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Overclaiming and the medial prefrontal cortex: A transcranial magnetic stimulation study

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The tendency to claim more knowledge than one actually has is common and well documented; however, little research has focused on the neural mechanisms that underlie this phenomenon. The goal of the present study was to investigate the cortical correlates of overclaiming. Transcranial magnetic stimulation (TMS) was delivered to the medial prefrontal cortex (MPFC), supplementary motor area, and precuneus during the presentation of a series of words that participants were told made up a cultural IQ test. However, participants were not informed that 50% of the words were actually fabricated. False claiming was reduced following MPFC TMS. Furthermore, reaction time decreases following MPFC TMS indicated that participants engaged in less reflection during the task, suggesting a potential reduction in social monitoring of behavior.

Keywords: Self-monitoring; Deception; Medial prefrontal cortex; Overclaiming; Self-deception; Transcranial magnetic stimulation; Self-enhancement; Social monitoring.

INTRODUCTION

Misperceptions about the self and others pervade social life, and the degree to which individuals can correctly perceive and report on their abilities has been debated (John & Robins, 1994; Kwan et al., 2007; Paulhus, 1998; Paulhus, Harms, Bruce, & Lysy, 2003). In the domain of trait attributions, one may find a large discrepancy between the perception and presentation of self-related information and the actual reality of those characteristics (Alicke, 1985; Kwan, John, Kenny, Bond, & Robins, 2004; Neisser, 1988). Motivation to portray oneself in a more positive light is quite common in social interactions. Snyder (1974) describes monitoring of the self as the process through which people regulate their own behavior in order to be perceived in a favorable way. With the use of social comparison information, it is possible not only to direct the appropriateness of one's actions from situation to situation, but also to present the most favorable image of the self to others (Amodio & Frith, 2006; Snyder & Cantor, 1980; Snyder & Gangestad, 1982; Snyder & Simpson, 1984). This egoistic bias represents a deceptive tendency to enhance one's social, moral, physical, and intellectual status (Paulhus & John, 1998). Specifically, this self-enhancement bias can result in an individual reporting higher intelligence or claiming to have more knowledge than he or she actually possesses (Paulhus & Harms, 2004; Paulhus et al., 2003).

In studies of desirable responding, Paulhus (1991) has defined overclaiming as the tendency to claim more knowledge than is possible. With the overclaiming phenomenon, it has been demonstrated that false knowledge can be claimed on tests requiring individuals to admit familiarity with non-existent or impossible topics or events (Paulhus et al., 2003). Such common inclinations to overclaim may serve to

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maintain self-esteem, promote social desirability, and aid in impression management (Mesmer-Magnus, Viswesvaran, Deshpande, & Joseph, 2006). Biases of this nature may be adaptive and reveal a connection to mental health, particularly positive self-regard (Bonanno, Field, Kovacevic, & Kaltman, 2002; Sedikides, Rudich, Gregg, Kusmashiro, & Rusbult, 2004).

Researchers have yet to fully explain the process of overclaiming. Overclaiming may result, in part, from a memory bias in which humans tend to find familiarity in almost everything (Williams, Paulhus, & Nathanson, 2002). Other empirical evidence confirms such a trend and suggests an adaptive prevalence of false memories related to the self (Okado & Stark, 2003). The extent to which overclaiming is an automatic or conscious process has not been fully investigated (Paulhus & Harms, 2004). Despite the ambiguities, it is generally agreed that at some level, respondents are not willing to admit ignorance on a topic that seems like it should be known (Paulhus, 1991). Specifically, Bradley (1981) highlights that this overconfidence is especially likely to occur in areas of perceived expertise. Overall, most of the research on overclaiming has focused on the degree to which it represents an ego-protecting response. A focal point in the literature has been on individual differences, such as narcissism, that are linked to overclaiming (Paulhus & Williams, 2002). Less work has presented it in the framework of deceptive self-monitoring, and little research has examined the neural correlates of overclaiming.

