DISORGANIZED SPEECH AND METACOGNITION IN SCHIZOPHRENIA: DIFFERENTIAL RELATIONS AND A COMPARISON OF BEHAVIORAL SPEECH MEASURES

by

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Dedicated to my parents

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ABSTRACT

Disorganized speech is a core feature of schizophrenia. It is a key component of formal thought disorder (FTD). Recent work has tied disorganized speech to deficits in metacognition, or one's ability to integrate experiences to form complex mental representations. In this study, we aimed to 1) explore the relationship between disorganized speech and metacognition and 2) compare trained rater and emerging automated analysis methods. Positive and Negative Syndrome Scale (PANSS) and Indiana Psychiatric Illness Interviews (IPII) were conducted; the IPII was coded for disorganized speech using the Communication Disturbances Index (CDI) and Coh-Metrix multidimensional indices. Metacognition was rated using the Metacognition Assessment Scale. We compared FTD (n = 16; PANSS conceptual disorganization ≥ 3) and non-FTD (n = 29; PANSS conceptual disorganization < 3) groups on metacognition and examined CDI and Coh-Metrix's ability to account for variance in metacognition. We hypothesized that the FTD group would have lower metacognition and that both CDI and Coh-Metrix would account for significant variance in metacognition. Analyses indicated metacognition did not differ between groups and neither measure accounted for significant variance in metacognition. Results also showed that the CDI was able to distinguish the groups. Overall, results suggest little relationship between FTD and metacognition. Findings also indicate that trained rater measures of disorganized speech may have clinical utility in classifying FTD. Future research examining these constructs should address important limitations of this study by ensuring adequate levels of FTD in the study sample and by assessing neurocognition.

INTRODUCTION

Overview

Composing an email to a family member, talking with a friend, and calling the doctor's office—these communications are central to everyday living. For people with schizophrenia, they are a daily struggle. Effective communication is disrupted by disorganized speech, a symptom of schizophrenia that has been linked to poor functional outcomes such as social disengagement, impaired friendships, and poor work performance (Bowie & Harvey, 2008; Racenstein et al., 1999). Disorganized speech is a part of schizophrenia's disorganized symptoms, one of three primary symptom clusters (Cuesta et al., 2007). Although originally thought to be closely related to reality distortion symptoms such as delusions, research has shown that disorganized symptoms are tied to disturbances in underlying thought processes and aspects of cognition (Hamm et al., 2012; Ventura et al., 2010). This includes metacognition, the processes by which a person forms an integrated sense of self and other people from their experiences (Lysaker et al.. 2020). Recent studies have directly linked disorganized speech to deficits in metacognition (Minor et al., 2015; Minor et al., 2019; Lundin et al., 2020). Although the causes of disorganized speech are likely multiple and complex, this evidence suggests that metacognition may underlie these deficits and could be targeted as a means of improving disorganized speech. Further work is needed to clarify this relationship and improve understanding of the variance captured by different methods of assessing disorganized speech.

A review of the relevant literature will follow. First, I will present an overview of disorganized speech and methods of its measurement. Next, I will introduce a model of metacognition and discuss its relevance to schizophrenia. Finally, I will examine the intersection of these constructs, describe the rationale for the current study, and present hypotheses.

Disorganized Speech

Disorganized speech or a "loosening of associations" has been observed since early conceptualizations of schizophrenia (Bleuler, 1911). It has been documented across the schizophrenia spectrum (Barch & Berenbaum, 1996; Bearden et al., 2000; Minor et al., 2016) and has been designated as a core feature of the illness (American Psychiatric Association,

2013). Though this feature is understood to be trait-like in nature, not all people with schizophrenia show patterns of disorganized speech. One large prevalence study of inpatients and outpatients with schizophrenia estimated the figure to be around 50% (Breier & Berg, 1999). Those that display disorganized speech are described as having a "formal thought disorder", a term originally used to emphasize the disorganization of the "form" or structure of speech rather than its content. The term is now used to denote general language disturbances in schizophrenia, which can be observed across many different levels of language (i.e., between-paragraph, between-sentence, within-sentence, single-word).

One method frequently used to measure disorganized speech are clinician-rated ordinal scales (Andreasen, 1986; Bell et al., 1994). These scales are typically used to measure features of thought disorder on a Likert scale. These measures rely on clinicians' perceptions of the severity of speech-related phenomena such as tangentiality (i.e., replying to a question in an unrelated or irrelevant manner) and circumstantiality (i.e., indirect speech that is delayed in reaching its goal). These scales have many limitations (Cohen & Elvevåg, 2014) including questionable inter-rater reliability and difficulty in clearly distinguishing between different features of disorganized speech. They also are not able to meaningfully compare speech in psychiatric populations with speech from a healthy control group because controls rarely score above the lowest point (Cohen & Elvevåg, 2014; Docherty et al., 2003).

In contrast to clinician-rated scales, trained rater and automated analysis approaches quantify disorganization within speech samples. These behavior-based systematic techniques count instances of disorganization and calculate a ratio of disorganization per standard unit of speech length. An advantage of these methodologies is increased sensitivity to low levels of disorganization, which allows for better direct comparison with healthy controls. Previous work in schizophrenia has demonstrated these tools' sensitivity to differences between people with schizophrenia, controls (Docherty et al., 1996; Elvevåg et al., 2007; Mota et al., 2017; Willits et al., 2018), and patients' unaffected biological relatives **(**Docherty et al., 1998; Elvevåg et al., 2010; Gooding et al., 2012; Haimo & Holzman, 1979). Although the trained rater method takes considerable time and training to produce reliable ratings, one of its advantages is that it explicitly counts discrete instances of disorganized speech; the computation involved in automated analysis is often less transparent.

Trained rater measures have provided new insights into the nature of disorganized speech. They have contributed to schizophrenia vulnerability research by identifying subclinical thought disorder in those with genetic vulnerability for schizophrenia (Hain et al., 1995; Shenton et al. 1989) and have shown promise in detecting thought disorder in youth at high-risk for psychosis (Arboleda & Holzman, 1985; Bearden et al., 2011). These measures have also demonstrated incremental validity above and beyond clinician-rated scales. Multiple studies have shown that performance on various cognitive tests is more closely related to trained rater measures than clinician-rated scales (Docherty et al., 2005; Docherty et al., 2012). One established trained rater measure that has shown great utility is the Communication Disturbances Index (CDI) (Docherty et al., 1996). The CDI has been linked to both neurocognitive (Kerns & Berenbaum, 2002) and social cognitive deficits (Docherty et al., 2013). However, no studies to date have examined the relationship between disorganized speech as measured by the CDI and metacognitive deficits.

In recent years, various automated analytical tools (Elvevåg et al., 2007; McNamara et al., 2014; Tausczik & Pennebaker, 2010) have been used to evaluate speech samples across the schizophrenia spectrum (Buck et al., 2015; Manschreck et al., 2012; Marggraf et al., 2018). These tools aim to improve upon previous methods by quickly quantifying properties of language such as word usage and linguistic cohesion. These methods have shown great promise, explaining additional variance in cognitive processes and predicting diagnosis beyond clinician-rated scales (Minor et al., 2019; Mota et al., 2012). Recently, automated measures have been used to predict conversion to psychosis in high-risk samples (Bedi et al., 2015; Corcoran et al., 2018).

