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Linguistic Measures of Symptomatology in Schizophrenia

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Abstract

This research investigates how to measure affected speech of patients with schizophrenia by analyzing how they orally describe a picture compared to controls. Currently, there is no single clear set of criteria for recognizing disorganized speech. By working with a standard set of parameters (descriptions of a single picture) we can find patterns of speech that differ between the two groups.

68 patients and 78 controls were asked to describe a line drawing of a beach scene as completely as possible for a period of 2 minutes. These picture descriptions were analyzed on the basis of i) NARRATIVE STRUCTURE, which examines how patients and controls transition between topics; ii) RELATIONSHIPS, which investigates how subjects construct connections between objects in the picture; and iii) COMPLETENESS, which investigates whether patients and controls differ in how detailed their respective descriptions are. The major findings of these analyses showed that patients use fewer complex transitions than controls when switching topics (that is, transitions that provide additional information, rather than basic ones like “and”), make fewer connections between objects in the picture than controls, and give less complete picture descriptions with fewer details.

These results are further expanded upon in a series of follow-up analyses, showing alogia’s effects on these findings and correlations between these linguistic measurements and psychiatric interview tools clinicians use to rate symptom severity in schizophrenia. In particular, the word counts of participants’ picture descriptions had a significant impact on the above findings, implying that alogia rather than disorganized speech may account for these differences. Additionally, correlations were found between the linguistic measurements of this paper and clinical measurements via psychiatric interviews for disorganized speech in patients participating in the study, but not with their ratings of alogia. Finally, this paper also makes

recommendations about prompting for additional speech in picture description tasks, based on evidence showing that discourse patterns do not change significantly when participants are encouraged to speak more.

1.0 Introduction

Linguistic approaches can offer insights on the inner workings of the brain and help to describe various psychiatric disorders. Linguistic studies have employed many different methodologies, from eye-tracking to discourse analysis, to understand various mental processes, including word-recall, syntax comprehension, and higher-order planning and reasoning. These same methodologies have also been employed to understand how these processes can be impaired by psychological disorders, including schizophrenia. Schizophrenia is a much maligned and misunderstood disorder that can greatly affect those diagnosed with it. While most would recognize delusions and hallucinations as hallmark symptoms of schizophrenia, those diagnosed with the disorder experience a wide variety of other symptoms, some of which even affect speech and language comprehension. Symptoms from “aprosody,” meaning monotone voice (e.g. Compton et al., 2018), to “alogia,” or lack of discourse in general (e.g. Miller et al., 1993; Docherty et al., 2011), have been explored by linguists for decades. One of the major linguistic abnormalities clinicians have noted in individuals with schizophrenia is “disorganized speech,” which describes a tendency to make loose associations between words, deviate from the current topic, and generally be incoherent, among other characteristics (American Psychiatric Association, 2013). This symptom is seen as embodying the “disorganized thinking” patterns of those diagnosed with schizophrenia, to the degree that even today it is used as a diagnostic criterion to recognize the disorder. Despite this, there is still a great deal we do not understand about how schizophrenia can affect linguistic patterns in those diagnosed. In particular, there is not a linguistic definition of what “disorganized speech” refers to in the literature, and as a result clinicians must often rely on the criteria that ‘you will know it when you hear it.’

So what specific linguistic differences *are* apparent when comparing the speech of those with schizophrenia and healthy controls? This research seeks to investigate this question and contribute to a better understanding of how language and schizophrenia are connected. To do so, this research compares how those with schizophrenia and healthy controls without schizophrenia orally describe a picture. This study compares how these two groups describe the same picture along the following three parameters: i) the NARRATIVE STRUCTURE of subjects' descriptions, ii) RELATIONSHIPS mentioned between components in the picture, and iii) the COMPLETENESS of the picture descriptions. The analysis of NARRATIVE STRUCTURE investigates how patients and controls transition between topics in their speech; RELATIONSHIPS investigates whether these two groups differ in how they make and describe connections between objects in the picture; and COMPLETENESS investigates whether the two groups differ in how complete and detailed on average their respective descriptions are. Each of these three domains will be investigated via an analysis with its own methodology and contextualized in terms of existing literature. By looking at these three domains, this paper builds on prior research and presents specific linguistic features that differentiate the speech of those with schizophrenia from that of controls. This research also looks at the effects that alogia has on these findings and uses quantitative methods to make recommendations for implementing elicited speech tasks. Finally, this paper will also show how these linguistic measurements correlate with clinicians' assessments of patients' linguistic symptom severity and suggest future avenues for additional research in this field.

