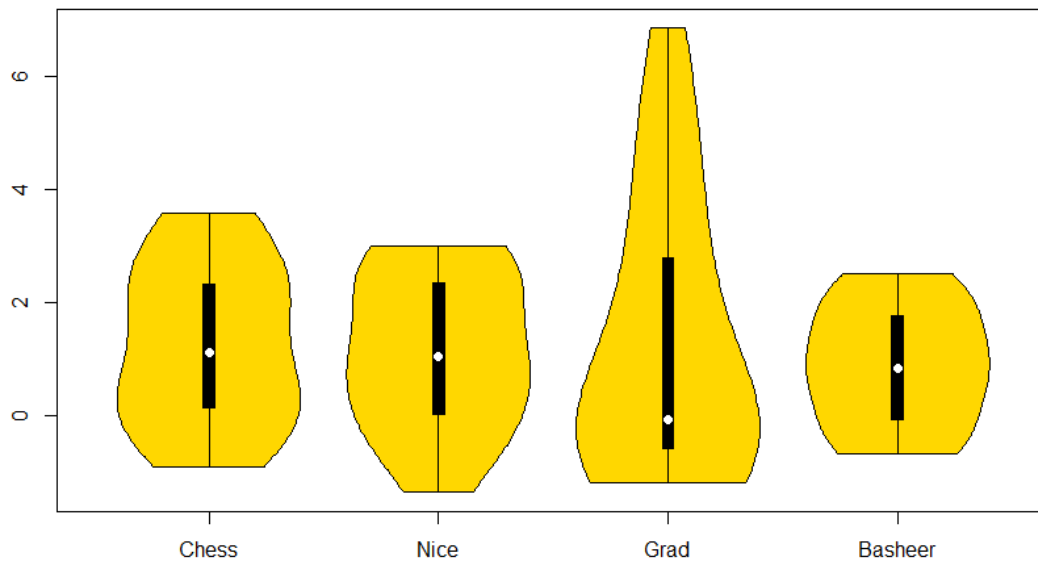


Figure 2. Engagement Measured in Channels 11 and 13

There is no significant effect of engagement on sectarianism in a regression model:

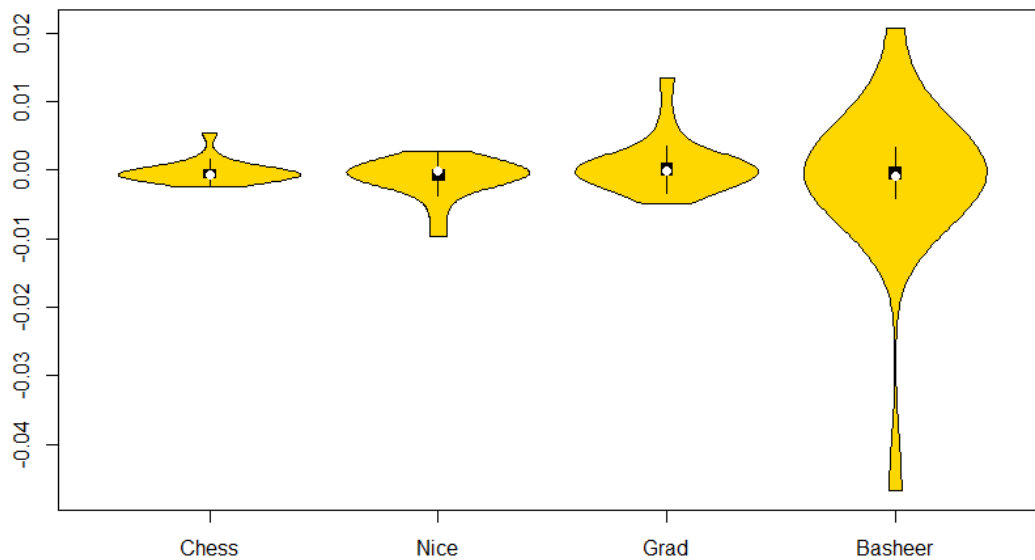
Table 2. Effect of Engagement on Sectarianism

Video	p-value	R-Squared
Chess	0.1486	0.12
Nice	0.4152	0.04
Grad	0.9213	0.00
Basheer	0.3555	0.05