Coh-Metrix (McNamara et al., 2014), one of these automated tools, compares speech samples to a large corpus of text to produce more objective indices of coherence and cohesion. Cohesion indices measure the characteristics of the explicit text that play some role in helping the reader mentally connect ideas in the text (Graesser et al., 2003). Cohesion has been theorized to be closely related to thought disorder (Andreasen, 1979; Harvey, 1983). To date, Coh-Metrix has been used to show how linguistic cohesion differs between people with schizophrenia and controls (Willits et al., 2018) and to explore how linguistic cohesion relates to aspects of cognition (Lundin et al., 2020; Minor et al., 2019). Despite the growing body of evidence supporting Coh-Metrix's use with psychiatric speech samples, one limitation is that the tool uses

written text as a comparison in computing indices. Therefore, its use with transcribed speech remains somewhat experimental. Further, the process behind the computation of some indices is opaque; that is, specific instances of complex indices such as deep cohesion are not able to be explicitly identified within a speech transcript. Therefore, to further examine its convergent validity, this study will compare Coh-Metrix indices with categories of the CDI, an existing gold standard behavior-based measure.

Metacognition

Metacognition can be defined broadly as thinking about one's thoughts (Flavell, 1979). As metacognitive research in psychiatric contexts has progressed, the construct has become more complex, incorporating emotional (Cartwright-Hatton & Wells, 1997) and social cognitive components such as theory of mind (i.e., understanding the thoughts and intentions of others). People with schizophrenia have demonstrated deficits in each of these areas (Corcoran et al., 1995; Sellers et al., 2017).

Semerari et al. (2003) created a complex model of metacognition that aimed to account for these different perspectives. This model has evolved over time and currently defines metacognition as the process by which embodied, cognitive, and emotional experiences within the flow of life are integrated into a broader and holistic sense of oneself and others (Lysaker et al., 2020; Lysaker & Klion, 2017). This includes both noticing discrete pieces of information and also synthesizing them together to form complex ideas and understandings. Metacognition is an ongoing process that changes over time with the introduction of new information. It facilitates the formation of one's personal identity and understanding of who others are, how they differ from us, and their motivations. This information is used to conceptualize and respond to psychosocial challenges in daily life.

Metacognition is related to, but distinct from, other forms of cognition such as neurocognition and social cognition (Buck et al., 2015; Lysaker et al., 2013). Whereas social cognition is primarily concerned with the accuracy of discrete social perceptions (e.g., correctly identifying the emotion of a facial expression), metacognition measures the capacity to synthesize multiple perceptions (e.g., facial expression, tone of voice, speech content) into complex mental representations, regardless of their accuracy. Further, it measures the ability to use this knowledge to understand and respond to challenges in the environment. Unlike social

cognition, metacognition also measures related self-perceptions (e.g., awareness and synthesis of one's own mental and emotional states). Metacognition is also related to neurocognition. Research has shown that neurocognition is necessary for efficient metacognition, but it is not a sufficient condition, suggesting that metacognition has significant unique variance as a construct (Lysaker et al., 2010a; Minor et al., 2014). More specifically, neurocognitive processes such as memory and attention fail to account for the synthetic nature of metacognition. For example, a person can hold in their memory many disparate details and facts about another person, but metacognition is required to integrate these facts into a cohesive and meaningful mental depiction of that person.

Metacognitive impairment occurs across the schizophrenia spectrum (Chan et al., 2015; Lysaker et al., 2014; Vohs et al., 2014). People with lower metacognitive capacity may have a fragmented sense of self and have difficulty understanding and responding to challenges. This lowered capacity is associated with poor current functioning, including decreased quality of life, diminished work performance, and lower levels of subjective recovery (Arnon-Ribenfeld et al., 2017; Kukla et al., 2014). Poorer metacognition is also predictive of future outcomes such as elevated negative symptoms and reduced intrinsic motivation (Hamm et al., 2012; Luther et al., 2016; Lysaker et al., 2015). These findings demonstrate the severe disruptions in the lives of those with schizophrenia, and they suggest that metacognition may be an important treatment target.

Metacognition and Disorganized Speech

There is substantial conceptual overlap between disturbances in metacognition and speech in schizophrenia. At a fundamental level, people with schizophrenia struggle to form complex ideas and connect ideas with one another. That is, there is a fragmentation of thought that results in difficulty synthesizing their different experiences to form cohesive ideas and speech.

As an example of this overlap, consider a man with schizophrenia who has substantial persecutory ideation. He believes that everyone is out to get him and refers to his persecutors as an ambiguous 'they', saying, *"They are always listening to me, following me."* Without further context, 'they' is an example of disorganized speech because the speaker did not introduce the subject of the sentence; rather, he erroneously assumed that the listener already knew who he

was referring to. If the speaker was consistently vague or shallow in his description of others in the transcript, this would also be an example of poor metacognition because it reflects simple, unnuanced mental representations of others.

It is unclear if these metacognitive deficits merely reflect higher order disturbances or if disruptions also occur at lower levels and are manifested in disjointed, incohesive speech. In the past few years, researchers have begun to explore the relationship between disorganized speech and metacognition. Disorganization symptoms more broadly have been shown to moderate the relationship between neurocognition and metacognition (Minor & Lysaker, 2014). Further research has provided evidence that conceptual disorganization, a clinician-rated item that measures disorganized thinking via cognitive-verbal processes (Kay et al., 1987), drives this moderation (Minor et al., 2015). Subsequent analyses have used automated analysis to explore this relationship at deeper levels of speech. These analyses provide evidence that greater linguistic cohesion (Lundin et al., 2020) and lexical diversity (Minor et al., 2019) predict higher metacognitive capacity.

Most studies in this area quantify disorganized speech continuously across samples of people with schizophrenia. However, it is known that up to half of people with schizophrenia (Breier & Berg, 1999) show no or minimal disorganized speech as rated by a clinician. This lack of signal could hinder studies' ability to explore this phenomenon. This raises the question of whether the presence or relative absence of thought disorder may differentially relate to cognitive processes. Indeed, there is some evidence that among people with schizophrenia, those with thought disorder show significantly greater impairments in social cognition and executive functioning than those without thought disorder (Barrera et al., 2005; Dwyer et al., 2019). However, it is unclear whether this relationship holds in metacognition. If differences in metacognition are not observed between people who have a clinician rating of minimal versus moderate formal thought disorder, it may suggest that behavior-based measures are sensitive to aspects of disorganized speech that are imperceptible to clinicians.

Purpose of the Study

Building upon previous research, the current study aimed to further clarify the relationship between metacognition and disorganized speech in schizophrenia and to provide a novel comparison of measures of disorganized speech. To accomplish this, metacognition was

compared between those who manifest at least mild levels of formal thought disorder and those who do not. First, I hypothesized that metacognition scores will be lower among people who manifest formal thought disorder. This comparison of metacognition tested the idea that those with thought disorder have relatively more severe metacognitive deficits. Second, I predicted that a trained rater measure of disorganized speech would outperform (i.e., account for more variance) automated analysis in predicting metacognition scores. Whereas the trained-rater measure was validated for use in a schizophrenia sample, the automated analysis tool's use in psychiatric research is experimental and suffers from a lack of relevant validation research. In comparing these methods, this study evaluated the convergent validity of an automated analysis approach. It also provided further evidence for the utility of behavioral speech measures in predicting aspects of cognition.