While Paulhus and Reid (1991) described the overclaimer as being prone to self-deceptive positivity, few have labeled the phenomenon as overt deception. Deception in this sense refers to a deliberate misrepresentation of information about the self or others (Trivers, 1991; Stevens, Guise, Christiana, Kumar & Keenan, 2007; Spence et al., 2001; Vrij, 2001). Such misrepresentations have been classified as Machiavellian social manipulations, and have been linked to both narcissism and a tendency to self-enhance on objective tests (Paulhus & Williams, 2002). Byrne (1997) describes this intelligence as a mechanism that has evolved out of the complexity of living in close social groups. As an adaptive ability, deceptive behavior characterizes many of our social interactions (DePaulo & Kashy, 1998). Such deception allows us to have exaggerated perceptions of control in conditions of extreme adversity (Taylor & Armor, 1996; Bonanno et al., 2002), and enables us to deal with a social environment that is simultaneously competitive and cooperative (Byrne, 1998).

Neuroimaging studies have presented a number of findings of particular relevance to self-monitoring, self-enhancement, and self-related deception. While different types of deception reveal varied patterns of activation, it appears that the medial prefrontal cortex (MPFC) plays an important role in processing self-related information necessary to misrepresent characteristics of the self. Specifically, the MPFC shows strong activation in self-referential processing (Izuma, Saito, & Sadato, 2009; Johnson et al., 2005, Oschner et al., 2005). For example, reflecting on one's own thoughts, personality traits, or personal reputations involves MPFC regions (Izuma et al., 2009). Oschner et al. (2005) suggested that subregions of the MPFC are selectively activated for self-judgments, and Macrae, Moran, Heatherton, Banfield, & Kelley (2004) concluded that activity in the MPFC significantly predicted memory performance for self-relevant judgments. In addition, it should be specified that such activation in the cortical midline regions is potentially stronger in reference to the present self, as differentiated from appraisals of the self in the past (D'Argenbeau, Feyers, Majerus, Collette, & Van der Linden, 2008). When comparing the self to close others on desirable and undesirable traits, a recent study found that transcranial magnetic stimulation (TMS) delivered to the MPFC disrupted self-enhancement, as compared to stimulation to the precuneus and a sham condition (Kwan et al., 2007). In this study, participants were presented with egoistic and moralistic words to determine if the positive or negative adjectives described themselves. It was found that TMS disrupted yes responses to egoistic words, suggesting a selective role of the MPFC for self-enhancement (Kwan et al., 2007). For self-evaluations and social desirability, Craik et al. (1999) also found involvement of the MPFC regions in judgments of trait adjectives during positron emission tomography (PET). Overall, regions of the MPFC are found to be particularly important for comparing the self to others.

With regard to deception, Langleben et al. (2005), in a functional magnetic resonance imaging (fMRI) study, found increased superior medial and inferolateral prefrontal cortical activation during deception. Spence et al. (2001) and Lee et al. (2002) found MPFC, anterior cingulate cortex (ACC), and bilateral ventrolateral prefrontal cortical activity during deceptive responses. Additionally, a study by Ganis. Kosslyn, Stose, Thompson, and Yurgelun-Todd (2003) revealed similar links between deception and changes of MPFC, ACC, motor cortex, and occipital activation. It was concluded by Spence et al. (2005) that MPFC and ACC are indeed involved in deception. Lou et al.

(2004) suggested that the medial parietal region could be thought of as a nodal structure in self-representation functionally connected to both the right and medial prefrontal cortices. Their TMS findings indicated that this network has similarities to networks of the resting conscious state, which may demonstrate that self-monitoring is a main function of resting consciousness (Lou et al., 2004). Similarly, Gusnard, Akbudak, Shulman, & Raichle (2001) suggested that self-reflective thought, as mediated by the MPFC, may represent a default mode of mental activity, and Johnson et al. (2006) was in accord with this position distinguishing the dorsal MPFC as an area associated with an inward-directed self-focused agenda. Specifically, these authors found the dorsal MPFC region to be associated with self-related intentions (Johnson et al., 2006). Furthermore, a review by Schmitz and Johnson (2007) implicates the dorsal–ventral axis of the MPFC as an ideal substrate for the evaluation and manipulation of self-relevant information necessary for the process of self-monitoring in a social environment. Nevertheless, these studies were not designed to test self-enhancement bias. The neural correlates of overclaiming remain largely unknown.

