The Irrational Brain: A Meta-Analysis on Social Cognition and Decision-Making

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April 30, 2019

Introduction

Since the turn of the century, the interdisciplinary application of neuroimaging as an investigative tool has potentially unleashed a revolution within the social sciences by becoming – what may have been – *the missing link* between old theoretical frameworks and contemporary empiricism. Its ability to provide *some evidence* to support, or oppose, previously unchallenged theoretical paradigms is an invaluable asset, however societally consequential its findings may become. As the metaphorical *nature vs. nurture* pendulum shifted from one radical end to the other – anecdotal evidence and emphases towards illogically-drawn conclusions were practically the only tools available to those, namely academics, skeptical of all-encompassing theories of human behavior and pseudo-scientific justifications for overtly oppressive social and international systems. Phrenology, for example, was employed as scientific argument in support for existing colonial hegemonies (McCandless, 1992). Even as the international balance-of-power danced around European monarchs' own selfish desires, the mainstream depiction of existing hierarchies – among, both, *liberal* scholars and political leaders – was one of fervent support for colonization by claiming it as "necessary" since the end-goal could only be to "protect" and "civilize" *so-called* "backward regions of the earth" – wholly aware that such noble intentions could only manifest themselves through imperial expansionism, territorial acquisition, the imposition of foreign political systems, and the near-absolute extraction of wealth (Mill, [1859], 1987, p.2-4). The American institution of slavery, in turn, embodied the belief that social, political, and economic inequalities were predetermined through evolutionary processes that inadvertently became national manifestations – through the country's continued westward expansion and, when successful, subsequent accumulations of wealth (Marx, Ledbetter & Wheen, 1999).

Contemporaneously, Social Darwinism persisted for decades as an unchallenged – albeit, baseless – theoretical framework for policymakers and researchers, and implicitly dominated most – if not all – aspects of daily life within the 19th and early-20th century. While this served to create an unsustainably violent global economy and balance-of-power, as demonstrated over the course of two World Wars and the *Great Depression*, its intellectual toxicity ought to be distinguished and analyzed due its continued relevance. One such example is the decades-long phenomenon known as the Eugenics movement; namely, its incorporation within eventual rise of Germany's Third Reich and the pervasive *Jim Crow* laws that became synonymous with the American South for nearly a full century. Thus, the despicable nature of Eugenics, genocide, and codified means of inequality understandably led to a complete reversal. Wherein, on the other end of the spectrum, the view that every individual becomes a product of his or her environment, logically ascertains that human nature – and thus states – is that of a fully rational being which subtracts the costs to any benefit the materializes in the form of: everyday decisions and actions, voting behaviors, and social engagements – a core component of the dominant *rational choice* and *game* theories for explaining human sociopolitical behaviors, as well as the paradigms of international relations known as *realism, liberalism, neoliberalism,* and *neoconservatism* (Mutz, 2016; Waltz, 2018).

Yet, this presents a significant challenge when analyzing the domestic and international problems of the Cold War and current, post-Reagan-Thatcher, era – as a significant amount of evidence demonstrates the emotional nature comprised within *ingroup vs. outgroup* biases, political inclusion and exclusion, the tendency to justify existing hierarchies and systems that reinforce extensive social and wealth inequalities, as well as implicit and explicit prejudice. As such, both *nature* and *nurture* accounts are individually inadequate for explaining: why some of the most socioeconomically disadvantaged individuals regularly vote against their own economic interests, the persistence and worsening of political polarization – often based on group identities – throughout much of the democratic world, clear information biases towards misinformation amid access to numerous alternatives, or whether the national decision-making process and international conflicts could ever really be viewed as *rational* instead of *emotional* – and thus, *irrational* – by their very nature. Therefore, neuroimaging studies may provide the answers, or – at the very least – the tools necessary for social scientists to test historically-unchallenged theories of human and state behavior.

