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Shared temptations: An fMRI study of dishonest profit maximization

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Abstract: A single case of a tempting-decision task involving financial gain is reported. The subject showed a prosocial Social Value Orientation and applied a profit-maximizing strategy. Differential brain activation patterns for self-serving and other-serving decisions were observed. Results provide new insight into the design of paradigms on bounded ethicality and self- and group-serving behavior.

Keywords: bounded ethicality; mentalizing; prosociality; self-serving behavior; social cognition

In rule-guided behavior, there can occur situations in which one can either choose an option to maximize profit by disobeying rules or to abide by the rules and sacrifice profit (e.g., by refraining from cheating). Some situations are ambiguous in such a way that it allows one to justify a beneficial but incorrect choice because of perceptual indifference. Disobeying normative expectations might also allow other persons to benefit, resulting in the "dark side of collaboration" (Weisel & Shalvi, 2015, p. 10655), which results in cooperating for profit maximization by crossing normative borders. Functional magnetic resonance imaging (fMRI)-based research in this field has brought a range of brain areas to attention and provides somewhat diverging explanations to the involvement of these areas. A trade-off between norm compliance and self-interest is often related to the dorsolateral prefrontal cortex (dlPFC) activations. Correlated with cognitive effort and information integration, this is often the case when strategic decisions have to be made, such as those involving sanctions (Makwana, Grön, Fehr, & Hare, 2015). It is suggested that either the dlPFC is important to implementing self-interest by overriding honest responses or the other way round. For the latter, there were positive results shown in a study with a dlPFC lesion cohort (Zhu et al., 2014). Often, medial prefrontal brain activation is involved in decision tasks that are said to be value based, representing an abstract value that is assigned to the options and allows computing a preference. Value attributes are not limited to a certain category, but can involve primary, monetary, or normative reward (Levy & Glimcher, 2012). Kestemont et al. (2015) mention that the prefrontal cortex is usually responsible for stable and abstract characteristics and therefore not found when a situational judgment is made spontaneously.

The approach presented here aims to disentangle processes involved in dilemmas of conflicting motivations, such as whether or not to abide by rules or behave prosocially. The main questions are whether prefrontal activation associated with value computations is a salient feature and whether the dlPFC is involved in increasing honesty or cheating. In this case, a subject from a pilot set (age 22 years, female) was chosen who showed a Social Value Orientation (SVO) test matching the value estimated most frequently in the population (SVO value of 37), indicating a prosocial orientation (closer to altruism than to individualism). The subject was presented with a flexible dots paradigm, consisting of 42 trials per condition depicting two fields of 25 small dots on one side and slightly fewer (one, three, or five dots' difference) on the other. The task was to indicate via button press which side had more dots. The payment scheme and allocation varied across conditions: In condition A, the subject received €1 for a correct answer, and €0.10 for an incorrect answer. In condition B, the subject received €1 for a left button press, and €0.10 for a right button press, regardless of the correct answer. Conditions C and D were identical to A and B, respectively, but the payment was allocated to an unknown third person.

The fMRI experiment was conducted using a pseudo-randomized event-related design with 42 stimuli per condition presented for 4 s each followed by a prompt to respond and a jittered inter-stimulus interval. The procedure had approval from the local ethics committee, and the subject provided informed consent. Using a 3T Philips ACHIEVA, a T1-weighted sequence as an anatomical reference and a T2*-weighted functional sequence (900 volumes, repetition time = 2.2 s, echo time = 30 ms, flip angle = 90°, 43 axial slices) were acquired. Statistical analysis was performed using SPM12 (http://www.fil.ion.ucl.ac.uk/spm) and preprocessing included slice time correction and 8-mm full-width half-maximum smoothing. The conditions were modeled by a boxcar function convolved with a hemodynamic response function, and T-contrasts were calculated using a cluster-level-corrected threshold of $p < .05$ family-wise error.

The subject's behavioral results indicated a low error rate (9.5% and 4.7% for conditions A and C, respectively). In conditions B and D, the subject opted for an absolute profit-maximizing strategy both for herself and the unknown third person, which resulted

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Table 1
Differences of Neural Activation Between Payment Schemes (Incentivized, Accuracy-Based) and Allocation (Self, Other).

Contrast	Brain region/Brodmann's area		k	H	Coordinates			z-statistics
					x	*y*	*z*	
Inc > acc	IFG	45/47	224	L	−44	32	16	5.40
Self inc > acc[a]	Angular g.	39	1012	L	−54	−68	28	5.46
Other > self	TPJ	37	259	R	50	−64	14	4.30

Note. Peak voxel *z*-scores from *t*-tests with *p*(family-wise error) < .05 on cluster-level. k = cluster size (no. of voxels); H = hemisphere (L = left, R = right); Inc. = incentivized; acc = accuracy-based; IFG = inferior frontal gyrus; g. = gyrus; TPJ = temporoparietal junction.
[a] Estimated activity during stimulus onset.

in a 100% rate of beneficial choices (deciding on the higher payoff irrespective of the correct answer). While this was not a unique behavior, the subject was considered an ideal type for a prosocial, profit-maximizing person. The general linear model (GLM) for the fMRI results was calculated by measuring activation during the prompt to respond. Comparing the incentivized (B, D) and accuracy (A, C) conditions, the left inferior temporal gyrus was activated. Comparing payment allocation (other vs. self; conditions A, B vs. C, D), the right temporoparietal junction (TPJ) was activated. An additional GLM was calculated with stimulus onset. This model revealed higher activation in contrast D versus C in the left angular gyrus (see Table 1).

The inferior frontal gyrus is highly coupled with dorsolateral and dorsomedial prefrontal cortices. All of these areas are found to be activated in cognitive control and response inhibitions occurring when economic cost is involved (Dogan et al., 2016). Extending the recruitment of dlPFC to IFG, these results favor the approach that suggests a higher neural engagement in this area for implementing self-interest. While the task was facilitated by the profit-maximizing strategy (pressing the same button for each trial with no need to care about accuracy), the IFG was still more engaged, potentially inhibiting suboptimal responses. While the right TPJ is suggested to be involved in mentalizing about intentions and beliefs, the left TPJ was found to be involved more in perception-related processes (Perner, Aichhorn, Kronbichler, Staffen, & Ladurner, 2006). The results indicate that self-perspective inhibition and executive control go hand-in-hand with profit maximizing for others (Hartwright, Apperly, & Hansen, 2012). The results also indicate that medial prefrontal activation is not involved in situative decisions like the series of trials used here, showing that the whole theory of value representation does not play a central role in tempting situations.

Further research of bounded ethicality—situative features of dishonest behavior with normative and social relevance—may provide a helpful stance for focusing on the dlPFC and surrounding areas in investigating recruitment of self- and other-serving behavior and features of social cognition.

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