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Neural correlates of Machiavellian strategies in a social dilemma task

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ABSTRACT

In spite of having deficits in various areas of social cognition, especially in mindreading, Machiavellian individuals are typically very successful in different tasks, including solving social dilemmas. We assume that a profound examination of neural structures associated with decision-making processes is needed to learn more about Machiavellians' abilities in exploiting other people. More specifically, we predicted that high-Mach people would show elevated activity in the brain areas involved in reward-seeking, anticipation of risky situations, and inference making. To test this hypothesis, we used an fMRI technique to examine individuals as they played the Trust Game. In accordance with our predictions, we found consistent activation in high-Machs' thalamus and anterior cingulate cortex (player 1), and dorsal anterior insula/inferior frontal gyrus (player 2). We suggest that Machiavellians conduct specific neural operations in social dilemma situations that make them successful in exploiting others. Machiavellians may have cognitive heuristics that enable them to make predictions about the future reward in a basically risky and unpredictable situation.

1. Introduction

Machiavellianism refers to interpersonal strategies that advocate self-interest, deception, and manipulation (Fehr, Samsom, & Paulhus, 1992, Jones & Paulhus, 2009). A person high in Mach is likely to exploit others and less likely to be concerned about other people beyond his or her own self-interest. It has been argued that advanced human computational power would be a necessary precondition for the ability to manipulate others (Byrne, 1995; Dunbar, 1998). Particularly, mindreading ability would be an important cognitive device for successful manipulation. This is because good mind readers – that is, people who can easily understand the others' intentions, beliefs and knowledge – are one step ahead of others and can mislead them more easily than those with poor mindreading ability. It appears that the manipulative behavior characteristic of Machiavellianism cannot work efficiently without the refined use of a theory of mind (ToM) (McIllwain, 2003; Repacholi, Slaughter, Pritchard, & Gibbs, 2003).

However, surprisingly, the first study did not find any relationship between Machiavellianism (measured on Mach-IV scale) and theory of mind (measured on a verbal comprehension test) (Paal & Bereczkei, 2007). Furthermore, later studies, using tests for ToM differences in comprehension of stories, in the eye region, and in facial expressions found a significant but negative relationship – that is, people having high scores on the Mach IV test proved to be weak mindreaders (Ali & Chamorro-Premuzic, 2010; Lyons, Caldwell, & Shultz, 2010). Moreover, other studies have revealed that high-Machs show a lower level of empathy, less advanced emotional intelligence, and worse skill in understanding emotions than low-Machs (Austin, Farrelly, Black, & Moore, 2007; Barlow, Qualter, & Stylianou, 2010; McIllwain, 2003; Nettle & Liddle, 2008, Wastell & Booth, 2003).

Therefore, rather than having a superior understanding of others, Machiavellian individuals appear to have deficits in various areas of social cognition, especially in attributing mental states and emotions to others. Nevertheless, as a matter of fact, Machiavellians are smart; many studies have demonstrated that Machiavellians are very successful in various tasks, including social dilemma situations (Gunnthorsdottir, McCabe, & Smith, 2002). In experimental settings, high-Machs frequently outperform low-Machs, whether in bargaining and alliance forming or assuming leadership in group situations (Cherulnik, Way, Ames, & Hutto, 1981; Christie & Geis, 1970). A study using the Trust Game found that high-Mach people did not reciprocate the favor they received from their partner and gained a higher profit than low-Machs (Gunnthorsdottir et al., 2002). A more recent study found that high-Mach players in a modified Ultimatum game of 24 trials earned higher income by the end of the game than did low-Machs (Spitzer, Fischbacher, Herrnberger, Gron, and Fehr (2007)).

Recent evidence suggests that one of the crucial Machiavellian characters underlying successful adaptation to the social environment is flexibility. Machiavellian people are frequently described as rational, cold, impersonal, aloof, and practical; they can stay

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emotionally detached from a situation (Christie & Geis, 1970; Fehr, Samsom, & Paulhus, 1992). They can calmly identify the optimal strategy in each situation and behave in a self-interested way if it is to their advantage (Gunnthorsdottir et al., 2002). Because of this opportunism, they easily leave an alliance when it is advantageous for them, and are likely to steal from someone who trusts them (Christie & Geis, 1970; Harrell & Hartnagel, 1976; Wilson, Near, & Miller, 1998). A recent study using a modified Ultimatum game found a positive correlation between overall earnings and Machiavellian score. This finding appeared to result from the Machiavellians' flexible adaptation to the social context: they earned most in the non-punishing condition of the game, whereas they escaped punishment in the punishment condition (Spitzer et al., 2007).

As a means of flexibility, Machiavellians frequently conceal their intentions in order to achieve their goals (Wilson, Near, & Miller, 1996). In a recent study, subjects were asked to volunteer and offer a less and a more costly charity service in both public and anonymous conditions (Bereczkei, Birkas, & Kerekes, 2010). Subjects with high scores on Mach-IV were not likely to give assistance when they were not observed by the others but increased their help to others when their group members could observe their behavior. High-Mach persons seemed to give specific responses to different social circumstances: they disguised their selfishness and pretended altruism in the presence of others, but realized their self-interest when others could not observe their behavior.

