Assessing Strategic Risk and Uncertainty in Coordination Games and Lotteries using fMRI

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Abstract

Neuroscientists and economists have recently begun to study jointly how strategic thinking regulates human individual and social behaviour. In this paper we measure strategic uncertainty in coordination games with strategic complementarities (CC) and substitutes(CS) in 2 person and large groups and risk within lottery setups, all framed in a similar way. The question we are addressing is whether the neural systems mediating decisions in individual and social context are distinct. More precisely, we are trying to identify whether risk and strategic uncertainty are mediated by different brain networks.

We found enhanced activity in bilateral anterior insula related to outcome uncertainty. We see clear differences in brain activity when comparing risk averse subjects and risk loving subjects playing lotteries and CC-games (stug-hunt games), but not when playing CS-games (entry games). This complements our behavioral data which shows a strong correlation between risk attitudes and CC-games, but no correlation between risk attitudes and CS-games. Activity in the medial prefrontal cortex (mPFC), superior temporal sulcus, temporo-parietal junction, and posterior cingulated cortex was related to playing in stug hunt games and entry games. Increasing strategic uncertainty was correlated with neural activity in the mPFC. Furthermore, activity in this brain region is positively correlated with strategic IQ (measured in payoff gains) in CS games but not in CC games. We interpret this result that higher order of believes (theory of mind) are important in games with substitutes but not in games with complements as also suggested by game theory.

Our results suggest that a common neural substrate (anterior insula) is shared in the individual and social contexts for the resolution of uncertainty. Moreover, the pattern of activity in the mPFC revealed the fundamental role of this area in strategic reasoning (Coricelli and Nagel, 2009, PNAS).