2.0 Background

2.1 What Is Schizophrenia?

While schizophrenia as a condition has likely been around for millenia, it was only given a name and formal scientific study about a century ago. In 1911, Dr. Eugen Bleuler published a seminal book in which he coined the term “schizophrenia,” meaning “split mind” (Bleuler 1911/1950). Bleuler created this name due to the major characteristics he observed in his patients: a tendency to dissociate and make loose associations between words and concepts (Moskowitz & Heim, 2011). This led him to conclude that schizophrenia was a thought disorder in which the mind was split, leading to fractured and fragmented thinking patterns. These observations became the foundation for the study of schizophrenia and still remain major criteria when diagnosing the disorder.

Over the years, a more comprehensive view of schizophrenia has emerged, focusing on major symptoms characteristic of the disorder. Due to the work of Kurt Schneider, it is the positive symptoms (i.e. additional symptoms that those without the disorder do not experience) which are considered most integral to understanding schizophrenia (Katschnig, 2018). These symptoms include delusions and hallucinations, which most recognize as the hallmark characteristics of schizophrenia. There are a great number of negative symptoms as well (deficits which inhibit normal functioning), which include apathy, aprosody, aphasia, and many others (Andreasen et al., 1995).

2.2 Language and Schizophrenia

Linguistics has greatly contributed to the study of schizophrenia in many ways. Although the past century has seen great developments in the field of medicine, much is still not understood about schizophrenia. Doctors are still unsure about what causes the disorder, how

to treat it, and even how to diagnose it — all of which are contested, especially when looking across the globe at how different communities approach this disorder (Luhrmann, 2016). In response to this uncertainty, research about schizophrenia has been conducted in many interdisciplinary fields, including linguistics. This is because schizophrenia can lead to abnormalities in speech and language processing, such as aprosody, aphasia, alogia, and other symptoms (Andreasen & Grove, 1986). Many patients with schizophrenia are described as having “disorganized speech,”; however, what exactly “disorganized speech” refers to in linguistic terms remains unclear. This is due to both controversy in the very nature of schizophrenia and the lack of a concrete definition of “disorganized speech.”

First, while disorganized speech has been observed in patients with schizophrenia, there is controversy as to whether this is caused by disordered thinking or a speech disorder (Harrow et al., 2003). That is, do patients have strange speaking patterns because their brains create abnormal discourse in their heads? Or is the thinking coherent but lost in translation when patients try to explain their thoughts verbally? In the words of Andreasen (1979) “. . . the term ‘thought disorder’ or ‘formal thought disorder’ is most often used as synonymous with ‘disorganized speech’”, which makes parsing the two apart from each other more difficult. To make things even more complicated, there is evidence supporting both claims. Research conducted by Harrow et al. (2003) supports the thought disorder theory by showing that not only do patients have disordered speech patterns, but they also tend to sort objects into uncommon groupings, thereby showing that thought patterns are also abnormal. However, schizophrenia patients with disorganized speech tend to exhibit symptoms of aphasia (Halpern, 1984), and many report that the discourse they uttered is not what they originally intended to say, as if the words are not their own (Maher, 2003). This is certainly a complicating factor when conducting research on speech patterns in schizophrenia, and unfortunately this study cannot resolve these

issues on its own. To hopefully mitigate misunderstandings between these two concepts of disorganized thinking and speech respectively, I will refer to abnormalities in the speech found in this research as “disorganized speech,” and this paper will not confront the debate about what the underlying causes and mechanisms of schizophrenia are.

Secondly, the definition of disorganized speech found in those with schizophrenia remains unclear. It is important to note that disorganized speech is not pathognomonic to schizophrenia and can be present in various psychological disorders (Knight et al, 1986). As a result, there are many different kinds of disorganized speech. While abnormalities in discourse by patients with schizophrenia have been noted since the term was coined, defining what characterizes this speech has been difficult. In the words of Lorenz, “We are faced with the paradox that while we recognize schizophrenic language when we see it, we cannot define it” (Lorenz, 1961. p. 28). The DSM-5 defines disorganized speech as including the following traits: suddenly switching between topics, giving information or answers not pertinent to the topic at hand, and generally incoherent speech approaching word-salad (American Psychiatric Association, 2013). However, these measures do not qualify exactly how patients do this in linguistic terms, and to what degree this varies from the speech of healthy controls.