However, and as previously stated, neuroscientific explanations for political and economic decision-making could prove incredibly consequential: extending Jost's (2006) account to its natural – most problematic – conclusion, one could empirically challenge concepts like democracy and the use of deliberative bodies as fallacies due to humans being genetically predisposed to identify somewhere between the *right-left* spectrum; but on the other hand, and as Sapolsky indicated (2019), students of political violence could finally understand the biological drivers for genocide – when exposed to the perfect economic and political variables – and, perhaps, occasionally save hundreds-of-thousands, or millions, of lives by preventing the actual emergence of a brutal body politick. Thus, the authors' review of the theoretical and empirical literature surrounding, both, biological and environmental accounts for political and economic decision-making have enabled the formulation of two testable hypotheses through a meta-analysis of the substantial quantity of neuroimaging studies that surround neuropolitics – an ever-expanding subfield comprised of political scientists, social and cognitive psychologists, and cognitive neuroscientists.[1]

Hypothetical Assessments. In lieu of this, null hypothesis, $\boldsymbol{H_0}$**:** it should be expected that – when subjects are presented with ambiguous social scenarios, the opportunity to cooperate or defect, *high-risk/high-reward* and *low-risk/low-reward* economic prospects, and to recognize or empathize with people of differing socioeconomic and ethnic groups – activations across the human brain's emotional processing regions will not be significantly different from 0 relative to those responsible for long-term memory <u>and/or</u> processes of higher cognition.[2] In contrast, under $\boldsymbol{H_1}$**:** emotional centers – namely activations within the amygdala and insula – should be <u>significantly different from 0 when contrasted to the mean processes of higher cognition</u>. As such, $\boldsymbol{H_1}$ hypothesizes that <u>there are emotional components to *all* social, economic, and political tasks and decisions</u> that are regularly imposed on human beings internationally. Finally, $\boldsymbol{H_2}$ assumes that resource artifacts for <u>higher cognition, self-inhibition, and reward-learning *will* be significantly different from 0,</u> while nonetheless being less significant than emotional centers of activation. This stipulates that *rational centers of cognition* activated separately, in response to emotional activates and when cued to specific task demands – as opposed to emotional activations occurring in a significant majority of the experimental conditions incorporated within this study.

Methodology

[1] The study of "neuropolitics" is more commonly cited as "social cognition" and/or "emotional" and "affective decision-making" in *Sleuth* terminology.

[2] Such areas of the brain will be occasionally be referenced as "rational centers of activation" and "cognition" – in relation to the middle and dorsal prefrontal cortexes, anterior cingulate cortex, and hippocampus.

Results

GingerALE Results. The meta-analysis results yielded a total of eleven significant clusters, which was the result of a total of 122 experiments. There was a total number of 3,730 foci and a total of 2,218 subjects. The minimum ALE score was 3.46E-9 and the maximum ALE score was 0.105. The *p-critical* value applied was $p<.0001$ and the cluster-level inference value was set at $p<.001$ score, meaning that there should be no more than a 0.01% chance that the authors' significant results were discovered through random error.

Cluster #	*x*	*y*	*z*	ALE	*p-value*	*z-score*	Hemisphere	Lobe	Gyrus	Cell
1	*40*	*24*	*-2*	0.07738413	1.05E-10	6.3538485	Right Cerebrum	Frontal	Inferior Frontal	BA47
1	*44*	*18*	*24*	0.07280612	1.01E-09	5.9962506	Right Cerebrum	Frontal	Middle Frontal	BA46
1	*42*	*12*	*28*	0.07158118	1.83E-09	5.8987064	Right Cerebrum	Frontal	Inferior Frontal	BA9
1	*34*	*24*	*2*	0.07141733	1.98E-09	5.885967	Right Cerebrum	Frontal	Inferior Frontal	BA47
1	*46*	*30*	*14*	0.06952921	4.88E-09	5.7348466	Right Cerebrum	Frontal	Middle Frontal	BA46
1	*48*	*24*	*12*	0.06882788	6.79E-09	5.6785145	Right Cerebrum	Frontal	Inferior Frontal	BA45
1	*44*	*4*	*34*	0.06074974	2.68E-07	5.0129375	Right Cerebrum	Frontal	Precentral	BA6
2	*-42*	*26*	*-2*	0.08887839	2.52E-13	7.2240853	Left Cerebrum	Frontal	Inferior Frontal	BA47