Activation of the medial prefrontal cortex, measured in Channel 12, indicates adoption of new behavior. None of the four videos shows increased adoption:

Table 3. Increased Adoption

Video	p-value
Chess	0.675
Nice	0.9368
Grad	0.2251
Basheer	0.7183

**Figure 3. Adoption Measured in Channel 12**

Video 2, the Nice video, shows decreased adoption:

Table 4. Decreased Adoption

Video	p-value
Chess	0.325
Nice	0.0632
Grad	0.7749
Basheer	0.2817

There is no effect of adoption on sectarianism in a regression model:

Table 5. Effect of Adoption on Sectarianism

Video	p-value	R-Squared
Chess	0.3985	0.05
Nice	0.5353	0.03
Grad	0.9118	0.00
Basheer	0.7791	0.00

Activation of the right lateral prefrontal cortex, measured in Channel 18, indicates counter-arguing. None of the videos showed increased counter-arguing (Figure 4) in a one-tailed, two sample T-test:

Table 6. Increased Counter-arguing

Video	p-value
Chess	0.4917
Nice	0.9664
Grad	0.7636
Bashir	0.9799

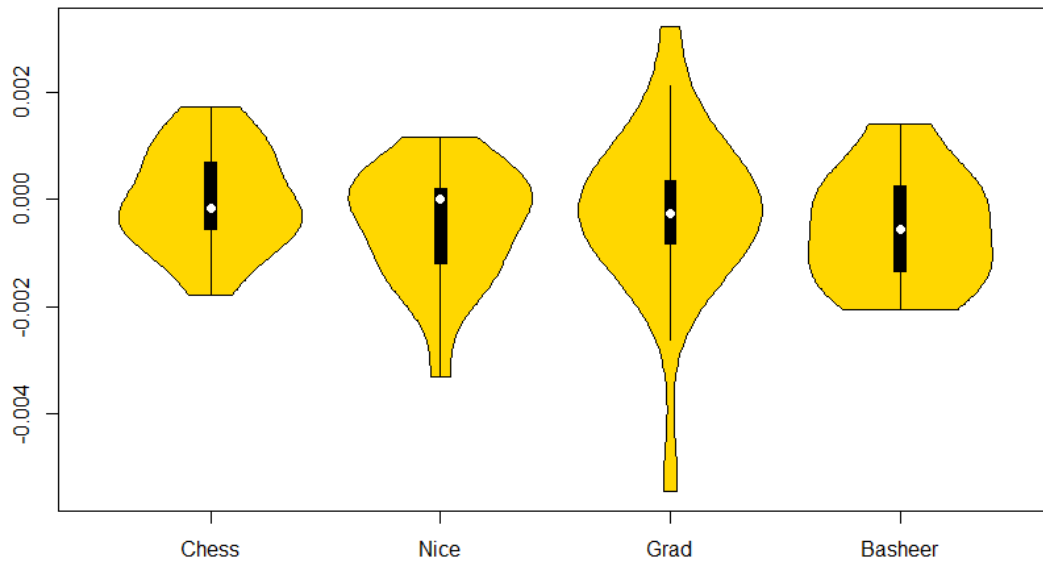


Figure 4. Counter-Arguing Measured in Channel 18

Video 2, the Nice video, and Video 4, the Basheer video, shows decreased counter-arguing in a one-tailed, two-sample T-test comparing baseline and stimulus block-averages:

Table 7. Decreased Counter-arguing

Video	p-value
Chess	0.5083
Nice	0.0335
Grad	0.2364
Basheer	0.0201

Video 4, the Basheer video, shows decreased sectarianism as a function of counter-arguing in a regression model:

Table 8. Effect of Counter-arguing on Sectarianism

Video	p-value	R-Squared
Chess	0.4176	0.04
Nice	0.7784	0.00
Grad	0.4225	0.04
Basheer	0.0112	0.32

The Basheer video was not a published public service announcement. The Basheer video is the only video to demonstrate the effect of decreased sectarianism. This video is longer and allows the audience to identify with the speaker, a popular comedian and cultural icon, through evocative rhetoric.

One individual scored a statistically significant increase in sectarianism, greater than two standard deviations above the mean. This was a twenty year old Sunni with a bachelor's degree, with no known unusual characteristics compared to the rest of the population.