METHOD

Participants

This project involves the secondary analysis of data from two completed studies. Participants were primarily recruited from the Richard L. Roudebush VA Medical Center and Midtown Community Mental Health Center. All participants (n = 45) were adult outpatients who have a primary diagnosis of schizophrenia, schizoaffective disorder, or psychotic disorder NOS, which was confirmed with the Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 2006). Participants whose diagnosis could not be confirmed were excluded from this analysis (n excluded = 2). Other inclusion criteria were: a) age 18–60; b) English fluency; c) no change in medication or outpatient status in the 30 days prior to testing; d) ability to give informed consent; e) no active substance dependence; f) no documented intellectual disability; and g) no history of a neurological illness or traumatic brain injury that resulted in loss of consciousness greater than five minutes. Participants from these studies were only included in this project if they completed the Indiana Psychiatric Illness Interview (n excluded = 6) (IPII; Lysaker et al., 2002). The IPII serves as the basis for ratings of metacognition and disorganized speech. Control participants were excluded from this project.

Participants were divided into two groups, those who manifested at least mild levels of formal thought disorder (FTD) and those who did not (non-FTD). This grouping was based upon their level of conceptual disorganization, an item on the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987). Conceptual disorganization is a clinician-rated item that measures cognitive-verbal processes such as loose associations and circumstantiality on a seven-point Likert scale. Those who were rated < 3 ("Absent" or "Minimal") formed the non-FTD group (n = 29); those ≥ 3 ("Mild" or greater) will form the FTD group (n = 16). The PANSS has demonstrated strong internal consistency (Kay et al., 1987) and interrater reliability (Bell et al., 1992; Lysaker et al., 2013). For both prior studies, staff achieved good interrater reliability on the PANSS ($\alpha \geq .80$).

Measures

Disorganization

Communication Disturbances Index (CDI; Docherty et al., 1996)

The CDI (Appendix A.1) is a validated, behavior-based measure of formal thought disorder that identifies specific instances of disorganized speech. Instances are rated based upon a loss or ambiguity of meaning. These instances span six categories: 1) "vague references" which are words or phrases that are unclear because they are overly inclusive; 2) "confused references" which refer to one of at least two alternate referents, and the choice is not clear; 3) "missing information references" which assume the reader has some information that they do not have and should not be expected to have; 4) "ambiguous word meanings" in which a word or phrase has more than one possible meaning, and the intended meaning is uncertain; 5) "wrong word references" in which a seemingly incorrect word or phrase is used; 6) "structural unclarity" which meaning is unclear due to a breakdown of language structure (Docherty et al., 1996). To calculate a CDI score, communication disturbances are summed, divided by total word count, and multiplied by 100. In calculating a total word count, each instance of disturbance, regardless of its length, is counted as a single word. The score is generated as a ratio of instances per 100 words which accounts for differences in the amount of speech generated by participants. Scores calculated in this manner produce a total CDI score as well as scores for each category of disorganized speech. The CDI has shown strong evidence of construct validity, showing significant correlations with other measures of thought disorder, communication deviance, and linguistic impairment from $r = .32$ to $r = .60$ (Docherty et al., 1997; Docherty et al., 2003; Docherty et al., 2012). The CDI has also demonstrated good inter-rater reliability and stability over time (Docherty et al., 2003). The author, another graduate student, and an undergraduate student rated IPII transcripts independently for CDI, blind to PANSS conceptual disorganization rating, and then met to discuss ratings and arrived at a consensus rating. Interrater reliability was calculated for 30 randomly selected narratives prior to consensus meetings. For total CDI score, intraclass $r = .90$.

Coh-Metrix (McNamara et al., 2014)

Coh-Metrix 3.0 is a software program that analyzes texts in terms of coherence and cohesion. Coh-Metrix computes over 100 language indices ranging from basic descriptive indices (e.g., total spoken words) to complex ones that measure lexical associations between sentences and paragraphs. This project examined eight of these complex indices: narrativity, syntactic simplicity, word concreteness, referential cohesion, deep cohesion, verb cohesion, connectivity, and temporality (see Table 1 for descriptions). These indices were chosen based upon a principal components analysis conducted by the creators of Coh-Metrix which showed that these eight indices accounted for 67.3% of the variability in a corpus of language arts, social studies, and science texts (Graesser et al., 2011). Two of these indices, deep cohesion and referential cohesion, have previously been linked to metacognition (Lundin et al., 2020; Minor et al., 2019). Three other indices, verb cohesion, connectivity, and temporality, have yet to be examined in a schizophrenia sample. In addition to these indices, a Coh-Metrix composite score was computed by averaging the standardized scores of the eight indices. All indices were coded such that positive scores indicate more organized speech, and negative scores indicate more disorganized speech.

Metacognition

Metacognition Assessment Scale - Abbreviated (MAS-A; Lysaker et al., 2005)

The MAS-A (Appendix A.2) was used to assess metacognitive capacity, or the capacity to identify and integrate one's experiences to form complex understandings of oneself and others, and to be able to apply those understandings to respond to psychosocial problems. The scale was originally developed to measure metacognition in the context of therapy (Semerari et al., 2003), and it has since been adapted to assess metacognition in narratives of self and illness (Lysaker et al., 2005). The MAS-A consists of four subscales (self-reflectivity, understanding the mind of the other, decentration, and mastery) that measure participants' understanding of their own and others' mental states and apply that understanding to cope with problems or challenges in their life. Total scores can range from 0 to 28, with higher scores indicating increased metacognitive capacity. Transcripts were scored by raters who had demonstrated good interrater reliability ($\alpha \geq .80$). None of these raters were involved in CDI ratings. Interrater reliability for

the total score has consistently been in the good to excellent range within schizophrenia samples (Lysaker et al., 2013; Lysaker et al., 2014). Evidence of the MAS-A's validity includes studies that link it scores to awareness of illness (Nicolò et al., 2012), cognitive insight (Lysaker et al., 2008), complexity of social schema (Lysaker et al., 2010b), and self-reported coping preference (Lysaker et al., 2011). Further validity evidence comes from studies that indicate that participants with schizophrenia show lower metacognitive scores than do people with serious and chronic non-psychiatric illnesses (Lysaker et al., 2012).

Indiana Psychiatric Illness Interview (IPII; Lysaker et al., 2002)

The IPII (Appendix A.3) is a semi-structured clinical interview that served as the basis for MAS-A ratings of metacognitive capacity. The IPII was developed to assess how people with severe mental illness view their lives and understand their experiences of mental illness. It is divided into five sections. First, rapport is established, and participants are asked to tell the story of their life from as early as they can remember and in as much detail as possible. Second, they are asked if they have a mental illness and how they understand it. In the third section, they are asked about how the illness has altered their life socially and psychologically, and what has stayed the same. Next, they are asked how the illness controls their life and in what ways they control the illness. Finally, they are asked about what they anticipate for themselves in the future. In contrast to many other interviews, the participant generates the content of the interview spontaneously. The interviewer is trained not to introduce content beyond the scripted prompts and to be non-directive during the interview. The prompts are open-ended which allows the participants to speak for as much or little time as they would like. The interviews typically last 30-60 minutes and were administered by trained graduate students. Interviews were audio-recorded and later transcribed.

For this project, only speech generated in the first section of the interview (i.e., life story) was analyzed for disorganized speech. For participants who generated less than 400 words in the first section of the IPII, the second section of the interview was also analyzed. Sections were added in this manner until the 400-word threshold was reached. Interviewer speech was excluded from analyses and did not count toward the 400-word minimum.