Many psychiatric tools, such as the Brief Psychiatric Rating Scale (BPRS), have also been used to measure disorganized speech, but the efficacy of these tools is still hotly debated (Park et al., 2018). One problem with these tools, including the Scale for the Assessment of Negative Symptoms (SANS) and Clinical Assessment Interview for Negative Symptoms (CAINS), is that it is difficult to assess abnormalities in speech after the fact (Andreasen, 1989; Kring et al., 2013). These tools are used in interviews with patients to assess their symptoms, including speech but also emotional and psychiatric symptoms like apathy, hallucinations, or strange thought content. However, these interviews often last upwards of an hour, after which

practitioners are expected to fill out their observations of the patient's speech along very limited criteria, such as "facial expression" and "quantity of speech," in the case of the CAINS scale. This places a great burden on medical professionals but also is limited in its scope, as many of these diagnostic tools fail to address many of the DSM-5's symptoms of disorganized speech, such as topic digression. To this day, the definition of "disorganized speech" used by clinicians in diagnosing schizophrenia remains unclear, and so the methods for evaluating disorganized speech in the current work rely heavily on linguistic research which has elaborated on this subject.

Prior research has found various abnormalities of speech and language comprehension in people with schizophrenia. Multiple studies have supported the finding that those with schizophrenia have impaired language processing, as they create more syntactically simple sentences and have greater difficulty understanding syntactically complex sentences when compared with controls (Chaika 1974; Hong et al., 2015; Condray et al., 2002; Fraser et al., 1986). In addition to having less complex understanding of syntax, they also make more grammatical errors than controls (Hoffman, 1988; Chaika, 1974). They also have difficulty when parsing metalinguistic information from a sentence, particularly aspects like humor and sarcasm, metaphors and idioms, and implicatures. (Pawelcyz, 2018; Kuperberg, 2010; Buck et al., 2015). Patients also tend to have a "loosening of associations," causing them to quickly go off topic and lose the original purpose of their utterance (Andreasen & Grove, 1986). This causes them to also overassociate and intermingle personal experience and thoughts with the topic at hand, often to the point where it derails the conversation or is socially inappropriate (Harrow et. al, 1983; Harrow & Prosen, 1978, 1979; Harrow & Miller, 1980; Lanin et al. 1981). From these studies, it is clear that schizophrenia has an impact on the language facilities of patients diagnosed with the disorder, but still much remains to be discovered about this interaction.

2.3 Discourse Markers and the Narrative Structure of Language

In order to compare the speech of those with schizophrenia and controls, one must first understand the basic structure of narrative discourse, and particularly the concepts of cohesion and coherence, as defined by Halliday and Hasan (1976). They claim that, to be coherent, a text must be consistent with its context; to be cohesive, the text must be linked together by "cohesive devices," which often take the form of discourse markers and transitional phrases. Van Dijk later expanded on this, saying "Coherence is a semantic property of discourse, based on the interpretation of each individual sentence relative to the interpretation of other sentences." (van Dijk, 1977, p.96) Coherence and cohesion are now accepted and studied vigorously as integral parts of discourse and narrative structure.

These concepts are particularly important for the analysis of disorganized speech in schizophrenia as they can help to linguistically evaluate claims of patients' discourse being incoherent, with patients frequently switching between topics with no transitions. Indeed, there is some evidence that those with schizophrenia lack this linguistic definition of cohesion in their speech. In Chaika's (1974) analysis of a 37 year-old patient, it was shown that the patient had an abnormal way of maintaining and switching between topics. Chaika (1974, p. 268) wrote,

> "Examination of X's productions shows that the propositional content of individual sentences are usually understandable, but that they are not subordinated to any subject matter. Or, if they are, what are absent are the discourse markers necessary to show connections and to orient listeners to her topic."

Observations like these are prevalent in literature from clinicians interviewing patients with schizophrenia as well, implying that there is an abnormal pattern to how those with schizophrenia use cohesion to transition between topics.

Additionally, other researchers have found abnormalities in how those with schizophrenia use referential cohesion markers (Docherty et al., 1996; Noel-Jorand et al., 1997). Cohesion markers are words which involve “linking one word – the anaphor – with a previously presented word in the discourse (e.g., linking ‘he’ in “John went to the store because **he** needed to buy milk” with ‘John’)” (Ditman & Kuperberg, 2010). Many clinicians and researchers have noted that patients tend to introduce new topics and pronouns without clear referents, thereby impeding the cohesion and coherence of their speech (Andreasen & Grove, 1986; Buck et al., 2015).