9. Discussion: The Results Are Significant

These findings confirm the impression that public service announcements are not effective in reducing sectarian violence. The findings are original. The Iraqi, Arab populations, Sunni and Sh'ia, have not been previously studied. Iraqi culture is not well understood by neuroscientists from Western, industrialized countries. These findings are relevant for local, regional, and world security. We evaluate the mental processes of engagement, adoption of new behavior, and decreased message resistance as a function of brain regions of interest. Adoption of new behaviors has been demonstrated to relate to activation of the medial prefrontal cortex. A favorable profile of neural activity supporting behavior change might include high engagement (left greater than right frontal pole), increased adoption (medial prefrontal cortex), and decreased counter-arguing (right lateral prefrontal cortex) relating to decreased message resistance. The Basheer video most closely fits this profile. The Basheer video is engaging and has decreased message resistance relative to message adoption. The Basheer video is the only video which reduces sectarianism.

All videos were engaging, none of the videos increased adoption, nor decreased sectarianism as a direct function of adoption. The provocative videos, video 1, the Chess video, and video 3, the Grad video, did not affect adoption or counter-arguing. Of the pleasant videos, the Nice video decreased adoption and counter-arguing, and the Basheer video decreased counter-arguing, but not adoption. The Nice video did not decrease sectarianism. The Basheer video decreased sectarianism. Each video has distinct features: Video 1, the Chess video, is violent, provocative, and engaging. The Chess video does not increase adoption or counter-arguing, nor does it decrease sectarianism. Video 2, the Nice video, is pleasant in tone, and engaging. The Nice video decreases adoption and counter-arguing, but does not decrease sectarianism. Video 3, the Grad video, depicts violence and is provocative, and engaging. The Grad video does not increase adoption or counter-arguing, nor does it decrease sectarianism. Video 4, the Basheer video is pleasant in tone, and engaging. The Basheer video does not decrease adoption but does decrease counter-arguing and sectarianism. The Basheer video decreases sectarianism as a function of counter-arguing, not adoption (Tables 5, 7). The results of the unpublished Basheer video suggest a relationship between reduction of counter-arguing in the right lateral prefrontal cortex (RLPFC) and reduction of sectarian beliefs:

Function of the RLPFC is complex and incompletely understood. Hutcherson describes the interplay between the ventromedial prefrontal cortex and dorsolateral prefrontal cortex in cognitive regulation generating decision-making (Hutcherson, 2012). The ventromedial and lateral prefrontal cortices cross-talk, arguing and counter-arguing back and forth, counter-balancing each other, resulting in normative processing below the level of consciousness. Anatomic differences in these regions affect cognitive processing (Schmidt, 2018). Attitudes and actions regarding sectarianism are a behavioral state. Transformative processes and influences affecting behaviors include engagement, identification, emotion, narrative immersion, reviewing previous experience, internal dialogue, inoculation, and resolving cognitive dissonance. Cognitive dissonance results from conflicting information, beliefs, or feelings, causing discomfort. Individuals tend to resolve the conflict by various mechanisms to achieve consistency to resolve discomfort (Festinger, 1957). Inoculation involves reinforcing previously held beliefs (Banas, 2010). Inoculation helps protect an individual against un-wanted change. The majority of Iraqis already reject violence and terrorism, and tend to view sectarianism as a recent, externally incited phenomenon, caused by the American invasion. The Basheer video is different from the published videos. Basheer is a popular comedian who addresses the audiences directly in a personal manner. The Basheer video is longer than the published videos. Iraqis identify with Basheer who is popular. Affirmation of core values increases the effectiveness of a message (Falk, 2015). Kaplan reports challenges to establish political beliefs can increase activity in the default mode network. The default network mode is associated with self-representation and disengagement from external reality (Kaplan, 2016). The audience relates to Basheer whose message reinforces negative perceptions of violence and terror. Inoculation of established beliefs against sectarian violence could explain the decrease in sectarianism seen in the Basheer video. Soutschek evaluated the role of Dorsolateral Prefrontal Cortex (DLPFC) in decision-making regarding cooperation. Previous studies, including those using functional magnetic resonance imaging, reported a correlation between cooperative behavior and DLPFC activity (Emonds, 2012). Soutschek used trans-cranial magnetic stimulation to disrupt the DLPFC while playing the prisoner's dilemma game. In the prisoner's dilemma game, the subject risks short-term loss, even if the other player has previously defected, to accrue long-term benefit. To make that strategic decision, the subject has to suppress the impulse to defect. This is an important cognitive control process. Disrupting the DLPFC magnetically disrupts that cognitive process. Incapacitating the DLPFC decreased cooperation rates. This was most pronounced when the partner had previously defected (Soutschek, 2015). This experiment demonstrates that the DLPFC contributes to strategic decision-making in the prisoner's dilemma game. Soutschek infers the DLPFC plays a role in weighing long-term versus short term benefits. Prefrontal cortex is a relatively late evolutionary development, moderating behavior, allowing mutual altruism, among non-relatives, as a basis for cooperation and survival (Soutschek, 2015). "Few things are as fundamental to human