2	*-32*	*20*	*6*	0.080612384	2.02E-11	6.6023145	Left Cerebrum	Sub-Lobar	Insula	BA13
2	*-50*	*22*	*12*	0.06995412	4.00E-09	5.768554	Left Cerebrum	Frontal	Inferior Frontal	BA45
2	*-48*	*16*	*10*	0.06895387	6.42E-09	5.688183	Left Cerebrum	Frontal	Inferior Frontal	BA44
2	*-48*	*26*	*8*	0.06828713	8.76E-09	5.6349287	Left Cerebrum	Frontal	Inferior Frontal	BA45
2	*-44*	*6*	*6*	0.06108734	2.31E-07	5.0415506	Left Cerebrum	Sub-Lobar	Insula	BA13
3	*-4*	*4*	*54*	0.10045647	3.67E-16	8.076571	Left Cerebrum	Frontal	Medial Frontal	BA6
3	*-6*	*18*	*42*	0.05776133	9.74E-07	4.7587404	Left Cerebrum	Limbic	Cingulate	BA32
4	*-20*	*-4*	*-10*	0.09222104	4.01E-14	7.469696	Left Cerebrum	Limbic	Parahippocampal	Amygdala
4	*-10*	*-12*	*4*	0.060389843	3.14E-07	4.9825764	Left Cerebrum	Sub-Lobar	Thalamus	Ventral Lateral Nucleus
4	*-18*	*6*	*-2*	0.055909038	2.12E-06	4.5990686	Left Cerebrum	Sub-Lobar	Lentiform Nucleus	Putamen
5	*20*	*-2*	*-12*	0.08335196	4.86E-12	6.81051	Right Cerebrum	Limbic	Parahippocampal	Amygdala
5	*24*	*-20*	*-12*	0.058486637	7.13E-07	4.8212295	Right Cerebrum	Limbic	Parahippocampal	BA28
6	*0*	*54*	*24*	0.07240141	1.23E-09	5.9638047	Left Cerebrum	Frontal	Superior Frontal	BA9
6	*-6*	*46*	*28*	0.06614432	2.38E-08	5.4601593	Left Cerebrum	Frontal	Medial Frontal	BA9
7	*-42*	*-2*	*36*	0.07837971	6.33E-11	6.431131	Left Cerebrum	Frontal	Precentral	BA6
7	*-44*	*12*	*26*	0.052647054	8.06E-06	4.312891	Left Cerebrum	Frontal	Middle Frontal	BA9
7	*-42*	*8*	*42*	0.05077238	1.70E-05	4.144875	Left Cerebrum	Frontal	Middle Frontal	BA8
8	*-46*	*-58*	*20*	0.080686204	1.94E-11	6.608426	Left Cerebrum	Temporal	Superior Temporal	BA39
8	*-50*	*-56*	*16*	0.07723148	1.13E-10	6.3422256	Left Cerebrum	Temporal	Superior Temporal	BA22
9	*-2*	*-56*	*30*	0.06580609	2.77E-08	5.4331603	Left Cerebrum	Parietal	Precuneus	BA7
10	*46*	*-50*	*18*	0.069602415	4.72E-09	5.7404695	Right Cerebrum	Temporal	Superior Temporal	BA39
11	*0*	*46*	*4*	0.060884856	2.53E-07	5.023886	Left Cerebrum	Limbic	Anterior Cingulate	BA32

(Table 1)
Meta-Analysis Results – Grouped by Subjects

The first cluster had five peaks. The left cerebrum had an activation of 100%, but more specifically the frontal lobe's activation was 65.7% and the Sub-lobar was 34.3%. The inferior frontal gyrus, insula, precentral gyrus, claustrum, middle frontal Gyrus, and extra nuclear gyrus's were all activated as well. The second cluster had nine peaks. The right cerebrum was the hemisphere the peaks were found in this cluster. The frontal lobe activation was at 67.6% and 32% was in the sub-lobar. In terms of the gyrus's, 56.5% activation occurred in the inferior frontal gyrus, 26.9% in the insula, 11.6% precentral gyrus, and 3.3% middle frontal gyrus. Cluster three had two peaks. The left cerebrum and right cerebrum were both activated. In this particular cluster, the frontal lobe still had majority of the activation at 83.5%, but limbic lobe also had a 16.5% activation. The medial frontal gyrus, superior frontal gyrus, and cingulate gyri were all activated as well. Cluster four had three peaks that all occurred in the left cerebrum. The sub-lobar had 64.8% activation, the limbic lobe had 34.2% activation, and the frontal lobe only had 1.1% activation. Cluster five had two peaks in the right cerebrum. The two peaks were 72.3% in the limbic lobe, 23.7% in the Sub-lobar, and only 4% in the frontal lobe. The Parahippocampal gyrus, lentiform nucleus, subcallosal gyrus, and uncus were activated as well. In cluster six, two peaks occurred in the left cerebrum (66.5%) and the right cerebrum (33.5%). The frontal lobe involved, and specifically the superior frontal gyrus and medial frontal gyrus. In cluster seven, there were three peaks in the left cerebrum. The frontal lobe's activation was 100%. The precentral gyrus, inferior frontal gyrus, and middle frontal gyrus were activated as well. Cluster eight had two peaks in the left cerebrum. The Temporal lobe's activation was 89.6% and the occipital lobe had an activation of 10.4%. The middle temporal gyrus and superior temporal gyrus were activated as well. In cluster nine, there was one peak. The left and right cerebrum were activated. The limbic lobe, parietal lobe and occipital lobe were all activated as well. In cluster ten, there was one peak as well in the right cerebrum. 93.8% in the temporal lobe and 5.6% in the parietal lobe. Finally-- in cluster eleven—one peak occurred. 58.2% in the left cerebrum and 41.8% in the right cerebrum. The limbic lobe and frontal lobe were activated specifically. The anterior cingulate had 61.2% activation and the medial frontal gyrus had 38.8% activation.