Analyses

Preliminary Analyses

Analyses were conducted using IBM SPSS Statistics 26 and R version 4.0.3. All analyses used the significance threshold of $p < 0.05$ unless otherwise indicated. Preliminary analyses also included comparison of the FTD and non-FTD groups on possible confounding variables. Groups were compared on age, years of education, length of studied IPII segment, and general symptom severity (i.e., PANSS total score) using independent samples t-tests. They were compared on sex, race, and ethnicity using chi-squared tests. If the groups differed significantly on any variables, those variables were controlled for in subsequent analyses.

As a preliminary step to testing the relationship between disorganized speech and metacognition between FTD and non-FTD groups, there was a construct validity check of the FTD and non-FTD groups based upon the PANSS conceptual disorganization item. Groups were compared both on their CDI total score and Coh-Metrix composite score using two independent samples t-tests. Because of the behavioral measures' greater sensitivity to disorganized speech relative to the PANSS, it was strongly expected that the FTD group would show greater disorganization than the non-FTD group in both (but at least one) of these measures. However, if neither test was significant, then the grouping would be abandoned, and the first hypothesis would not be tested.

Hypothesis 1: Metacognition will be lower in the FTD group

An independent samples t-test was conducted comparing the FTD and non-FTD groups on their mean MAS-A total scores. Based upon past research showing an inverse relationship between disorganized speech and metacognitive capacity, the FTD group is predicted to have a significantly lower MAS-A total score than the non-FTD group.

Hypothesis 2: The CDI will better predict metacognition scores than Coh-Metrix

Separate regressions for each group allow for further investigation of a possible differential relationship between FTD status and metacognition. However, due to the small sample size of each group, those analyses would be limited to detecting extremely large effects.

Consequently, two hierarchical multiple linear regressions predicting MAS-A total score from the CDI total score and Coh-Metrix composite score were conducted across the entire sample. The first regression entered CDI total score at step one and added Coh-Metrix composite score at step two. The second regression entered Coh-Metrix composite score at step one and added CDI total score at step two. Hierarchical regressions allow for the analysis of each measure's predictive ability in isolation and each measure's incremental validity or ability to capture unique variance. Standardized regression coefficients were examined to determine which measure accounted for the most variance in metacognition. At step one, I predicted that each measure will significantly predict metacognition, with CDI total score accounting for more variance than Coh-Metrix composite score. At step two, I anticipated that this same pattern would hold.

Post-hoc Analysis 1: Correlations between disorganized speech indices

Correlations were conducted between CDI and Coh-Metrix indices to observe the relationships between different components of these measures.

Post-hoc Analysis 2: Correlations between metacognition and disorganized speech indices

Correlations were conducted between MAS-A total score and the CDI and Coh-Metrix indices to better understand which indices may be particularly relevant to metacognition.

Power analysis

Power analyses were conducted using G*Power 3.194 (Faul, Erdfelder, Buchner, & Lang, 2009). For Hypothesis 1, given the group sizes (n = 29; n = 16), alpha level (α = .05), and power (0.8), analyses will be able to detect large effects (Cohen's d = 0.89). Based upon prior similar research, this is likely adequate. A recent study comparing FTD and non-FTD groups on a social cognition task reported an effect size of d = 0.91 (Dwyer, et al., 2019).

For Hypothesis 2, for step one, given the entire sample (n = 45), alpha level (α = .05), power (0.8), and one predictor, analyses will be able to detect medium to large effects (Cohen's f^2 = .18). For step two, with the addition of a second predictor and the same other parameters, Cohen's f^2 increases to .23, which is a medium to large effect. Cohen's f^2 is interpreted as a medium effect for values that approximate 0.15 and a large effect for values $\geq$ 0.35 (Cohen et al.,

2003). If the regressions were run separately for the FTD and non-FTD groups, Cohen's f^2 would be 0.57 and 0.29 at step one, respectively, and 0.77 and 0.37 at step two. The effect sizes for the FTD group are very large, and it is unrealistic to expect such large effects.

RESULTS

Sample Characteristics

Participants were mostly middle-aged (M = 46.89, SD = 10.11), male (n = 26, 58%), Black (n = 25, 56%), non-Hispanic (n = 39, 87%), and had at least a high school education or GED (n = 33, 73%). Participants in the FTD group (n = 16) did not significantly differ from the non-FTD group (n = 29) on any demographic variable, length of studied speech segment, or general symptom severity (see Table 2). Thus, we did not control for these variables in subsequent group comparisons.

As a preliminary step to testing the relationship between disorganized speech and metacognition between FTD and non-FTD groups, the construct validity of the groups was assessed by comparing them on two independent measures of speech disorganization. Groups were compared on composite scores for the CDI and Coh-Metrix using independent samples t-tests. Groups significantly differed on the CDI, $t(43) = -2.78$, $p = .01$, with the FTD group showing greater speech disorganization. However, groups did not significantly differ on the Coh-Metrix, $t(43) = 0.55$, $p = .58$. Thus, only the CDI was able to adequately distinguish the groups based on disorganized speech.

Aim 1: Metacognition will be lower in the FTD group

Metacognition was not significantly different between the FTD group (M = 11.06, SD = 3.67) and non-FTD group (M = 10.97, SD = 2.66), $t(43) = -.10$, $p = .92$ (Table 2). Metacognitive domains also did not significantly differ between groups when they were compared. These results do not support the hypothesis that those with thought disorder would show greater metacognitive impairment than those without thought disorder.

Aim 2: The CDI will better predict metacognition scores than Coh-Metrix

To compare measures of disorganized speech, two hierarchical multiple linear regressions predicting metacognition from the CDI total score and Coh-Metrix composite score were conducted across the entire sample (Table 3). Model 1 entered CDI total score at step one and added Coh-Metrix composite score at step two. Model 2 entered Coh-Metrix composite

score at step one and added CDI total score at step two. Neither model was significant at step one, Model 1: $F(1, 43) = .54$, $p = .47$; Model 2: $F(1, 43) = .12$, $p = .73$. At step two, the overall model did not reach the level of significance, $F(2, 42) = .31$, $p = .73$. These results do not support the hypothesis that CDI would outperform Coh-Metrix in predicting metacognition, as neither was a significant predictor. Together, they accounted for only 2% of the variance in metacognition (*R* squared = .02).

Post-hoc Analysis 1: Correlations between disorganized speech indices

Correlations were conducted between the CDI and Coh-Metrix indices to observe the relationships between different components of these measures across the full sample (Table 4). Eight out of 63 total correlations showed a medium effect size, with no others reaching statistical significance. CDI total score showed a medium correlation with word concreteness ($r = -.34$). Structural unclarities (CDI) showed medium correlations with syntactic simplicity ($r = .37$), word concreteness ($r = -.37$), and temporality ($r = .35$). Confused references (CDI) showed medium correlations with narrativity ($r = .36$) and syntactic simplicity ($r = -.33$). Ambiguous word meanings (CDI) showed medium correlations with deep cohesion ($r = .31$) and word concreteness ($r = -.30$). All correlations were significant at the $p < .05$ level without correction for multiple comparisons.