If overclaiming is a form of deceptive self-monitoring that relies highly on self-relevant processing, it is plausible that it may be mediated, in part, by contributions of the MPFC. To test this possibility, the current study utilized TMS in a "virtual lesion" design. In this manner, TMS allows one to temporarily disrupt processing of brain regions during cognitive tasks. An advantage of this method is that a causal role can be determined in light of the recent neuroimaging findings on deception.

In this study, we delivered TMS to the MPFC under conditions that would reveal overclaiming behavior on a basic response task. To measure overclaiming, a technique similar to that used by Paulhus and Bruce (1990) was implemented in which respondents had to rate their familiarity with a set of items presented as a cultural IQ test. The list contained a corpus of items that an educated individual would likely know, including notable historical individuals, novels, events, vocabulary, and characters (Paulhus & Bruce, 1990). Unknown to the participants, 50% of the items on the IQ test were foil words, fabricated to sound like real items. A yes response would indicate familiarity with the term, and a no response would indicate having never heard of the term. Based on previous research, we expected that participants would behaviorally respond in ways that indicated overclaiming; that is, participants would say that they knew a number of the foil words, even though there is no possibility that they definitively had knowledge of those terms. Importantly, we predicted that TMS to the MPFC would affect overclaiming, such that disruption of the region would reduce the overclaiming bias.

To control for the possibility that TMS merely disrupted one's ability to process self-relevant information, and not specifically overclaiming, TMS was also applied to the precuneus (Pz). This region has been shown to be more engaged when one is processing self-related information across a number of self-evaluation experiments (Lou et al. 2004; Segar, Stone, & Keenan, 2004). To our knowledge no studies have implicated Pz in deception. Hence, stimulation to Pz would possibly slow down reaction times, but not influence overclaiming significantly. TMS was also delivered to the supplementary motor area (SMA) as a control stimulation site because it has not been implicated in self–other differentiation or deception. Sham TMS—application of the magnetic coil to the scalp without stimulation—served as our absolute control condition.

METHOD

Participants

Eleven university students were recruited (8 males and 3 females; age M = 27.1 years, SD = 10) via flyer and word of mouth for the study. All participants were paid $25 for their participation and were treated in accordance with guidelines of the Internal Review Board at Montclair State University and of the American Psychological Association. All TMS was delivered within the parameters provided by Wasserman (1998).

Materials

A Magstim single-pulse TMS device was used for all stimulation. A 70-mm figure-of-eight coil was used throughout the experiment. All stimuli were presented on a Dell desktop computer with a 17-inch CRT monitor. All triggering occurred through BioPack amplifiers, which were also used for motor threshold determination.

Stimuli

All items were drawn from the comprehensive list adopted by Paulhus et al. (2003) containing words adopted from Hirsch (1988). The items contained words referring to historical names, events, books, fine arts, poems, literature, authors, social science, physical science, law, and popular culture (Paulhus et al., 2003). The foil words were created to appear as if they legitimately belonged to one of these categories of cultural literacy. Foils did not resemble any of the other target words in the study, nor did they closely resemble other already existing terms. They were created to appear to be plausible members of the same categories (Paulhus et al., 2003). Participants were informed that they were taking a cultural IQ test, and were instructed to respond (yes or no) on the keyboard, depending on whether or not they knew the word that appeared on the screen. They were not informed that 50% of the terms being presented consisted of foil words.

TMS procedure

Wasserman's (1998) guidelines were used to set the limits of stimulation throughout the testing sessions. The testing was executed in two phases: motor threshold determination and the experiment proper. Participants were initially fitted with a tight Lycra swim cap. Suprathreshold TMS pulses were delivered to locate the region that provided the greatest motor evoked potential (MEP) response to the contralateral abductor pollicis brevis (APB) muscle. The coil was relocated across the scalp until the most responsive region was found that induced MEPs of maximal peak-to-peak amplitude. Determination of individual magnetization transfer (MT) was employed using procedures outlined by the International Federation of Clinical Neurophysiology (IFCN; Rossini et al., 1994), such that threshold was established when 50% (5 of 10) of the TMS pulses delivered induced a measured MEP of >50 μV. All active stimulation was delivered at 90% MT during the experiment proper. All MT measurements were made via BioPack MP150 amplifiers and software. Once the MT intensity was determined, the cap was marked in the 10/20 international system for electroencephalography (EEG) electrode positions.