This research builds on these previous studies by looking at cohesion, but through a slightly different lens. Rather than examining “cohesion markers,” this analysis examines the use of discourse markers. Schiffrin (1987) defines discourse markers as “sequentially dependent elements which bracket units of talk.” By bracketing sections of speech, discourse markers signify where one speech unit ends and another begins. They therefore often act as an organizational tool to facilitate cohesion and coherence and aid listeners in interpreting the speaker’s intentions (Schiffrin, 1987).

Discourse markers come in all kinds of shapes and sizes, and they also have different distributions and uses in speech. As a result, Schiffrin (1987) groups these discourse markers into categories of use, some of which are pertinent for this research. Schiffrin creates the grouping “discourse connectives,” composed of the conjunctions “and, but, and or.” While there are various ways to use all these conjunctions in a sentence, all three can act as coordinators in structuring and connecting ideas in discourse. Schiffrin also notes the category of “markers of cause and result,” including “so” and “because.” While these markers also connect and structure ideas in discourse, like the “discourse connectives,” they expand on the relationships between ideas and actions and provide greater context through the lens of result and causation. These definitions and groupings of discourse markers will be drawn on for Analysis 1, NARRATIVE

STRUCTURE, in establishing a methodology for assessing coherence and cohesion via these markers.

2.4 Linguistics' Contributions to Schizophrenia Research

Although some fruitful research has been conducted on the abnormalities of the speech of patients with schizophrenia, much still remains unknown, especially what linguistic measurements correlate to the diagnosis of disorganized speech. In addition to the controversies about the nature of schizophrenia detailed above, there are a number of other gaps in our knowledge about how disorganized speech manifests in those with schizophrenia. For one, many characteristics of so-called affected speech have resulted from clinical observations, rather than empirical studies conducted in contrast to controls, which has possible limitations. As Van Leer and Turkstra (1999) showed, while those with traumatic brain injuries were thought to have less "coherent" speech, when their speech was actually analyzed using discourse analysis methods, there were no major differences between their speech and that of controls. Recently, linguists have conducted similar research into aprosody in schizophrenia. While blunted affect and lack of expressiveness when speaking are symptoms often associated with schizophrenia, even included in various psychological diagnostic tools, various studies have found that these subjective measurements of "aprosody" do not match up with objective linguistic measurements (Hogoboom et al., *submitted*; Compton, et al., 2018; Meaux, et al., 2018). As a result, while clinical observations are very important, it is also essential to study these observations and verify them. Furthermore, many studies which have contributed to our knowledge of disorganized speech in schizophrenia either lack a large number of participants (often much fewer than 100) or do not completely match the conditions of controls and patients, making the results less concrete than we would like.

Finally, more research about disorganized speech in schizophrenia is necessary due to how greatly it can affect those diagnosed with the disorder. Although only 1.1% of the population is estimated to have schizophrenia, it is the eighth leading cause of disability worldwide due to the debilitating nature of the symptoms (Theodoridou & Rössler, 2010). Many with schizophrenia either go untreated or have difficulty managing their symptoms to function every day. Some research has connected severity of speech disorder with prognosis, which is very relevant and important for clinicians (Bowie, 2008). In addition, there is evidence that these linguistic abnormalities are present in those diagnosed with schizophrenia even before psychotic symptoms start, and they may even be detected in family members without schizophrenia (Ott et al, 2002). Finally, there is a very large stigma associated with the diagnosis of schizophrenia, which leads to increased stress and burden on those diagnosed with the disorder. As a result, a greater understanding of the language patterns of those with schizophrenia could lead to more expedient diagnosis and better management of the disorder, along with a greater social understanding. Consequently, quantitative evaluations of the speech of patients with schizophrenia are needed in order to aid those struggling with the condition and ramifications of its diagnosis, which is the goal of this study.