Post-hoc Analysis 2: Correlations between metacognition and disorganized speech indices

Correlations were also conducted between metacognition and the CDI and Coh-Metrix indices (Table 5, Table 6). Three out of 16 total correlations showed a medium effect size, with no others reaching statistical significance. Syntactic simplicity ($r = -.38$), narrativity ($r = .37$), and deep cohesion ($r = .33$) showed statistically significant medium size correlations (all $p < .05$) with metacognition without correction for multiple comparisons. No CDI variable was significantly associated with metacognition.

DISCUSSION

The present study built on prior research that has identified a link between disorganized speech and metacognition and aimed to further clarify this relationship. Four key findings emerged. First, only one of the two speech measures was able to differentiate FTD and non-FTD groups. This finding suggests that speech measures may differ in their sensitivity and their clinical utility in classifying thought disorder. Second, the FTD and non-FTD groups did not differ in metacognition. People with thought disorder do not seem to have more severe metacognitive deficits, which was surprising given previous research suggesting an inverse relationship between disorganized speech and metacognition. Third, the two measures of disorganized speech did not account for significant variance in metacognition. In our sample, disorganized speech and linguistic cohesion were only minimally related to metacognition. Fourth, post-hoc analyses revealed some relationships between subscales across these measures. Although significant relationships were observed, it is important to note that the majority of expected relationships were not shown. Overall, there were few relationships, but points of convergence may indicate areas for future study.

Surprisingly, the FTD and non-FTD groups only differed on one of the two speech measures. The trained rater speech measure, the CDI, was able to differentiate groups, which may reflect its ability to detect subtle instances of disorganized speech (Docherty et al., 1996). This ability may be particularly relevant with respect to the observed sample, which generally had minimal to mild levels of disorganized speech. This result provides additional evidence of its clinical utility in classifying this core symptom. In contrast, the groups did not differ in their Coh-Metrix composite score. One possible explanation is that Coh-Metrix may measure gross disturbances in disorganized speech and be less equipped to measure the milder levels of disorganization exhibited by the study sample. A second explanation why Coh-Metrix did not differentiate groups is that the composite score may include indices of linguistic cohesion that are only tangentially relevant to the study of disorganized speech in schizophrenia. As shown in Table 4, the CDI total score showed expected negative relationships with only two of the eight Coh-Metrix complex indices and a near-zero correlation with the composite score, raising questions about the composite score's construct validity. Further research is needed to clarify which Coh-Metrix indices are most relevant to the study of disorganized speech and to better

understand the utility and limitations of automated tools such as Coh-Metrix in measuring speech both generally and within psychiatric samples.

Despite conceptual overlap between disorganized speech and metacognition, FTD and non-FTD groups did not exhibit significantly different levels of metacognition. This finding is surprising given that previous work has found an inverse relationship between disorganized symptoms and metacognition (Minor & Lysaker, 2014), as well as evidence that disorganized speech moderates the relationship between neurocognition and metacognition (Minor et al., 2015). Minor and colleagues demonstrated that connections between neurocognition and metacognition begin to break down at minimal levels of disorganized speech, which suggests that disorganized speech may disrupt metacognition even when it is only minimal to mild in severity. Even though the FTD group largely showed mild levels of disorganized speech, the expected group differences in metacognition were not observed. One possible explanation for this null finding is that there were confounding third variables that may have differed between groups. The non-FTD group showed slightly higher scores on the PANSS negative subscale (Table 2), which has been shown to be inversely related to metacognition (Lysaker et al., 2005; Nicolò et al., 2012). Thus, had the groups been equivalent in their negative symptoms, a greater difference in metacognition would be expected. However, the relatively small difference in symptoms is probably insufficient to fully explain the null finding. There could be other confounding third variables that differed between groups, such as neurocognition, which was not assessed, but has shown a strong, positive relationship with metacognition (Nicolò et al., 2012).

Another reason metacognition may not have differed between groups is a potential sampling bias inherent to many studies of community outpatients. Participation in research that requires many hours of engagement over multiple study sessions may select for higher functioning outpatients with fewer symptoms (i.e., those likely to have higher metacognition and/or lower disorganized speech). Outpatients with very low levels of metacognition or disabling disorganized speech may be less likely to participate in this research. This phenomenon would artificially limit both the floor of metacognition and the ceiling of disorganized speech in the study. This explanation may help explain why there was much less formal thought disorder in the sample compared to the Breier & Berg (1999) study that examined an even mix of inpatients and outpatients. Future studies examining relationships between disorganized speech and metacognition should ensure that levels of disorganized speech and metacognition are clinically

meaningful and span an adequate range. Group comparisons would further be strengthened by matching participants on characteristics such as symptom levels or neurocognitive score.

Additionally, neither measure of disorganized speech accounted for significant variance in metacognition. At the outset of the study, we expected that linguistic cohesion would account for significant variance in metacognition. Because people who show low metacognitive capacity have difficulty distinguishing between different cognitive operations (e.g., remembering and deciding) and between emotions, they would be expected to use simpler language structures and have fewer logical links between ideas, resulting in lower overall cohesion. Coh-Metrix indices such as deep cohesion, referential cohesion, and syntactic simplicity measure the cohesiveness and complexity of deep semantic structures, or how the organization of words and links between them affect the words' meaning. Consistent with this conceptual link, referential cohesion, an automated index of linguistic cohesion, has been shown to be related to metacognition (Minor et al., 2019). Similarly, Lundin and colleagues (2020) found that deep cohesion plays an important role in linking different aspects of cognition, mediating the relationship between executive functioning and metacognition in a schizophrenia sample. One explanation of the null finding is the aforementioned questionable construct validity of the composite score, an average of eight indices. These indices may measure disparate aspects of cohesion that are more useful individually. Examining post-hoc correlations (Table 6), certain complex indices may be particularly relevant to metacognition, but the composite score appears not to be. Post-hoc correlations replicated Lundin and colleagues' (2020) finding that deep cohesion is positively related to metacognition but did not replicate Minor and colleagues (2019) similar finding for referential cohesion.

We also expected the CDI to account for significant variance in metacognition for conceptual and empirical reasons. The CDI codes unclear instances of speech which could be vague, ambiguous, or lack sufficient context. In the context of a life narrative, people who have difficulty forming complex understandings of themself and of others (i.e., have lower metacognition) would be expected to have difficulty conveying their life story and inner experiences (i.e., thoughts and emotions) with requisite detail and in a nuanced and coherent manner. That is, if someone has difficulty making sense of their experience, it follows logically that clearly communicating that same experience would be very difficult. Empirically, Minor and colleagues (2019) found that clinician-rated symptoms of disorganization accounted for unique

variance not only in metacognition, but also neurocognition and social cognition. Because of its advantages over clinician-rated measures, we expected the CDI to account for significant variance in metacognition. The null finding was also unexpected because although the CDI had never been tested in relation to metacognition, it has previously shown to be related to other cognitive domains, showing small to medium relationships with neurocognition and social cognition (Docherty et al., 2012; Docherty et al., 2013).

We also examined relationships between speech measures and metacognition, which showed minimal associations, particularly among CDI categories. Correlations revealed possible relationships between metacognition and narrativity, deep cohesion, and syntactic simplicity. That is, as a person's speech is more story-like (and in this study, adheres to the life-story prompt), more causally and logically consistent, and has more complex sentence structures, it is associated with greater metacognition. These ideas are theoretically consistent with metacognition, or one's ability to integrate many experiences to form complex ideas about oneself and others and make meaning from experience. These correlations also provide preliminary evidence that automated tools such as Coh-Metrix that look at deeper levels of speech could hold promise in enhancing our understanding of complex constructs like metacognition, although in a targeted manner given the numerous negligible correlations.