The regions of interest were the Pz, the MPFC, and the SMA. Cortical placement was identical to that used in similar studies (Barrios et al., 2008; Kwan et al., 2007). First, one third of the distance, nasion to inion, was measured for each participant. MPFC was 1.5 cm anterior to this location, and SMA was identified as being 3 cm posterior to this location. The coil was oriented parallel to the midsagittal line for all stimulation with the handle pointed in a posterior orientation (except for APB MT determination, in which the coil was held at ~45° from the hemispheric line). The depth of cortical stimulation is no greater than 2 cm, ensuring that the initial effects of TMS are concentrated to the areas of interest (Wasserman, 1998).

Baseline performance was measured by a sham condition. During sham, the TMS coil was held at 90° orientation and held over Cz (standard 10/20 system coordinates). Because the regions (MPFC and SMA) are somewhat adjacent, single-pulse TMS was employed to avoid cortical spread. The coil was held manually (e.g., Lou et al., 2004) to ensure quick shifting of blocks as they changed approximately once per minute. For all testing sessions, participants wore protective earplugs to prevent transient threshold shifts caused by the acoustic artifact generated by the discharge of the TMS coil (Wassermann, 1998).

Measures of overclaiming

The list of words was divided into four blocks containing 36 words per block. For each block 50% of the words were real terms (e.g., Ayn Rand, Ampersand), and 50% were fake terms (e.g., Murphy's Last Ride, Trey Surf Wear). Therefore, TMS to each of the four brain regions was delivered during 36 word presentations. All words were randomized, and all lists were counterbalanced across participants. The order of all brain region sites was randomized. All words within a block were also randomly presented.

Participants indicated their response (yes or no) via a standard keyboard. For all trials, TMS was delivered 500 ms after the word appeared on the screen (see Figure 1). Response times were measured as the length of time after the TMS pulse.

RESULTS

We first analyzed reaction time. Overall reaction time was 574.67 (SE = 72.80). Response times for all conditions are reported in Table 1. To determine if TMS influenced reaction time, we performed a 2 (veracity) × 4 (brain site) repeated measures analysis of variance (ANOVA). The dependent variable was reaction time (RT). There was no overall interaction between the IVs, $F(3, 30) = 1.34$, $p = .28$. We then examined the main effects. It was found that there was a significant difference in reaction time for word veracity, $F(1, 10) = 22.37$, $p < .001$. Real words (M = 535.98, SE = 70.59) were identified significantly more quickly than fake words (M = 613.37, SE = 75.84). Additionally, there was a trend for the main effect of brain area, $F(3, 30) = 2.35$, $p = .09$.