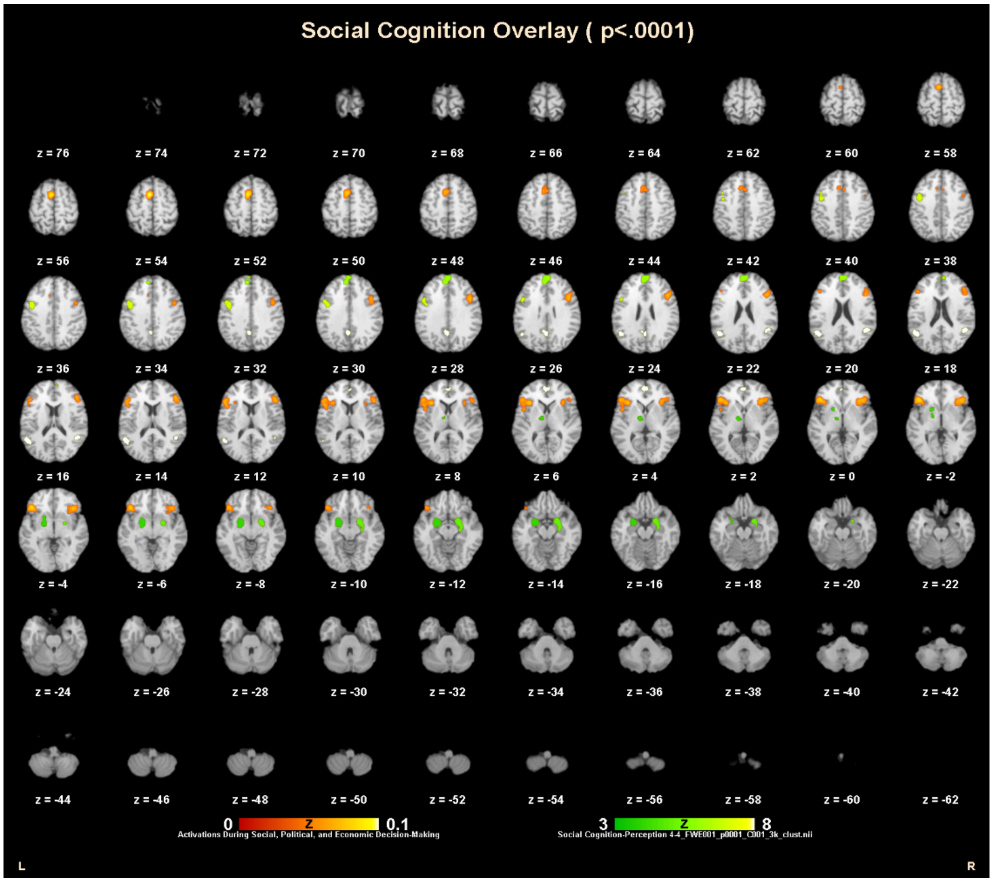

Figure 2: Final Social Cognition Overlay

Overall, the most significant brain region was the Amygdala. The clusters in which the frontal lobe was activated, there was also a correlation with a high activation of the frontal gyrus's—Inferior Frontal Gyrus, Medial Frontal Gyrus, and Superior Frontal Gyrus. The Limbic Lobe was also a prominent region of the brain that was activated in five clusters. These five clusters also had activation within the frontal gyrus, lentiform nucleus, parahippocampal gyrus, and anterior cingulate. The higher parahippocampal gyrus coincides with a lower activation of the frontal lobe, and a higher activation of the limbic lobe. The insula was activated as well. The insula's role is emotion-based, so the insula's activation also correlated with the inferior frontal gyrus. The function of the inferior frontal gyrus is the response inhibition, so refraining from an action once told to stop. Alongside the inferior frontal gyrus, the insula activation coincides with reduced frontal lobe activity.

Cluster #	x	y	z	ALE	p-value (<.0001)	z-score	Hemisphere	Lobe	Gyrus	Cell
1	44	20	24	0.09176423	1.54E-12	6.9743605	Right Cerebrum	Frontal	Middle Frontal	BA46
1	42	12	28	0.08928094	5.25E-12	6.7995706	Right Cerebrum	Frontal	Inferior Frontal	BA9
1	40	24	-2	0.087017775	1.58E-11	6.6387877	Right Cerebrum	Frontal	Inferior Frontal	BA47
1	48	26	12	0.08188289	1.83E-10	6.267465	Right Cerebrum	Frontal	Inferior Frontal	BA46
1	44	4	34	0.07289013	1.09E-08	5.5970707	Right Cerebrum	Frontal	Precentral	BA6
2	-42	24	-2	0.0937648	5.63E-13	7.11413	Left Cerebrum	Frontal	Inferior	BA47
2	-34	20	6	0.09251367	1.06E-12	7.0268908	Left Cerebrum	Sub-lobar	Insula	BA13