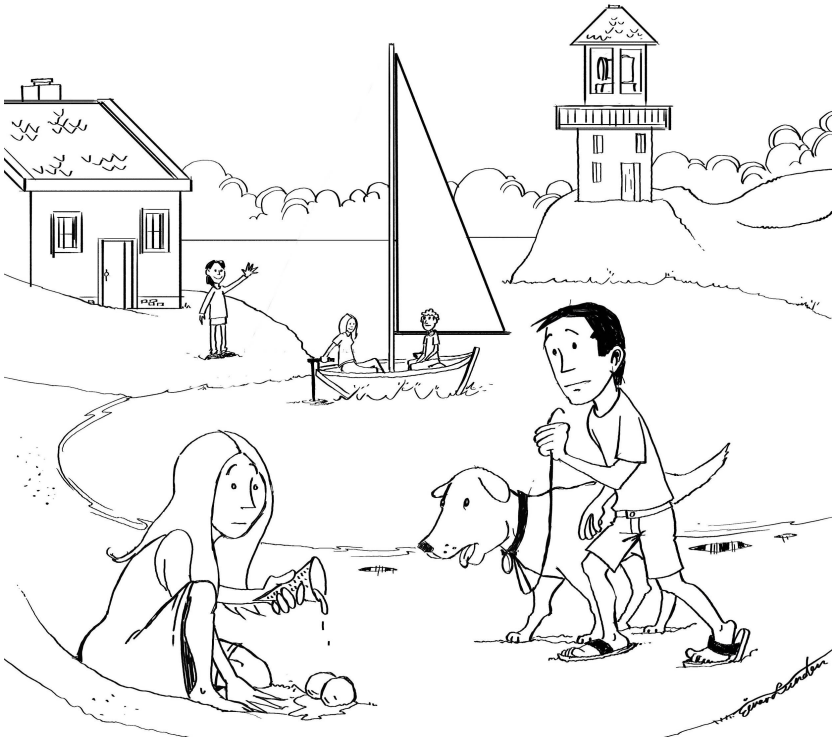
3.0 Data Collection

Drawing on this background of research in both schizophrenia and linguistics, this research analyzes the differences in narrative speech between patients with schizophrenia and controls. To do this, I compared how patients and controls orally described a picture, using data collected from an ongoing collaborative project headed by Columbia University Vagelos College of Physicians & Surgeons Professor of Psychiatry Michael T. Compton (Compton, et al., 2018). In this dataset, 68 patients and 78 controls (matched for age and ethnic background; controls

more likely to have higher education) were asked to describe a picture with as much detail as possible for a period of 2 minutes, being prompted if they ended early. Describing a picture was the first task of a total of five recorded speech tasks, which were conducted to get a wide variety of data from participants. The participants were recruited from the District of Columbia (DC) and New York City (NYC) areas, and patients with schizophrenia were enrolled by various outpatient care facilities. Controls, aged 18 - 50 and without known or suspected medical conditions compromising their ability to participate, were recruited via advertisements placed in the Washington Post, AM New York, Craigslist, and The Southwester. A smaller amount also heard about the study via word of mouth or flyers handed out in the area.

All subjects were asked to describe the picture in Figure 1.

Figure 1: Research Picture for Descriptions



The picture is a line drawing of a beach scene with two figures in the foreground, three in the midground, with other objects near each, and a lighthouse and various scenery in the background. In the foreground on the left sits a young girl who is holding a cone, from which two scoops of ice cream have fallen onto the sand. On the right, approaching her, is a young boy holding a leash and walking a dog. Behind them, in the midground, is a small body of water, in the middle of which sits a pair of people in a small sailboat. To their left stands a woman in front of a house on a small grassy hill, and she appears to be waving to them. In the background, on the very right across the body of water, is a lighthouse on another grassy hill. Finally, there are bumpy shapes, often interpreted as either trees/bushes or clouds, on the horizon. This picture was particularly composed for the collaborative project led by Dr. Compton.

Because all participants described the same picture, this provides us with a comparable base with which to analyze the speech of controls and patients. As was briefly touched on in the theoretical background, not having identical tasks and elicitation of speech from both patients and controls can compromise findings. For instance, in Deutsch-Link's (2016) study, essays from both patients and controls were analyzed, and it was found that patients used 1st person "I" language less than controls and more words related to perceptual experiences, especially auditory. However, the content of these essays was different, with patients asked to describe their experience with mental illness, compared to the controls — college students who were asked to describe their transition to university life. After analyzing the differences between these essays, Deutsch-Link (2016) concluded that, while the results were still very important and salient, "A standardized prompt might allow future research to pick up differences in language irrespective of content." Other studies have run into the same confounding factor of non-standardized prompts or prompts that are too open ended, therefore giving rise to widely varying elicited responses (Hoffman, 1988). This research hopes to address this by giving both patients and controls not only the same standard prompt, but also a controlled task. Rather than asking patients to come up with a completely creative story or response, the data collectors presented subjects with a picture to describe, thereby ensuring that the content of the responses would be comparable and constrained to a narrow topic.