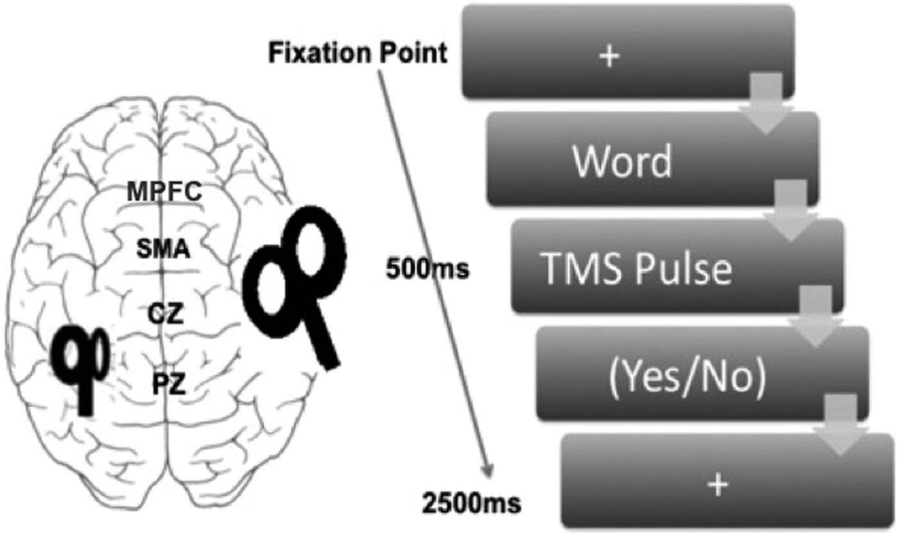

Figure 1. Experimental design.

TABLE 1
Reaction time for fake and real words during each stimulation condition

	Fake words		*Real words*	
Brain region	*Mean (ms)*	*SE*	*Mean (ms)*	*SE*
Sham	685.50	106.27	550.42	76.03
SMA	558.56	70.12	499.53	60.24
Pz	687.86	114.63	617.12	94.98
MPFC	521.57	64.61	476.84	78.38

Because the main effect of brain region existed as a trend only, we employed a series of comparisons to sham. Only MPFC differed significantly from sham, $t(10) = -2.68$, $p = .023$. This result that indicated reaction time during MPFC stimulation ($M = 499.17$, $SE = 70.65$) was significantly less than reaction time during sham stimulation ($M = 617.93$, $SE = 89.85$). Multiple comparisons were controlled for by employing a modified stepwise Bonferroni test.

We were unable to include all of the responses in the overall ANOVA due to a significant number of blank cells for one participant (for example, Participant 3 never answered "yes" to a fake word during sham stimulation). Because of these blank cells, we considered response independently. First, there was no significant difference between yes (yes response indicated the person thought they knew the word) and no responses, $t(10) = 1.58$, $p = .15$. There was a significant interaction between word veracity and response, $F(1, 10) = 5.43$, $p = .04$. Post-hoc tests revealed that the only difference occurred between yes responses for real and fake words, $t(10) = 3.26$, $p = .009$. The nature of the effect indicated that yes responses for real words ($M = 478.94$, $SE = 51.18$) were significantly quicker than yes responses for fake words ($M = 617.04$, $SE = 68.12$).

We then analyzed responses of identification (yes responses). The overall identification of words was .46 ($SE = 0.06$). To simplify presentation, all data are given in terms of proportion of positive responses. We first performed a 4×2 ANOVA for brain region by veracity to identify where differences in identifications came from. Specifically, we were interested in the main effects. For veracity, it was found that there was a significant main effect such that real words were identified at a significantly higher rate than fake words, $F(1, 10) = 17.14$, $p = .002$. The real word identification rate was .58 ($SE = 0.06$). The fake word identification rate was .34 ($SE = 0.07$). There was no main effect for brain region, indicating that overall response rate did not change due to TMS, $F(3, 30) = 0.06$, $p = .98$. The main hypothesis in terms of responses was that the overclaiming bias would decrease across brain regions compared to sham. During sham TMS, the rate of claiming to know fake words was .34 ($SE = 0.07$). To further analyze the interaction, we examined fake words by employing a chi squared test in which we subtracted each participant's number of fake yes responses from their real yes responses. For example, if a participant claimed knowledge of 11 real words and 4 fake words, his/her index would be 7. This number represents the difference between real and fake claims of knowledge. For the sham condition, the average difference was 2.82

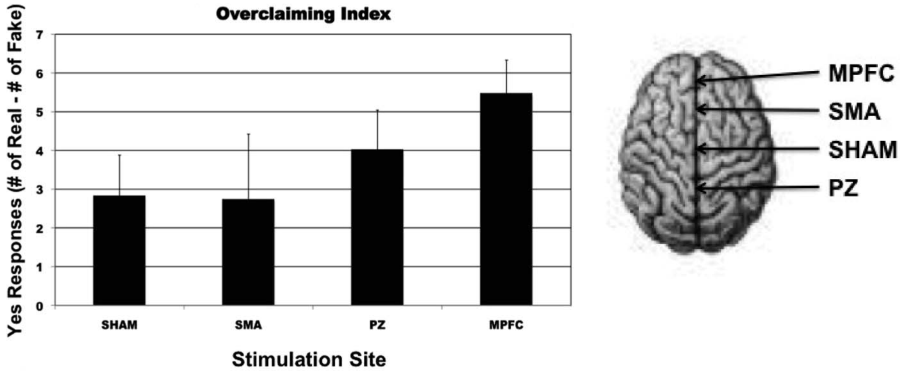

Figure 2. Yes responses (real–fake).

