GAME THEORY

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1. **LEVELS OF COMPLEXITY**

How natural selection influences social dynamics within decision-making.
Decision Making within Social Context

- Cooperative behaviors
- Competitive behaviors
Modern version of the multilevel theory—EVOLUTIONARY FACTORS
Selections between genes within an individual

Selections between individuals within a group

Selections between groups within a population

Competition is the name of the evolutionary game of natural selection.
Natural selection promotes competitive behavior between individuals.

Promote within group cooperation

Competition between groups.
Cooperation

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Abstract

We review game-theoretic models of cooperation with self-regarding agents, starting with retaliation against noncooperators and reputation-building in repeated dyadic interactions. We then study the Folk Theorem in large groups of self-regarding individuals with imperfect information. In contrast to the dyadic case with perfect information, we find that the level of cooperation deteriorates rapidly with larger group size and higher error rates. Moreover, there is no plausible account of how the dynamic, out-of-equilibrium, behavior of these models would support cooperative outcomes. We then analyze cooperation with other-regarding preferences, finding that a high level of cooperation can be attained in groups of substantial size and with modest informational requirements, and that conditions allowing the long term evolution of such social preferences are plausible.
"Cooperation is said to occur when two or more individuals engage in joint actions that result in mutual benefits."

CHEATING & NON-COOPERATIVE BEHAVIOR

Natural selection promotes competitive behavior between individuals.

—even at the expense of a group

Cooperative behaviors

\[ \uparrow \uparrow \text{the fitness of the group} \]

Promote within group cooperation

When groups compete with each other, it is advantageous to have within group cooperation.
Cooperative behaviors \[ \uparrow \text{the fitness of the group} \]

Promote within group cooperation

Cheating & Non-Cooperative Behavior\[ \leftarrow \text{even at the expense of a group} \]

Society has ways to:

1. Punish non-cooperators
2. Reinforcing cooperation

When there is inter-group competition, within-group cooperation is enhanced.
Prolonged developmental period provides the time needed to learn social norms and rules.
Social complexity is essential to our survival → evolutionarily, it selected in nervous system.
2. **BRAIN IS WIRED TO BE SOCIAL**

Therefore, it is important to take into account the social implications in decision-making.
Dunbar's number

From Wikipedia, the free encyclopedia

Dunbar's number is a suggested cognitive limit to the number of people with whom one can maintain stable social relationships—relationships in which an individual knows who each person is and how each person relates to every other person.[1][2] This number was first proposed in the 1990s by British anthropologist Robin Dunbar, who found a correlation between primate brain size and average social group size.[3] By using the average human brain size and extrapolating from the results of primates, he proposed that humans can comfortably maintain only 150 stable relationships.[4] Dunbar explained it informally as "the number of people you would not feel embarrassed about joining uninvited for a drink if you happened to bump into them in a bar".[5]

Proponents assert that numbers larger than this generally require more restrictive rules, laws, and enforced norms to maintain a stable, cohesive group. It has been proposed to lie between 100 and 250, with a commonly used value of 150.[6][7] Dunbar's number states the number of people one knows and keeps social contact with, and it does not include the number of people known personally with a ceased social relationship, nor people just generally known with a lack of persistent social relationship, a number which might be much higher and likely depends on long-term memory size.

Dunbar theorized that "this limit is a direct function of relative neocortex size, and that this in turn limits group size [...] the limit imposed by neocortical processing capacity is simply on the number of individuals with whom a stable inter-personal relationship can be maintained". On the periphery, the number also includes past colleagues, such as high school friends, with whom a person would want to reacquaint himself or herself if they met again.[8]
THE SOCIAL BRAIN: Mind, Language, and Society in Evolutionary Perspective

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Key Words  brain size, social cognition, theory of mind, social group size, culture

Abstract  The social brain (or Machiavellian Intelligence) hypothesis was proposed to explain primates’ unusually large brains: It argues that the cognitive demands of living in complexly bonded social groups selected for increases in executive brain (principally neocortex). The evidence for this and alternative hypotheses is reviewed. Although there remain difficulties of interpretation, the bulk of the evidence comes down in favor of the social brain hypothesis. The extent to which the cognitive demands of bonding large intensely social groups involve aspects of social cognition, such as theory of mind, is explored. These findings are then related to the evolution of social group size, language, and culture within the hominid lineage.
Mean social group size for individual primate taxa (principally, one species per genus) plotted against relative neocortex volume (indexed as neocortex volume divided by the volume of the rest of the brain). Simian (solid symbols) and hominoid (open symbols) taxa are shown separately. The datapoint for humans is that obtained by Dunbar (1992a). With a logged axis, neocortex ratio is mathematically identical to the more commonly used residuals of logged variables (except that the baseline is taken to be the value of the individual taxon’s brain component rather than the scaled average value for the Order or other higher taxonomic grouping). Reproduced with permission from Barrett et al. (2002).
The social network-network: size is predicted by brain structure and function in the amygdala and paralimbic regions

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The social brain hypothesis proposes that the large size of the primate neocortex evolved to support complex and demanding social interactions. Accordingly, recent studies have reported correlations between the size of an individual’s social network and the density of gray matter (GM) in regions of the brain implicated in social cognition. However, the reported relationships between GM density and social group size are somewhat inconsistent with studies reporting correlations in different brain regions. One factor that might account for these discrepancies is the use of different measures of social network size (SNS). This study used several measures of SNS to assess the relationships SNS and GM density. The second goal of this study was to test the relationship between social network measures and functional brain activity. Participants performed a social closeness task using photos of their friends and unknown people. Across the VBM and functional magnetic resonance imaging analyses, individual differences in SNS were consistently related to structural and functional differences in three regions: the left amygdala, right amygdala and the right entorhinal/ventral anterior temporal cortex.