Another recent study, using Public Goods Game, found that situational factors like the other players' behavior proved to be more predictive for the high Mach people's final payoff, compared to that of low-Machs (Czibor & Bereczkei, 2012). Machiavellians offered significantly less in every round and gained a higher profit by the end of the game than non-Machiavellians. Regression analyses have revealed that high-Machs track the previous movements of others and adjust their contributions to the behavior of their group mates. The authors concluded that Machiavellians are highly sensitive to signals in a social dilemma situation and capable of making flexible decisions. Therefore, they successfully exploit others in spite of their deficits in social cognition.

Now, the question is, what abilities and their neural correlates are involved in their behavior? In the present experiment we used an event-related fMRI paradigm during Trust Game for analyzing cooperative and non-cooperative strategies and the underlying brain areas. In this bargaining game, the first player (investor) has the chance of choosing a costly trusting action, that is transferring some of the money she/he possesses. Then the player 2 (trustee) is informed about the investor's action and can honor it by reciprocating a part of her/his payoffs. Trusting is always risky given the unpredictability of the intentions of the partner (player 2) in a social exchange. The decision to reciprocate, on the other hand, is dependent on evaluating consequences for the second player's personal outcomes and the others' previous behavior. Consequently, player 1 faces unpredictability and potential threat from the partner, whereas player 2 is expected to consider the norm of reciprocity.

Recently, several studies, using Trust Game, have demonstrated the neural correlates of the participants' responses to various conditions of social dilemma situations. One found that the breaking of the promise, that the participants made before playing, was associated with elevated activities in dorsolateral prefrontal cortex (dlPFC), anterior cingulate cortex, and amygdala (Baugmgartner, Fischbacher, Feierabend, Lutz, & Fehr, 2009). Another study have demonstrated ventromedial and dorsomedial PFC when the participants decided not to honor the partner's trust (Chang, Smith, Dufwenberg, & Sanfey, 2011). Different types of trust evoke different activity patters: conditional trust (one's partner is self-interested) selectively activated the ventral tegmental area, whereas unconditional trust (one's partner is trustworthy) activated the septal area (Krueger et al., 2007). Also individual differences in social value orientation were found to modulate activation in temporal-parietal-junction, bilateral anterior insula, and anterior cingulate cortex (van den Bos, van Dijk, Westenberg, Rombouts, & Crone, 2009).

We propose that an examination of neural structures associated with decision-making processes in a social dilemma task, such as Trust Game, is needed to learn more about the motives underlying the Machiavellians' behavior. We hypothesize that instead of having an advanced theory of mind, general intelligence, and emotional intelligence, Machiavellians have specific cognitive skills that allow them to evaluate the most important factors associated with the situation around them and other people's behavior. In the light of evidence, Machiavellians can change their tactics creatively and flexibly as the social games changes (Bereczkei et al., 2010; Christie & Geis, 1970; Czibor & Bereczkei, 2012; Spitzer et al., 2007). They are characterized by practical problem-solving, flexibility, and risk-taking (Jones & Paulhus, 2009).

We predict that Machiavellians as first players show an elevated activity in the brain regions associated with reward-seeking and anticipation of a risky situation involving a gain or a loss of money (thalamus, caudate nucleus). They may feel intense conflict between their long-term interest to obey the social norms and wish to desert the partner that is expected to activate anterior cingulate cortex. High-Machs as second players are expected to show increased activities in brain areas involved in making inferences and skills such as planning and mental flexibility (inferior and middle frontal gyrus).

2. Methods

2.1. Participants

Thirty right-handed healthy volunteers participated in the study. Three participants were excluded from the analysis after data collection due to motion artifacts, previous knowledge about the study and claustrophobia. The final sample included 27 participants, 13 males and 14 females aged between 19 and 30 (mean age: 23 years, standard deviation: 2.42 years). The participants were selected from a large sample of our previous studies ($N = 620$) on the basis of their scores on the Mach-IV scale. From this sample we retained extreme values below and above one standard deviation (SD = 13.04) of the mean score of 101.08. Individuals who obtained scores lower than 88 were defined as low Mach (LM) persons, whereas subjects who scored higher than 114 were defined as high-Mach (HM) persons. The LM group consisted of seven males and eight females, while the HM group was made up by six males and six females. No subject had any neurological, medical or psychiatric disorder.

2.2. The Trust Game

During fMRI scanning, participants were playing a Trust Game. In this game, a player (the Investor) must decide how much of his or her initial capital of 1000 HUF (about $5) to transfer to a partner (Trustee). Once transferred, this money is tripled by the experimenter, and the Trustee will have the opportunity to return all, some, or none of the money to the Investor. From a purely economic point of view, the Investor's interest is not to trust in the partner and – consequently – transfer only a small amount of money. Similarly, the Trustee gains when he or she does not reciprocate but keeps the major part of the money for him- or herself (Fehr & Rockenbach, 2003).