3	-20	-6	-10	0.12907761	1.86E-21	Infinity	Left Cerebrum	Limbic	Parahippocampal	Amygdala
3	-10	-12	4	0.085639164	3.08E-11	6.5398827	Left Cerebrum	Sub-lobar	Thalamus	Ventral Lateral Nucleus
4	0	52	24	0.109466426	1.43E-16	8.209537	Left Cerebrum	Frontal	Medial Frontal	BA9
4	-10	44	38	0.05641249	9.30E-06	4.2811313	Left Cerebrum	Frontal	Superior	BA8
5	-4	6	54	0.12049451	2.90E-19	Infinity	Left Cerebrum	Frontal	Superior	BA6
5	4	14	42	0.06508187	3.03E-07	4.989346	Right Cerebrum	Limbic	Cingulate	BA32
5	-8	22	32	0.058092624	4.90E-06	4.4214783	Left Cerebrum	Limbic	Cingulate	BA32
6	22	-2	-12	0.1274862	4.81E-21	Infinity	Right Cerebrum	Limbic	Parahippocampal Gyrus	Amygdala
6	28	-14	-12	0.08417872	6.19E-11	6.434636	Right Cerebrum	Limbic	Parahippocampal Gyrus	Hippocampus
7	-46	-58	20	0.123879924	4.05E-20	Infinity	Left Cerebrum	Temporal	Suprerior Temporal	BA39
8	-42	0	34	0.08384067	7.27E-11	6.410029	Left Cerebrum	Frontal	Precentral	BA6
8	-46	10	26	0.06668294	1.56E-07	5.1159906	Left Cerebrum	Frontal	Inferior Frontal	BA9
8	-42	8	42	0.056097858	1.04E-05	4.255058	Left Cerebrum	Frontal	Middle Frontal	BA8
9	44	-52	18	0.08113428	2.61E-10	6.2126007	Right Cerebrum	Temporal	Superior Temporal	BA22
9	44	-74	-4	0.065015875	3.10E-07	4.9845743	Right Cerebrum	Occipital	Inferior Occipital	BA19
9	48	-64	10	0.054426104	1.95E-05	4.1135836	Right Cerebrum	Temporal	Middle Temporal	BA39
10	-2	-56	30	0.11495702	6.79E-18	Infinity	Left Cerebrum	Parietal Lobe	Precuneus	BA7
11	0	46	2	0.075720534	3.10E-09	5.8112125	Right Cerebrum	Limbic	Anterior Cingulate	Gray Matter*

(Table 2)
Meta-Analysis Results – Grouped by Experiments

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