SIZE OF SOCIAL NETWORK CORRELATES WITH AMYGDALA ACTIVITY

BRAINS EVOLVED TO ADAPT TO ENVIRONMENT - BRAIN IS BIASED TO SEE FACES

https://www.echalk.co.uk/amusements/OpticalIllusions/hollowMask/hollowface.html
Convex or Concave?

To most people, some of these circles look convex. The one at bottom center looks concave. In fact, all the circles are identical. The one at bottom center is just upside down. However, the brain interprets the circles with the darker part at top as concave and the darker part at bottom as convex. This is because the visual system assumes light is coming from above (the sun, an overhead light) and perceives the shape according to that model.
3.

FACES = KEY TO SOCIAL

Faces are important to being social
Review

Neural bases of eye and gaze processing: The core of social cognition

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ABSTRACT

Eyes and gaze are very important stimuli for human social interactions. Recent studies suggest that impairments in recognizing face identity, facial emotions or in inferring attention and intentions of others could be linked to difficulties in extracting the relevant information from the eye region including gaze direction. In this review, we address the central role of eyes and gaze in social cognition. We start with behavioral data demonstrating the importance of the eye region and the impact of gaze on the most significant aspects of face processing. We review neuropsychological cases and data from various imaging techniques such as fMRI/PET and ERP/MEG. In an attempt to best describe the spatio-temporal networks underlying these processes. The existence of a neuronal eye detector mechanism is discussed as well as the links between eye gaze and social cognition impairments in autism. We suggest impairments in processing eyes and gaze may represent a core deficiency in several other brain pathologies and may be central to abnormal social cognition.

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"The human face is arguably the most important visual stimulus we process every day as it informs us how to behave socially."

1. Introduction

The human face is arguably the most important visual stimulus we process everyday as it informs us how to behave socially: being able to discriminate whether the person coming at you is your friend or your boss and whether he looks angry or joyful will certainly make a difference in how you interact with him. The eye region of the face represents a special area due to the extensive amount of information that can be extracted from it. You can perceive your boss's fake smile by the absence of wrinkles around the eyes while a friend's averted gaze can inform you something is wrong. More than other facial features, the eyes are central to all aspects of social communication such as emotions, direction of attention and identity. The field of Cognitive and Behavioral Neuroscience has recently witnessed an explosion of studies investigating the processing of the eye region and gaze direction in various tasks and social situations but due to their extensive complexity, the underlying neural systems subtending these processes are far from being understood. The central role of eyes and gaze in social cognition and the state of knowledge of the neural networks involved in perceiving these fundamental social cues are the topics of the present review.
“A room full of strangers every day”: The psychosocial impact of developmental prosopagnosia on children and their families

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What happens to you when you are face blind?

Our results are also consistent with findings from Yardley et al. [9], who interviewed adults with DP. Those adults reported difficulties with social interactions, elevated levels of anxiety, and negative feelings, such as embarrassment and guilt. For some, their face recognition difficulties had a long-lasting impact on social functioning. An open question is how the children in the present study will transition into adulthood, and whether they will encounter some of the specific experiences reported by adult DPs [9]. This seems likely given the similarities between results from Yardley and colleagues' findings and our own, as well as the tendency for adults with DP to recall experiences from their childhood reminiscent of those of the children in this report.
4. GAZE DIRECTION AND DECISIONS

How does gaze direction affect decision-making?
Perceived Gaze Direction Modulates Neural Processing of Prosocial Decision Making

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Three types of eye photos:
(a) human eyes with a direct gaze,
(b) human eyes with an averted gaze and
(c) robot’s eyes.

You are invited to interact with anonymous counterparts in an online game.

You should treat each trial as a single-shot interaction since counterparts will vary across trials and players cannot recognize each other.

A photo of either human eyes or a robot’s eyes will be shown on a given trial to represent the counterpart type, i.e., human or robot, but not identity.
Computer mimicked stock market:

A monetary investment offer is presented from the counterpart to the participant.

counterpart's offer:

The cyan and purple areas in the vertically stacked bars represented the proportions of reward assigned to the counterpart and the participant.

To accept the counterpart’s proposal is beneficial to both players.

To reject the proposal indicates a plan more advantageous to the participant.

If the participant makes no action, all benefits will be delivered to the counterpart in that trial.

The counterpart will have 50-50 chance to know whether the participant has accepted or rejected the counterparts offer.

If the participant rejects an offer, their share in that trial will be transferred to the counterpart when he/she knows your choice – else participant will keep their share.

FIGURE 2 | Functional magnetic resonance imaging (fMRI) findings of the interaction between Gaze and Choice. (A) Prosocial vs. selfish choices were associated with stronger activations in right superior temporal gyrus (R STG) for averted than direct gaze. Imaging results were height-thresholded at $p < 0.001$ and survived $p < 0.05$ family-wise error (FWE) correction. (B) Larger fMRI beta values averaged within the cluster in R STG were found for prosocial choice than selfish choice when averted gaze was presented ($t_{(26)} = 4.583, p = 0.006$ corrected). Error bar denotes standard error mean. (C) Significant correlation (Pearson's $R = -0.585, p = 0.008$ corrected) was found between fMRI betas in R STG and reaction time (RT) for the condition of prosocial choice accompanied with averted gaze. **$p < 0.01$, ***$p < 0.001$. 