(*SE* = 1.06). All four conditions were compared in terms of this response value. It was found that there was a significant overall difference between the conditions, $\chi^2(3) = 14.32$, $p = .002$ (see Figure 2).

To test the nature of this difference, each active brain group was compared to sham. It was found for MPFC that the mean difference was 5.45 (*SE* = 0.88), which was a significant difference when compared to sham (*M* = 2.82, *SE* = 1.06; $\chi^2(1) = 9.24$, $p = .002$). This difference indicated fewer knowledge claims for fake words with MPFC TMS than for sham. Neither Pz (*M* = 4.0, *SE* = 1.04) nor SMA (*M* = 2.73, *SE* = 1.69) differed significantly from sham. These data indicate that overclaiming responses were reduced only by MPFC stimulation.

Inspection of individual data revealed that none of the subjects undergoing MPFC TMS endorsed fake words more often than real words, whereas 18.2% (*n* = 2) claimed to know fake words more often than real words in the sham condition. This proportion, 18.2%, was the same for Pz. Surprisingly, 36.4% (*n* = 4) of participants undergoing TMS to SMA claimed to know fake words more often than real words.

DISCUSSION

The data suggest that overclaiming is significantly reduced when TMS is delivered to the MPFC. The difference between claiming to know real and fake words varied depending on TMS delivery site, such that false claiming (e.g., overclaiming) may be mediated via the MPFC. Furthermore, decreases in the reaction time found following MPFC TMS indicated that participants engaged in less reflection during this task, suggesting a potential reduction in social monitoring of one's behavior.

Previous research has described the overclaiming phenomenon as a deceptive bias involving self-related information, namely one's knowledge about particular topics or events (Paulhus, 1991; Paulhus & Harms; 2004). Neuroimaging findings have demonstrated that the MPFC plays an important role in self-referential processing and reflecting on self-relevant information (Johnson et al., 2005; Oschner et al., 2005). Regions of the MPFC have also been demonstrated to be important for the appraisal of positive traits for the self in studies employing TMS (Barrios et al., 2008; Kwan et al., 2007) and PET (Craik et al., 1993). Furthermore, the ability to deceive about self-information shows strong activation in the MPFC in studies utilizing fMRI (e.g., Ganis et al., 2003; Langleben et al., 2005; Spence et al., 2005). This investigation provides further support for the role of the MPFC region in deceptively presenting misinformation about the self; specifically, how much one knows about popular culture.

The misperception and misrepresentation of vital personal attributes such as social, moral, physical, and intellectual traits is well documented in research on social monitoring and self-enhancement (Brown, 1986; John & Robins, 1994; Snyder, 1974). The inclination to give desirable responses is guided by the motivation to present the best impression of oneself from one social situation to another (Mesmer-Magnus et al., 2006; Snyder, 1974). With regard to social appropriateness and social comparisons, the tendency to monitor one's actions is quite common. In situations that induce either public or private self-awareness, differential response patterns have been observed between high and low self-monitors (Web, Marsh, Schneiderman, & David, 1989). This implied connection between self-awareness and social monitoring is supported by neuroimaging findings presented by Lou and colleagues (2004) describing a network of structures involved in self-representation that are functionally connected to the right and medial prefrontal cortices. Our study contributes to additional findings that networks involving the MPFC are important for the processes underlying positive self-presentation and social monitoring. Specifically, our findings further demonstrate that the MPFC may be important for monitoring of the self in a socially demanding situation.