progress as our ability to arrive at a shared understanding of the world” (Kaplan, 2016).

10. Limitations: Several Concerns Limit the Ability to Generalize These Results

“Functional Magnetic Resonance Imaging (fMRI) has become the gold standard for in vivo imaging of the human brain. In practice, fNIRS is a more convenient and less expensive technology than fMRI” (Cui, 2011). fNIRS correlates well with fMRI (Cui, 2011). fNIRS is limited relative to fMRI. fNIRS lacks the spatial discrimination of fMRI. The MPFC has voxels of function identified below the level of fNIRS discrimination. For example, activation of the MPFC predicts behavior change, whereas activation of the Dorsomedial Prefrontal Cortex (DMPFC) is more specifically associated with narrative immersion. This is a significant limitation since narrative immersion plays a key role in decision-making. The Ventromedial Prefrontal Cortex (VMPFC) plays multiple, varied roles including social, cognitive, and affective functions (Hiser, 2018). Confirmatory evaluation by fMRI may be necessary for better spatial resolution. Similar limitations likely affect other ROI including the RLPFC. fNIRS has a decreased Signal-to-noise Ratio (SNR) than fMRI. fNIRS can not access deep brain structures, whereas fMRI can (Cui, 2011).

Measuring behavioral change is problematic. All subjects were male and education levels varied, although this was not controlled. This study assumes a relationship between extreme beliefs and the capacity, willingness, and propensity to commit violence. Implicit is the assumption that reducing sectarianism will reduce sectarian violence. The sectarian survey has not been validated or used in other settings. The study design may have inappropriately increased engagement scores. Videos were contrasted with a blank screen. Instead of a blank screen between videos, it might be useful instead to use videos with some neutral content. The videos do not generate a large range of signal strength to facilitate discrimination. Future studies should create a greater range of output values across input stimuli. The effects of one video lasts well past the baseline/rest period and into the subsequent stimuli. This may contaminate findings. Dynamic changes occur within the span of a single video, between videos, and beyond. Subsequent events, including sleep, may affect integration of changes.

It is reasonable to question whether any single, brief intervention may change deeply rooted, inter-generational beliefs and biases. Motivational states play a role in behavior change. Falk’s smoking cessation studies involved subjects who expressed a desire to change behavior to quit smoking. Motivation was not addressed in this study. The subjects in this study are highly sectarian, and in focus groups did not express any desire to change that fact. It is reasonable to infer that the subjects were not likely motivated to decrease sectarianism. One subject significantly increased sectarian beliefs for unknown reasons. Emotion plays a role in prefrontal cortical, cognitive processing (Dor’e, 2019*), (Kaplan, 2016). The predictive value of activation of regions of interest is moderated by emotional influences (Dor’e, 2019)**. Emotional states were not addressed in this study. The focus groups offer

insights into thoughts and emotions: The videos elicited opinions and revealed mood states. The violent Chess video evoked skepticism motivating a desire to seek more information. Common responses to the Nice video was that all Muslims should get along and that sectarianism is a relatively new phenomenon. The Grad video message is that "ISIL destroys families". The Grad video evoked emotion, but failed to address sectarianism, more addressing terror and violence. The greater length of the Basheer video is problematic for confounding error in fNIRS measurement.