While using a picture description task is an ideal way of minimizing confounding factors, such as nonstandard prompts or open-ended questions leading to incomparable narratives from participants, it does not mitigate these problems completely. Many participants incorporated their respective backgrounds into their picture interpretations; for instance, one participant described how the setting looked like a community from his native New England. However, this methodology still helps to both standardize the prompt participants receive and constrain their

elicited responses to be as comparable as possible, allowing us to analyze their discourse on the basis of language alone, rather than varying content and context.

While this approach has not been greatly utilized by other researchers in this field, there are a few examples of studies using picture descriptions to study disorganized speech in schizophrenia. Marini et al. (2008) elicited narratives from patients with schizophrenia to analyze their macrolinguistic language processing and found that these narratives were often filled with irrelevant information or topic derailments. Marini et al.'s approach is slightly different from this study's, as they asked their patients to create a narrative based on a series of cartoon strip pictures. Maher et al. (2005) used a picture description elicitation task more comparable to this paper's, presenting patients with a picture and asking them to describe it. However, they used this data to measure a different variable: whether patients with schizophrenia were indeed more likely to make more abnormal associations than controls using CAST software, which compares words in a given sequence with a dictionary of normal associations, to gauge how common their surrounding words were. Consequently, this current study is exploring new territory in the field of language and schizophrenia by using picture description and discourse analysis methodology to look at various aspects of patients' speech when compared to controls.

In particular, these picture descriptions are being analyzed for differences between patients and controls in the following 3 domains: i) NARRATIVE STRUCTURE of subjects' descriptions, ii) RELATIONSHIPS mentioned between components in the picture; and iii) COMPLETENESS of the description. A different methodology was used to analyze the data in each of these domains. As a result, the analysis of this research is split up into 3 separate analyses, for each of the 3 domains, with a methodology section preceding its corresponding analysis, results, and conclusions.

4.0 Analysis 1: NARRATIVE STRUCTURE

4.1 How Do Patients and Controls Transition Between Topics?

The first part of this research investigates how subjects transition between topics when describing the picture. To accomplish this, the use of discourse markers as connective devices will be analyzed. As detailed in section 2.3, using discourse markers helps speakers to organize their thoughts and communicate their intentions and meaning in a coherent fashion. This is an important lens through which to view disorganized speech, because it is often described by clinicians as incoherent and missing such structure. If patients truly do use discourse markers less frequently than healthy controls, this could greatly contribute to a perceived "disorderliness" of speech, switching from topic to topic seemingly at random, rather than transitioning smoothly. As a result, this analysis seeks to answer the question: "Do patients and controls transition between topics at the same rate and in the same ways?"

4.2 Methodology

This research on NARRATIVE STRUCTURE analyzes how patients and controls use discourse markers to introduce new topics. Based on Schiffrin's (1987) definition of discourse markers and the various types, a methodology was developed to look at multiple kinds of transitional discourse markers and how they are used by subjects when describing the picture. To investigate the kinds of markers used by subjects, the major figures of the picture were decided upon, and two main groups of discourse markers were formed: basic transitions and complex transitions (of 3 types).

First, to determine the main figures of the picture, 6 major "groups" were created based on objects that were in close proximity to each other and therefore often mentioned closely together as part of the same topic. These groups were: (1) girl + ice cream; (2) boy + dog; (3)

woman + house; (4) kids + boat; (5) lighthouse; (6) general background (e.g. sunny day, at the beach, etc.). It was decided that transitions would only be coded if they introduced a new topic, rather than expanding on the same one. This was to assess the claim that patients with schizophrenia do not introduce topics in a cohesive way.

Then the categories of basic and complex transitions were formed. The category of “basic transitions" was based on the unifying category of “discourse connectives,” coined by Schiffrin (1987) to group together the conjunctions “and, but, and or.” This research’s category of “basic transitions" co-opted Schiffrin’s grouping of markers that connected separate topics, and so included these three conjunctions, in addition to “also,” “in addition,” “then,” and “with.” “Also” and “in addition” played the same roles as the discourse connective “and" in the picture descriptions, in that they introduced new information in an additive manner. While Schiffrin (1987) defined “then” as a temporal adverb, when using the word in picture descriptions, subjects were not using it to show a progression in time events. Rather, because they were describing a static snapshot in time, “then” was used to introduce new topics much like “and,” so it was included in the “basic transitions" group as well. Finally, “with” also played the same role as “and” in the descriptions, as in the following sentence: “There’s a little girl in the picture, **with** another woman who’s waving to some people in a boat.” Here, “with” is not used to connect the two in a relationship and show some sort of connection, but really just serves to introduce a new topic. Because all of these markers served the basic purpose of introducing new topics but did not provide new information while introducing them, they were combined in the singular category of “basic transitions.” Of course, this is not to say that these discourse markers are “basic” in any way; as many scholars have shown, there is endless nuance and sophistication to be found in the uses of these transitional markers, particularly in the field of discourse analysis. However, for the purposes of this research, this study delineates between these “basic”

one-word transitions and “complex” markers which provide more information or require more observation in order to use appropriately.

