Scalar Implicatures And The Literal-First Hypothesis: Theory Of Mind And Working Memory Effects In Pragmatic Inferences By Patients With Psychosis

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Introduction: Successful social interactions rely heavily on one's ability to go beyond the explicit, literal content of conversational statements and grasp the actual, intended meaning for in daily communication. The message that one wants to express is often not explicitly mentioned. For decades, researchers have illustrated the difficulties patients diagnosed with psychosis experience when they have to decode the non-literal content of conversational statements. These difficulties include trouble grasping the figurative meaning of proverbs and metaphors and problems with understanding humor and irony (e.g., Bambini et al, 2016; Brüne & Bodenstein, 2005;Sponheim et al., 2003). In the present study, we aim to gain more insight in the ability of people with psychosis to derive scalar implicatures (SIs). SIs are among the most studied types of pragmatic inferences but, to the best of our knowledge, have not yet been studied in people with psychosis.

SIs are based on linguistic expressions like *some, or, must* etc. Such expressions are part of a scale of informativeness. Examples of such scales are: <*All/many/some* >, <*Must/may*>, <*Always/often/sometimes*>. The statement (1) "*Some patients were attentive"* will be generally interpreted as (2) "*Some but not all patients were attentive*" and not as (3) "*All patients were attentive*". However, on a strictly semantic level "*some*" means "*some and possibly all*". The (implicit) addition of "*but not all*" does not follow logically but is the result of a SI. A popular explanation for an SI starts with the observation that the speaker did not use the alternative "*All patients were attentive*" A likely explanation for not uttering the "*all*"-sentence is that this sentence is not the case, otherwise she, being a cooperative speaker, would have said so. Combining the previous premises leads therefore to the interpretation that the speaker intended to say that she has a good relationship with some but not all of her colleagues. One of the consequences of this view is that listeners access the literal interpretation of an utterance before computing conversational implicatures such as scalar inferences. This viewpoint is sometimes referred to as the literal-first hypothesis, and argues that the enriched interpretation is associated with a processing cost (e.g., De Neys & Schaeken, 2007; Degen & Tanenhaus, 2015; Noveck, 2001). However, not all theorists agree. Some argue that it is possible for an utterance to get an enriched interpretation right from the start without any processing costs. The precondition for this immediate and automatic enrichment to happen is that it is supported by the context (e.g., Chierchia, Fox, & Spector, 2012; Récanati, 1995). Both sides of the debate have emphasized the importance of psycholinguistic evidence to decide whether the literal-first hypothesis is correct. We believe that insights might come also from patients' studies. In the present study, we test in three experiments how people with psychosis respond to underinformative statements containing scalar expressions. We expect patients with psychosis to have problems deriving SIs. They will respond less pragmatically when confronted with the scalar expression "some" than controls.

Experiment 1: We focused on the scalars *some/all* and tested the hypothesis that, in a binary sentence verification task (true/false), patients with psychosis would choose the pragmatic interpretation of *some* (i.e., the "not all" interpretation) less often than controls, in favor of the logical interpretation (i.e., "all"). The patient group consisted of 25 adults diagnosed with schizophrenia according to DSM-IV by an experienced psychiatrist. All patients were outpatients. The second group, the control group, was matched to the patient group with respect to age and educational level On average, patients derived less SIs than controls, which is in line with our hypothesis and this difference was marginally significant. Moreover, the number of participants that consistently derives SIs, is significantly higher in the control group than in the patient group. These differences are not due to

differences in the ability to perform the task since both patients and controls attain high levels of accuracy on the filler items. Rather, these findings suggest that patients with schizophrenia are less likely to derive SIs.

Experiment 2: We tested the same hypothesis as in Experiment 1, but now in young hospitalized individuals with psychosis. The patient group consisted of 17 young psychotic patients, who were diagnosed with psychosis according to DSM-IV by an experienced psychiatrist. All but two patients were hospitalized. The control group was matched to the patient group based on age and educational level. Apart from the patient group, there were two changes compared to Experiment 1. Instead of a binary judgment task, we used a ternary judgment task. Additionally, we investigated whether the amount of pragmatic interpretations is associated with theory of mind (ToM) ability. At group level, patients preferred the logical interpretation, yet a clear association between ToM and the amount of logical answers was found. Only patients with an impaired ToM preferred the logical interpretation.

Experiment 3: We examined whether working memory (WM) influenced the amount of pragmatic responses. Moreover, different scalar implicatures (*might/must*, *warm/hot*, *or/and*, *good/excellent*, *big/enormous*) were studied. The patient group consisted of 21 adult psychotic patients, who were diagnosed with psychosis according to DSM-IV by an experienced psychiatrist. The control group was matched to the patient group based on age and educational level. Like healthy controls, individuals with psychosis showed scalar diversity: not all scalars were treated alike. In the clinical group, an effect of WM was observed for some of the scalars, but not all.

Discussion: Taken together, these results can only be interpreted in a nuanced manner. The general picture is in line with the predictions of the literal-first hypothesis, as indicated by the working memory and ToM-effect. However, the limitations of these effects make it clear that a strict literal-first view is not consistent with the data. Moreover, we will briefly address the claim that a decreased pragmatic ability is a core feature of psychosis.

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