The majority of people in the Middle East reject Al Qaeda and ISIL. This is already widely accepted. The subjects are Iraqi expatriates residing in Amman, Jordan. This may indicate biases limiting generalizations to the Iraqi population. This may include personal experience with sectarian violence which may have led to expatriation. The authors acknowledge cultural and social biases, including Western origins, and military backgrounds and associations, including service in Iraq and the global war on terror.

11. Future Areas of Inquiry

This study provides interesting findings which should be explored. There is a need to develop and identify messages which activate adoption in the MPFC to decrease sectarian beliefs. Further research is needed to evaluate the relation of adoption to counter-arguing affecting target behaviors. Further study is needed of the relation between counter-arguing and decreased sectarianism including demographic influences. Further research is needed to optimize the location of the counter-arguing region of interest for each subject, as this may vary by individual and with cap fitting. fNIRS is a cost-effective tool to measure the effectiveness of video messages. Confirmation and delineation of key findings with Functional Magnetic Resonance (fMRI) imaging would be useful.

It may be useful to develop simple tools for field use which focus solely on the MPFC and RLPFC, create better signal discrimination, upload data to a central processor, develop streamlined analytic algorithms, including exception and error handling, and provide quick feedback to the field. A direct measurement of MPFC and RLPFC activation in the field would be useful, perhaps a using color indicator. It might be interesting to monitor continuous telemetry output of ROIs during various stimuli, including speeches, debates, movies, and athletic events. Video messages could be formulated, selected, and tailored to population segments. This could optimize efficacy and efficiency, including likelihood of propagation, or going viral. Ineffective media campaigns waste resources and good will. "Mass media can powerfully affect [health] decision-making"(Falk, 2016). Further study may provide insight into how social media promotes radicalization, including domestically in the United States. Many neurologic processes underlying behavior change are not under conscious control. Normal people are vulnerable to subliminal messaging, and some people are vulnerable to radicalization and violence. Likewise, we are subject to ethical countermeasures, including education.

The authors hope this investigation will stimulate discussion and research regarding sectarian violence in Iraq and elsewhere. Future areas of inquiry include exploring and refining methods to study how social messages lead to behaviors, including organized violence. Studying violent acts of terror is limited by ethical and practical constraints. Surrogate violent behavior, such as sport-related fighting, may be an appropriate venue to study violent beliefs and behavior. Naturalistic and retrospective investigations might be useful to gain insight in designing more rigorous studies. Future studies might include characterizing the mental transition from sectarianism to planning to implementation of violence. Negative behaviors may be countered, redirected, and reformed by positive messages which activate the brain. Persuasive messages can change behavior. We seek to reduce sectarian-inspired violence in Iraq. Messages should be legitimate, transparent, and respectful (Aly, 2014). Iraq has an ancient, venerated history of heterogeneous cultures. Iraq has endured millenia of invasions and decades of brutal dictatorship, war, and domestic violence. It would be useful to learn how social media promotes radicalization. Enduring peace, based on pluralistic tolerance, is worthy of our best efforts. We seek to honor the commitment and sacrifices of those who served to secure the future and freedom of Iraq. The impact of sectarianism in Iraq, the Middle East, and the world, merit further inquiry.

12. Conclusion

Public Service Announcements (PSAs) do not reduce sectarian violence in Iraq. This experiment measures neural activity in subjects viewing PSAs against sectarianism. Neural activity is correlated with changes in sectarianism. Infrared spectroscopy measures activity in three key brain regions of interest. Activity in these brain regions involve: (1) getting attention, (2) changing behavior, and (3) resisting behavioral change. Three PSA videos fail to activate behavioral change and have no effect on sectarianism. A fourth, un-published video decreases resistance to behavioral change, decreasing sectarianism. This suggests a potential relation between the brain region which changes behavior and the region which resists behavioral change. Messages which activate new behavior need to be identified and studied in relation to their effect on sectarianism. Infrared spectroscopy is a convenient, inexpensive, and effective tool to identify persuasive messages to reduce sectarian violence in Iraq. Cost effective analysis of brain activity can assist selection of messages which may go viral to reduce sectarian violence. This may be a useful tool to ethically influence behaviors which reduce violence and enhance security.

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