A number of studies on desirable responding and overclaiming have focused on personality factors (Paulhus & John, 1998; Paulhus & Williams, 2002; Taylor & Lerner, 2003; Taylor et al., 2003). For example, narcissism was found by Paulhus and Williams (2002) and Kwan, John, Robins, & Kuang (2008) to be linked to overclaiming and self-enhancement respectively. Individual differences have also been observed in the domain of social monitoring. In validation studies of social monitoring scales, Snyder (1974) found that theater actors scored highest on scales of self-monitoring, while hospitalized psychiatric patients scored lower than university students. It would be interesting for future studies to investigate activity in the same brain regions with respect to such individual differences and personality variables. Furthermore, it would be beneficial to examine the extent to which those individuals who demonstrate overclaiming also score high on measures of self-enhancement.

The virtual lesion design employed by this investigation has enabled us to establish a link between the brain area of the MPFC and the behavior in question. More research is needed to determine a definitive causal relationship between the MPFC and deceptive self-monitoring as witnessed by the overclaiming technique. It remains to be specified whether this relationship is directly representing a specific connection to false knowledge claims or more generally to impression management, social monitoring, or self-related deception. While it may be premature to propose a definitive theoretical link between deception and overclaiming, it is important to understand whether overclaiming is as deliberate and purposeful as overt deception, or whether it exists merely as a failure of signal detection. It may very well be the case that overclaiming on psychometric tests qualifies as a more automatic phenomenon, whereas overclaiming in the context of a social interaction is more willful and conscious. This key difference needs to be examined in future work. Moreover, comparisons between true identification and false knowledge claims cannot be drawn with this paradigm. True identification was not of interest in this study, but it would certainly be beneficial for future investigators to pinpoint whether participants actually knew the real words that they claimed to know, possibly by testing knowledge after TMS procedures. Furthermore, conclusions drawn from this experiment are limited by a somewhat small sample size, and an unequal number of male and female participants.

Previous studies have pointed out that the MPFC may mediate feelings of knowing and familiarity (Macpherson et al., 2008). It may be possible that TMS to the MPFC disrupts the signals associated with the tendency for fake items to seem familiar. Future studies should seek to investigate the extent to which an overclaiming bias might actually represent a false memory bias in which humans find familiarity in almost everything (Okado & Stark, 2003; Paulhus & Williams, 2002). Additionally, it is possible that a lesion to the MPFC might lead to a decreased ability to accurately assess one's memory for a given topic or event (Schnyer et al., 2005).

Possible widespread changes in areas functionally connected to the MPFC due to TMS also warrant discussion. For example, Hayward and colleagues (2007) reported that stimulation to the MPFC led to additional changes in the ACC, as well as other temporal and parietal regions. The MPFC has been described as being part of greater neural networks involved in social cognition, therefore it is important to realize that a "virtual lesion," although initially restricted to the MPFC, could lead to changes in other areas. While TMS to cortical regions only has effects at depths no greater than 2 cm, it certainly influences other regions later in the temporal sequence (Rossini et al., 1994).

When studying deceptive social behavior it is always a challenge to do so in naturalistic ways (Sip, Roepstorff, McGregor, & Frith 2007). Eliciting realistic behaviors in the laboratory can be difficult without sufficient motivation from participants. It is important when studying deception to take account of the intentions of the participants as well as the context (Sip et al., 2007). Therefore, it is to the advantage of researchers to study deceptive behaviors that are already intrinsically motivated within the typical human repertoire, such as the natural proclivity to self-enhance. Despite capitalizing on this inherent human tendency, our methods still do not completely replicate a naturalistic social circumstance. It cannot be assumed that metacognitive performance on a laboratory "IQ test" reflects behavior that would occur in real life. Therefore, we advise researchers to take this limitation into consideration as more ecologically valid ways to measure overclaiming are developed.

The goal of our study was to investigate the cortical correlates of the deceptive tendency to give desirable responses, as witnessed by the overclaiming technique. Overall, participants claimed to know fewer fake words with MPFC TMS than sham. The results extend the findings implicating this region in deceptive responding and lend significant support to previous studies that link the MPFC to self-referential processing and self-related deception.

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