Post-hoc analyses revealed some relationships between subscales across speech measures, but the relationships were minimal overall. Exploratory correlations showed a consistent negative relationship between word concreteness and CDI total score and two CDI categories. The correlation suggests a point of convergence between the measures—as words become less concrete and more abstract, communication becomes less clear and seems to lose some of its meaning. Despite this finding, relationships between speech measures were minimal. One explanation for the lack of overlap is that whereas the CDI measures clarity of meaning and semantic aspects of speech, Coh-Metrix captures a mix of features, including syntactic structures and deeper semantic structures that may not be readily apparent. Another possible explanation for the lack of relationship between measures is that Coh-Metrix was validated using a large corpus of written language, rather than speech.

One strength of this study was that it utilized multiple behavioral measures of disorganized speech and linguistic cohesion, a gold standard trained rater method and a newer automated analytical method, to examine the relationship between speech and metacognition.

The study was also novel in that it directly compared these behavioral measures. In addition to its strengths, the study has several limitations. The primary limitation of the study is a relative lack of thought disorder in the sample, which may have hindered its ability to detect a relationship between disorganized speech and metacognition. Previous research suggests that as many as half of people with schizophrenia show no, minimal, or mild thought disorder. In our sample, 88.9% fell into this range. We decided to use a cut score of "3" ("Mild") to define FTD, rather than "4" ("Moderate"), which is more common in the literature (Breier & Berg, 1999; Mackinley et al., 2020). Our decision to use this cut point was made on both theoretical and pragmatic grounds: even mild conceptual disorganization indicates clear evidence of difficulty in sustaining goal-directed thought. From a practical perspective, just over 10% of the present sample showed moderate or greater conceptual disorganization. A second limitation of the study is that neurocognition was not assessed. Neurocognition, which includes abilities such as verbal learning and reasoning, is known to be impaired in people with schizophrenia and has been tied to both disorganization symptoms and metacognition (Lysaker et al., 2005; Ventura et al., 2010). Thus, it is important to account for neurocognition when examining these variables as a large difference in neurocognitive ability between groups could conceal a significant relationship. Another limitation is the small sample size in each group. The small sample size did not provide sufficient power to test the second hypothesis in each group.

Future work examining the relationship between disorganized speech and metacognition could address some of the limitations of this study (e.g., use a sample with higher levels of thought disorder; assess for neurocognition). Examining written narratives with Coh-Metrix and other measures of disorganized speech could also provide valuable information regarding the relationship between linguistic cohesion and formal thought disorder. If further evidence of a relationship between metacognition and disorganized speech exists, these findings could be extended by examining the real-world implications of such a relationship (i.e., how does it pertain to functioning and quality of life?). A relationship between disorganized speech and aspects of cognition may also have treatment implications. Existing cognitive interventions—particularly those that involve language—could secondarily improve disorganized speech. For example, Metacognitive Recovery and Insight Therapy (MERIT; Lysaker & Klion, 2017) may improve disorganized speech via the practicing and construction of cohesive speech within therapy sessions.

In conclusion, the study sought to test whether the presence or relative absence of FTD differentially relates to metacognition. It also tested an automated speech tool's ability to account for variance in metacognition. Although most study hypotheses were not supported, the results suggest that trained rater speech measures may show utility in classifying formal thought disorder. Results also partially replicate, albeit in a limited way, prior research linking certain indices of linguistic cohesion to metacognition. The study also provided a comparison of behavioral speech measures and exploratory correlations highlighted an area of convergence between these measures.

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TABLES

Table 1. Coh-Metrix index descriptions

Index	Index description
Narrativity	If speech tells a story with previously introduced characters or topics
Syntactic simplicity	The extent to which sentences contain fewer words and use simple structures
Word concreteness	If words are concrete versus abstract
Referential cohesion	How much words and ideas overlap across sentences and a conversation
Deep cohesion	The degree to which speech contains causal and logical links
Verb cohesion	The extent to which verbs overlap
Connectivity	The degree to which there are explicit links between ideas
Temporality	The extent to which speech contains cues related to time

Table 2. Participant data by group; with formal thought disorder (FTD) and without (non-FTD)

	FTD (n = 16)	non-FTD (n = 29)	Test of Significance
Age (*SD*)	47.00 (10.28)	46.83 (10.20)	$t(43) = -0.05$
Gender (*n*, %)			$X^2(1) = 1.23$
Male	11, 68.8%	15, 51.7%	
Female	5, 31.3%	14, 48.3%	
Ethnicity			$X^2(2) = 5.83+$
Non-Hispanic	14, 87.5%	25, 86.2%	
Hispanic	2, 12.5%	-	
Unknown	-	4, 13.8%	
Race			$X^2(2) = 0.53$
Black	8, 50.0%	17, 58.6%	
White	6, 37.5%	10, 34.5%	
Multiracial	2, 12.5%	2, 6.9%	
Education			$X^2(2) = 0.55$
<HS	5, 31.3%	7, 24.1%	
HS/GED	4, 25.0%	6, 20.7%	
>HS	7, 43.8%	16, 55.2%	
CDI total score	2.58 (1.65)	1.56 (0.81)	$t(43) = -2.78$**
VR	0.38 (0.38)	0.30 (0.24)	$t(43) = -0.89$
CR	0.14 (0.16)	0.16 (0.17)	$t(43) = 0.45$
MIR	0.75 (0.66)	0.38 (0.33)	$t(43) = -2.58$*
AWM	0.80 (0.61)	0.51 (0.34)	$t(43) = -2.06$*
WWR	0.10 (0.09)	0.03 (0.07)	$t(43) = -2.70$*
SU	0.40 (0.46)	0.18 (0.19)	$t(43) = -2.26$*
CM composite score	0.13 (.16)	0.17 (0.22)	$t(43) = 0.55$
NARz	2.07 (0.52)	2.32 (0.63)	$t(43) = 1.33$
SYNz	0.47 (0.83)	0.10 (0.76)	$t(43) = -1.52$
CNCz	−0.84 (0.71)	−0.69 (0.79)	$t(43) = 0.61$
REFz	1.11 (0.54)	1.50 (0.87)	$t(43) = 1.62$
DCz	0.69 (0.73)	0.92 (0.60)	$t(43) = 1.16$
VERBz	0.07 (0.45)	−0.17 (0.59)	$t(43) = -1.40$
CONNz	−2.52 (0.95)	−2.84 (1.07)	$t(43) = -1.01$
TEMPz	0.01 (0.53)	0.21 (0.43)	$t(43) = 1.36$
IPII word count	2257.56 (2944.88)	1546.52 (1032.19)	$t(43) = -1.18$
PANSS total score	66.87 (7.36)	61.44 (14.41)	$t(43) = -1.40$
Concept Disorg	3.50 (0.89)	1.31 (0.47)	$t(43) = -10.81$***
Negative subscale	15.88 (4.30)	16.83 (6.66)	$t(43) = 0.52$
Positive subscale	14.94 (3.70)	12.90 (4.75)	$t(43) = -1.49$
Depression subscale	8.94 (3.80)	10.72 (3.69)	$t(43) = 1.54$
Cognitive subscale	17.19 (3.64)	13.14 (3.75)	$t(43) = -3.51$**
Hostility subscale	8.06 (2.95)	6.45 (2.38)	$t(43) = -2.00+$