The category of “complex transitions” is made up of three types of markers: positionals, causatives, and syntactic markers. Positionals are markers that introduce a new topic by placing it in spatial context with the rest of the picture. For example, “There’s a boy. **To his left**, there’s a girl.” Here, not only does the positional introduce the next topic, but it also gives additional information as to where the girl is located in the picture. This creates a more robust description and exhibits greater attention to detail than the basic transitions. Even if the positional was not the first thing introducing the sentence, it was still coded as a transition, as in the example: “There’s a woman waving. There’s a lighthouse on the **right**.” As a result, all transitions which indicated the position of the new topic (e.g. “in the background,” “on the right,” etc.) were marked as positionals.

Secondly, causatives are transitions which introduce new topics by showing how one can be the result of another. This grouping was based on Schiffrin’s (1987) category of “markers of cause and result.” This research’s group of causatives includes the discourse markers “because, so, and therefore.” An example of this would be: “It must be a sunny day out **because** the boy is wearing sandals.” Here, the transition “because” not only introduces the new topic, “boy,” but it also explains how this topic is related to the previous one in a way that the basic transitions do not. As a result, all transitions that indicate a cause and effect relationship between topics were labeled as causative.

The final subgroup of the “complex transitions” category is based on syntax. This group of syntactic markers was based on the concept of cohesion markers. In order to link referents with their anaphors, one must keep track of these concepts and introduce them correctly. Consequently, the data was coded for syntactic markers whenever a subject transitioned

between two sentences by including the next topic in the first sentence. An example of this would be: “The man walking the dog is looking at the **girl. She** just dropped her ice cream.” Because using pronouns and and stringing sentences together in this way requires higher-order thinking and planning, it was included in the “complex transitions” category.

Having noted these contrastive categories of transitions, some other issues also had to be addressed. What if two different kinds of transitions were used to introduce the same topic? For instance, “There’s a lighthouse on a hill. **And then in front of the house across the lake** there is a woman.” This example includes both the basic transition “and then” and the complex positional transition “in front.” To solve this problem, a hierarchy of transitions was created, in which only the highest-ranking transition used to introduce the new topic was coded. All basic transitions were coded as equally strong, but complex transitions were always stronger. As a result, in the example sentence given, only the positional transition “in front” would be coded. Within the complex transitions subgroups, causatives were marked as the strongest, followed by syntactic markers and then positionals.

Finally, it was also recorded if a subject made overarching statements that connected multiple topics in a similar way. For example, it was quite common for subjects to go one-by-one and describe the color of each figure’s hair. If coding by the so-far established methodology, it would seem as though the subject were switching wildly if they were to say, “The boy has black hair, the girl has long blonde hair, the woman has black curly hair.” However, these statements are clearly connecting all three of these topics logically by describing how they vary in terms of the physical characteristic of hair. Consequently, a “meta” category was formed, with four subtypes. “Meta-figures” was coded when subjects made overarching comments about the figures or what they were all collectively doing (e.g. “there are two people in the foreground, and three in the back”); “meta-environment” was coded when subjects made overarching comments

about the environment and its characteristics (e.g. “the foreground looks like sand because of the dots, whereas the back is grassy.”); “meta-physical” was coded when subjects made connections about multiple figures’ characteristics, as in the hair example; and finally “meta-emotion” was coded when subjects made overarching comments about figures’ emotional states (e.g. “Everyone looks happy, except for the girl because she dropped her ice cream cone.”)

With the topics decided upon, transitions defined, and methodological rules finalized, each transcript was coded by hand whenever a transition was made between these topics, with the transition type recorded in addition to mentions of meta-observations and a number of additional details. One of these was the number of topics mentioned in total, in order to see how many times subjects returned to previous topics. Data was also collected on how many times a subject made a comment about finishing their description or remarked about how much time was left on the clock in the two-minute task. This was done to assess whether patients and controls expressed the same amount of difficulty in describing the picture in the allotted time. It was also coded when a subject “broke the fourth wall,” so to speak, or mentioned information pertaining to their personal life and not related to the picture. This was done because of previous findings about patients’ tendency to overly intermingle personal information with the topic at hand (Harrow et. al, 1983; Harrow & Prosen 1978, 1979; Harrow 1980; Lanin et al. 1981).

