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Irony comprehension and theory of mind deficits in patients with Parkinson's disease

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ABSTRACT

Many individuals with Parkinson's disease (PD) are known to have difficulties in understanding pragmatic aspects of language. In the present study, a group of eleven non-demented PD patients and eleven healthy control (HC) participants were tested on their ability to interpret communicative intentions underlying verbal irony and lies, as well as on their ability to infer first- and second-order mental states (i.e., theory of mind). Following Winner et al. (1998), participants answered different types of questions about the events which unfolded in stories which ended in either an ironic statement or a lie. Results showed that PD patients were significantly less accurate than HC participants in assigning second-order beliefs during the story comprehension task, suggesting that the ability to make a second-order mental state attribution declines in PD. The PD patients were also less able to distinguish whether the final statement of a story should be interpreted as a joke or a lie, suggesting a failure in pragmatic interpretation abilities. The implications of frontal lobe dysfunction in PD as a source of difficulties with working memory, mental state attributions, and pragmatic language deficits are discussed in the context of these findings.

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1. Introduction

Parkinson's disease (PD) is a chronic, neurodegenerative disorder associated with progressive depletion of dopaminergic neurons in the basal ganglia, a set of subcortical structures with extensive connectivity in the brain, particularly to areas of the forebrain (Brown and Marsden, 1998). While idiopathic PD is most commonly recognized by its motor signs, there is now little doubt that many non-motor signs emerge during the progression of the disease (e.g., changes in sensory processing and cognition), although these

symptoms tend to vary in nature and severity from one patient to another (Demakis, 2007; Dubois and Pillon, 1997).

In particular, many PD patients exhibit cognitive impairments which affect organization and planning ('executive functions') and/or working memory (Brown and Marsden, 1991; Gabrieli et al., 1996; Lewis et al., 2003; Taylor et al., 1986). In the majority of PD patients, reductions in executive processing and control occur in the absence of broad intellectual decline or dementia. Similarly, there is evidence that PD patients without dementia experience difficulties which affect the processing of verbal (Angwin et al., 2005; Berg et al., 2003;

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Grossman et al., 2002; Lieberman et al., 1990; McNamara and Durso, 2003; Monetta and Pell, 2007; Natsopoulos et al., 1997) and nonverbal language (Dara et al., 2008; Pell and Leonard, 2003). The negative impact of communication impairments on the social and functional independence of individuals living with PD is beginning to be documented (Pell et al., 2006; Pitcairn et al., 1990).

It is of special interest here that certain language abilities, such as those which rely on pragmatic knowledge and awareness, are believed to be highly dependent on intact cognitive resources during language processing tasks (McDonald and Pearce, 1998; Stemmer et al., 1994). Pragmatics is a general term that refers to the use of language in context, including both physical context and aspects such as speaker intentions, mood, and the emotional state of the speaker; as such, pragmatic processing reflects instances where the capacity to communicate rests not only on an intact language system but also on the knowledge of a specific communicative exchange context and high-level capacities (Martin and McDonald, 2003). Pragmatic language functions include the ability to generate appropriate inferences from linguistic material, to interpret metaphorical and nonliteral language (e.g., indirect speech acts, humor), and to interpret language in the context of paralinguistic, nonverbal, and situational cues which inform intended meanings.

A strong link has been made between the ability to understand “complex” and pragmatic forms of language and the individual cognitive resource capacity of patients with PD (Grossman et al., 2003; Monetta and Pell, 2007; Monetta et al., 2008b). In a recent study, Monetta and Pell (2007) investigated how participant groups with and without PD processed metaphorical versus literal meanings of language using a timed property verification task (Gernsbacher et al., 2001). They noted a selective decline in the ability to understand more cognitively demanding metaphorical meanings in individual PD patients with impaired working memory capacity when compared to PD patients with working memory scores in the control group range. The ability to generate inferences during story comprehension was also predicted by the working memory capacity of individual PD patients in another recent study (Monetta et al., 2008b). Other researchers have linked deficits in complex sentence processing in PD to underlying reductions in the rate of information processing or strategic allocation of attention (Grossman et al., 2002; Lee et al., 2003). Collectively, these findings argue for additional studies to look at the impact of PD on pragmatic language processing relative to the cognitive resource capacity of individual PD patients.

1.1. *The comprehension of verbal irony and theory of mind (ToM)*

Recognizing verbal irony necessitates the use of pragmatic knowledge to arrive at the intended (i.e., nonliteral) meaning. Irony is expressed when the intended meaning of language is different from or the direct opposite of its usual (i.e., literal) sense (see Gibbs, 2000, for an account of the different forms and functions of verbal irony). The main difference between an ironic remark and a lie, therefore, is whether the listener is aware of the context. For example, in the case of an ironic

remark, a person may look out the window and say, “What beautiful weather we’re having today!” when everybody else can clearly see that it is raining outside. Here, the speaker uses words to express something opposite to their literal meaning resulting in an ironic statement. In the case of a lie, a person may look out the window and say, “What beautiful weather we’re having today!” but in a situation where nobody else can see out the window (and thus, only the speaker is aware of the contradiction). This example demonstrates that ironic remarks and lies are both intentional false statements but their communication goal is completely different (i.e., to emphasize that the weather is in fact poor versus to deceive others about the status of the weather, respectively). In everyday life, one can predict that an inability to distinguish between these two interpretations of the same utterance would culminate in a failure to understand the true intentions of other speakers and could interrupt social interactions in a pronounced manner.

One factor that appears to be critical for understanding verbal irony is an individual’s ability to attribute correct second-order beliefs. The ability to attribute mental states to others, also known as ToM, refers to an individual’s ability to form representations of others’ mental states and to use these representations to understand, predict and judge their utterances and behaviors (see Brownell and Martino, 1998, for more information). Specifically, second-order ToM involves making an attribution about one person’s knowledge about another person’s knowledge (i.e., determining what one person thinks about another person’s thoughts). The evaluation of ToM generally requires participants to represent the false belief of other persons and to predict the other person’s actions (Leslie, 1994). Previous studies of clinical populations who typically display pragmatic language deficits (such as right-hemisphere-damaged individuals and autistic children) have reported an inability to distinguish lies from ironic remarks in these groups (Martin and McDonald, 2004; Winner et al., 1998). Moreover, deficits in comprehending irony often correlate strongly with individual deficits in attributing second-order beliefs (i.e., inferring what one person thinks about another person’s thoughts; Martin and McDonald, 2004; Winner et al., 1998). While there are hints that the ability to attribute mental states to others is compromised in PD (Saltzman et al., 2000), similar research has not been conducted on patients with PD. Should these patients have difficulties attributing mental states to others, the potential impact of these problems on irony comprehension or other aspects of pragmatic language interpretation is largely unknown.

In the investigation of right-hemisphere-damaged patients conducted by Winner et al. (1998), a series of stories were created that involved a main character who had either a true or a false belief about another character’s knowledge. Half of the stories ended with an ironic statement and half ended with a lie. Participants listened to each story and answered a series of questions which probed their comprehension of first-order ToM, second-order ToM and pragmatic reasoning. In the present study, we employed the same paradigm to test whether non-demented PD patients have similar problems differentiating verbal irony from lies and whether these difficulties are associated with the ability to make correct mental state attributions and/or with specific cognitive

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