Table 2, Continued

MAS-A total score	11.06 (3.67)	10.97 (2.66)	$t(43) = -0.10$
Self-reflectivity	4.16 (1.23)	4.08 (1.06)	$t(43) = -0.20$
Other	2.84 (1.17)	2.95 (0.91)	$t(43) = 0.33$
Decentration	0.63 (0.59)	0.66 (0.42)	$t(43) = 0.20$
Mastery	3.44 (1.42)	3.28 (1.15)	$t(43) = -0.41$

***$p < .001$; **$p < .01$; *$p < .05$; +$p < .10$; CDI (Communication Disturbances Index); VR (Vague references); CR (Confused references); MIR (Missing information references); AWM (Ambiguous word meanings); WWR (Wrong word references); SU (Structural unclarities); CM (Coh-Metrix); NARz (Narrativity z-score); SYNz (Syntactic simplicity z-score); CNCz (Word concreteness z-score); REFz (Referential cohesion z-score); DCz (Deep cohesion z-score); VERBz (Verb cohesion z-score); CONNz (Connectivity z-score); TEMPz (Temporality z-score) MAS-A (Metacognitive Assessment Scale – Abbreviated); Other (Awareness of the other's mind); PANSS (Positive and Negative Syndrome Scale); FTD ≥ 3 on Conceptual Disorganization item from PANSS; non-FTD < 3 on Conceptual Disorganization item from PANSS

Table 3. Stepwise regressions using behavioral measures of disorganized speech as predictors of metacognition across the full sample (n = 45)

	R^2	*B*	S.E. *B*	*β*
Model 1				
Step One	0.01			
CDI total score		−0.27	0.36	−0.11
Model 2				
Step One	0.00			
CM composite score		−0.80	2.29	−0.05
Models 1 & 2				
Step Two	0.02			
CDI total score		−0.26	0.37	−0.11
CM composite score		−0.73	2.31	−0.05

CDI (Communication Disturbances Index); CM (Coh-Metrix)

Table 4. Correlations between CDI and Coh-Metrix indices across the full sample (n = 45)

	CDI total	VR	CR	MIR	AWM	WWR	SU
CM comp	.04	−.01	.19	.09	−.06	−.02	.03
NAR	.11	.25	.36*	−.04	.11	.05	−.08
SYN	.13	−.18	−.33*	.29	.01	−.04	.37*
CNC	−.34*	−.18	.10	−.25	−.30*	−.05	−.37*
REF	−.17	.07	.27	−.24	−.21	−.03	−.20
DC	.11	.16	.16	−.02	.31*	−.08	−.21
VERB	.16	.10	.03	.26	.01	.02	.11
CONN	.09	−.04	−.01	.09	.07	.10	.14
TEMP	.08	−.10	−.10	.20	−.12	−.10	.35*

*$p < .05$; CDI (Communication Disturbances Index); VR (Vague references); CR (Confused references); MIR (Missing information references); AWM (Ambiguous word meanings); WWR (Wrong word references); SU (Structural unclarities); CM Comp (Coh-Metrix composite score); NAR (Narrativity); SYN (Syntactic simplicity); CNC (Word concreteness); REF (Referential cohesion); DC (Deep cohesion); VERB (Verb cohesion); CONN (Connectivity); TEMP (Temporality)

Table 5. Correlations between MAS-A total score and CDI categories across the full sample (n = 45)

	CDI total	VR	CR	MIR	AWM	WWR	SU
MAS-A	−.11	−.07	.13	−.16	.00	.06	−.20

MAS-A (Metacognitive Assessment Scale – Abbreviated) total score; CDI (Communication Disturbances Index); VR (Vague references); CR (Confused references); MIR (Missing information references); AWM (Ambiguous word meanings); WWR (Wrong word references); SU (Structural unclarities)

Table 6. Correlations between MAS-A total score and Coh-Metrix indices across the full sample (n = 45)

	CM comp	NAR	SYN	CNC	REF	DC	VERB	CONN	TEMP
MAS-A	−.05	.37*	−.38*	.05	.10	.33*	−.16	−.14	−.22

*$p < .05$; MAS-A (Metacognitive Assessment Scale – Abbreviated) total score; CM Comp (Coh-Metrix composite score); NAR (Narrativity); SYN (Syntactic simplicity); CNC (Word concreteness); REF (Referential cohesion); DC (Deep cohesion); VERB (Verb cohesion); CONN (Connectivity); TEMP (Temporality)

APPENDIX A. REVISED CDI MANUAL – ABBREVIATED

Six Types of Disturbance.

1. **Vague References**

Vague references are words or phrases that are unclear because they are overinclusive. They should be scored only if their lack of specificity is important and significantly diminishes the meaning communicated. These types of disturbance often leave the listener with a questionable impression about the intended meaning rather than a clearly communicated meaning.

The most difficult discrimination to make is between vague references and ambiguous word meanings. The vague reference category is limited to nominal or pronominal words and phrases in which the major source of unclarity is overinclusiveness.

EXAMPLES:

I'm hoping they don't get caught up in some of the ills of our life, of our society.
In this example, it is not clear what 'ills' the speaker is referring to that are present in 'our life' or 'our society'.

We had to go to court and other bad things.
It is unclear what 'other bad things' the speaker is referring to- are they talking about paying fines, being arrested, or did they have to do bad things separate from this court appearance like going to work afterward? It is impossible to know from this sentence.

2. **Confused References**

Confused references are unclear because they can refer to one of at least two alternate referents and the correct choice isn't obvious. Alternatives have usually been provided by the speaker, but it is not possible to determine which is correct. Confused references are counted if: a) it is impossible to be reasonably sure which referent is correct or b) it is only possible to be sure after some consideration.

EXAMPLES:

My son has two children and my daughter has three. The kids have counted on me for a lot.
Which kids? His son and daughter, his son's kids, his daughter's kids, or all of the grandchildren? The correct answer is most likely one of these three referents provided by the speaker, but it is difficult to determine which of these three they are referring to.

The cat reminds me of the cat in the Edgar Allen Poe story except it's not black.
Which cat isn't black? The cat in the story or the cat that is being referred to.

3. Missing Information References

Missing information references assume that the listener has prior information that he or she does not have and should not be expected to have. With our samples, missing information references will be common since participants often describe a photo without giving background. Unqualified references to persons, places or things not previously presented by the speaker and unknown to the listener are classified here. This category includes comparative references for which the basis of comparison is not implicitly clear and has not been made clear by the speaker.

EXAMPLES:

They let George go home, so why not me? (no previous mention of George)

I don't like cats very much. It's pretty gross.
If what 'it's' refers to is not mentioned, it is impossible to know what this is in reference to.

I want to move out of New Haven and they won't let me leave.
If there is not prior mention of "they", it is not possible to figure out who they are.

4. Ambiguous Word Meanings

These include instances in which a word or phrase has more than one possible meaning and is used in such a way that the intended meaning is uncertain. This does not include instances in which it seems that the wrong word has been chosen (Wrong Word References), but rather the word or phrase used could have a number of different meanings in its current context, and the correct meaning is not obvious. Pronouns with unknown referents are also included in this category unless there are clear cut alternative possible referents, in which case it would be classified as a confused reference.

EXAMPLES:

I hope my GPA doesn't inhibit me from being accepted into graduate school.
Here, 'inhibit' is a word that has multiple meanings and the most commonly associated meaning does not work. While an alternative meaning might work here, it is a confusing word choice.

These people don't belong on Earth. God will get them.
What is meant by 'get' them? Similar to confused reference, except here there are an unlimited number of possible meanings.

We used to party a lot.
If speaker does not provide a referrant to 'we'. This is a common ambiguous word meaning. One exception is if the person is married and you determine that they are referring to this dyad. In this case, 'we' is not counted.

5. Wrong Word References

This refers to when a seemingly incorrect word or phrase is used. Wrong word references go beyond awkwardness of usage. The words are not being used according to any of their possible correct definitional meanings, or else they seem to be used in the place of other identifiable more appropriate words (and often but not always resemble those words phonetically).

EXAMPLES:

I used to sit in the café, have something to eat, and just glare out into the night.
In this instance, 'glare' is incorrect. The speaker probably meant to say 'stare'.

He was doing well in the beginning, but then he sort of abused his study habits.
Here is an example used earlier. "Abused" is the wrong word choice. You can be negligient or lax with your study habits, but you can't abuse them.

My mother and father wasn't together… but it didn't hinder my likeness for her.
Here, the speaker probably meant to say 'like' and not 'likeness'. 'Likeness' makes the sentence unclear.

6. Structural Unclarities

Instances in which meaning is unclear due to a breakdown or inadequacy of language structure. This includes grammatical errors that impair meaning and incomprehensible statements that lack sentence structure. Common disturbances found here are semantically unworkable combinations of words (ex. *I thought I was going to live forever because of the sun, the horizon of the sun.*) where the sentence is not grammatically incorrect, but it is a semantically unworkable combination of words. This can also be a confusing category; there are quite a few judgment calls about what is or is not unclear.

EXAMPLES:

I got a sister in Buffalo, New York. I've been there… must have been about twice since I was up there.
'Twice since I was up there' does not make sense; what was about 'twice' ?

Either I do custodial work.
Again, this a grammatically incorrect sentence that does not make sense. It is basically a word salad.

It looks wet, like it might have just lost it's eye.
These are two separate thoughts that should not be placed together or if they do make sense, should be explained more thoroughly.

APPENDIX B. ANCHORS FROM THE METACOGNITION ASSESSMENT SCALE– ABBREVIATED

Self-Reflectivity (S)

S0	Patients are not aware that they have mental experiences.
S1	Patients are aware that they have mental experiences and that their thoughts are representational in nature
S2	Patients are aware that they are autonomous beings and that their thoughts are their own
S3	Patients can name and distinguish between the different cognitive operations which comprise mental activity (e.g. remembering, imagining, wishing, deciding, and anticipating).
S4	Patients can name and distinguish between significantly different valenced emotions.
S5	Patients can recognize that the ideas they have about themselves and the world are subjective, have changed, or are changeable and/or are fallible.
S6	Patients can recognize that what they expect, think, and want may not match what is possible in reality.
S7	Patients can form representations of themselves within at least one specific situation, or narrative episode, in which they can describe how different mental activities such as thoughts and feelings influence one another.
S8	Patients are able to recognize a psychological pattern over time, through connecting at least two narrative episodes, describing how the narrative episodes involve similar themes and relationships between different mental activities such as thoughts and feelings.
S9	Patients are able to recognize psychological patterns across their life, synthesizing multiple narrative episodes into a coherent and complex narrative which integrates different modes of cognitive and/or emotional functioning.

Awareness of the Other's Mind (O)

O0	Patients cannot recognize that the other experiences mental functions.
O1	Patients can recognize that the other experiences mental functions.
O2	Patients can recognize that the other has autonomous mental functions.
O3	Patients can recognize and distinguish between another person's different cognitive operations (e.g. remembering, imagining, wishing, deciding, and anticipating).
O4	Patients are able to distinguish many different emotional states experienced by another person.
O5	Patients can make plausible inferences about the mental state of another person, recognizing the meaning of verbal and non-verbal communications.
O6	Patients can give a complete description of another person's mental states in a specific moment, or narrative episode, distinguishing between and integrating different mental activities including thoughts, intentions. and feelings.

O7	Patients can form an integrated idea of another person's mental states across multiple narrative episodes into a coherent narration.

Decentration (D)

D0	Patients cannot recognize that they are not necessarily the center of other people's mental activities.
D1	Patients can recognize that they are not necessarily the center of other people's mental activities (their thoughts, feelings, and emotions) and/or that some of the actions of other people stem from goals and reasons etc. which are not related to the participant.
D2	Patients can recognize that others can perceive and/or interpret events in a validly different way than how the participant perceives and/or interprets events.
D3	Patients can recognize that the events that occur in regular life are often the result of complex emotional, cognitive, social, and environmental factors which vary according to the individual people involved. These factors include person-centered factors, such as individual development and life history, as well as the larger political and social context. Patients are further able to perceive the larger world as involving unique individuals who have unique relationships with one another which involve no central organizing theme.

Mastery (M)

M0	Patients cannot formulate any plausible or implausible psychological challenges.
M1	Patients can identify general distress affecting discuss behavior and psychological processes but cannot plausibly present a psychological challenge.
M2	Patients are able to plausibly describe a psychological challenge.
M3	Patients are able to respond to psychological challenges through gross avoidance or passive activities, such as following others' directions or other actions that grossly reduce distress.
M4	Patients are able to respond to psychological challenges by generally actively avoiding very specific things or by seeking support from others.
M5	Patients are able to respond to psychological challenges by voluntarily engaging in or inhibiting a specific behavior.
M6	Patients are able to respond to psychological challenges by changing how they think about the problem or themselves him/herself.
M7	Patients are able to respond to psychological challenges by utilizing unique metacognitive knowledge about him or herself in light of the specific challenge.
M8	Patients are able to respond to psychological challenges by utilizing unique metacognitive knowledge both about themselves and a specific other person in the context of a specific challenge.
M9	Patients are able to respond to psychological challenges by utilizing unique metacognitive knowledge about themselves, specific others, others in the general, and the human condition. The participant can take into account human limitations and acknowledge that some pain cannot be avoided and is part of life.

APPENDIX C. SECTIONS OF THE INDIANA PSYCHIATRIC ILLNESS INTERVIEW

Section I: General Free Narrative:

- I'd like you to tell me the story of your life, in as much detail as you can, from as early as you can remember up to now. If it helps you to organize your story, you can divide it into chapters or sections. Any questions?

Section II: Illness narrative

- *Do you think you have a mental illness (MI) and if so what do you think it is?*
- *Experience of MI in the past?*
- *What caused these problems?*
- *How do you feel about having this MI?*
- *What is going to happen to your MI in the future?*

Section III: What's changed vs. what's stayed the same

Since your MI, what about you has changed and what has stayed the same?

- *Vocational function:* Same/Different:
- *Social function (family/romantic, friends/acquaintances):* Same/ Different:
- *Personality:* Same/ Different:
- *Cognition/emotion*: Same/ Different:

Section IV: Degree of influence of illness construct

- To what extent and in what ways does your MI control your life?
- To what extent and how well are you able to control your MI?
- *How have others been affected by your mental illness?*
- *How have others affected your mental illness?*

Section V: The future, hopefulness and satisfaction?

- What do you see ahead of yourself in the future?