4.3 Results

First, average numbers for both patients and controls were run descriptively, as can be seen in the following table. Patients and controls were compared in 6 categories:

(1) Bins: how many topics they mentioned overall in their descriptions

(2) Basic Transitions: How many basic transitions were included on average in each transcription

(3) Complex Transitions: How many complex transitions were included on average in each transcription

(4) Meta Mentions: How many times on average each transcription included a meta-mention (out of meta-figures, meta-environment, meta-characteristics, and meta-emotion)

(5) Fourth-wall Breaks: How many times on average each transcript made mentions of personal information not associated with the picture description task

(6) Time/Done: How many times on average each transcript mentioned being done with the task or noted how much time was left on the clock

Figure 2: Descriptives for NARRATIVE STRUCTURE

	Patient vs. Control Status	Number of Participants	Mean	Standard Deviation	Standard Error Mean
Bins	control	78	10.18	2.4000	0.272
	patient	68	9.85	3.182	0.386
Basic Transitions	control	78	2.14	2.167	0.245
	patient	68	2.34	2.303	0.279
Complex Transitions	control	78	2.3077	1.9360	0.2192
	patient	68	1.5588	1.7820	0.2161
Meta-Mentions	control	78	1.3590	1.1507	0.1303
	patient	68	1.2941	1.1205	0.1359
Fourth-Wall Breaks	control	78	0.06	0.295	0.033
	patient	68	0.07	0.434	0.053
Time/Done	control	78	0.73	0.989	0.112
	patient	68	0.74	0.874	0.106

At a glance, patients and controls seem to have a lot of overlap. Both groups have the same amount of “bins” (times they mentioned a topic; controls = 10.18 vs. controls = 9.85), basic transitions (controls = 2.14 vs. patients = 2.34), meta-mentions (controls = 1.36 vs. patients = 1.29), fourth-wall breaks (controls = 0.6 vs. patients = 0.7), and mentions of time/done (controls = 0.73 vs. patients = 0.74). However, controls seem to have more complex transitions than patients, averaging at 2.31 complex transitions per transcript, compared to patients with

only 1.56. To see if these numbers were significant, an independent samples t-test was run on these different aspects of NARRATIVE STRUCTURE, comparing patients and controls.

First, the number of topics was computed to see if patients and controls were equally likely to go back and repeat topics. This was done by taking the total number of "groups" mentioned and comparing patients and controls. While controls on average had slightly more bins than patients (10.18 vs. 9.85), this was found to be non-significant (Independent Samples t-test[1], $t_{144} = 0.692$, $p = 0.490$). That is, both groups were equally likely to move on from a topic and then return to it later on. Then the number and types of transitions (basic vs. complex) used by patients and controls were aggregated and compared. It was found that both controls and patients used about the same amount of basic transitions to introduce new topics ($t_{144} = -.533$, $p = 0.595$). Both groups made the same number of meta- comments, making similar overarching connections between characteristics and emotional states of figures in the picture ($t_{144} = 0.344$, $p = 0.731$). Surprisingly, controls and patients also made equal mentions of personal information/4th wall breaks ($t_{144} = -0.155$, $p = 0.877$) and remarks about the time left in the task ($t_{144} = -0.029$, $p = 0.977$). However, it should be noted that very few participants (less than 10 total) made any mention of fourth-wall breaking information, and mentions of being done with the task were also fairly infrequent compared to the other measurements, with patients making 0.74 mentions per transcript vs. controls with 0.73. As a result, it is possible that simply not enough data exists to get results on these aspects of participants' speech.

While patients and controls were found to be similar in many cases, one major difference was found: controls used statistically significantly more complex transitions than patients to introduce new topics ($t_{144} = 2.419$, $p = 0.017$). That is, controls introduce new topics with a greater amount of context and information. So while both patients and controls make basic

[1] All t-tests from now on will be Independent Samples t-Tests.

transitions at the same rate, patients are much less likely to make complex transitions which give extra information or require information tracking.

4.4 Analysis 1 Conclusion

The results of this analysis both support and challenge previous research conducted in this field. While clinical observations and the DSM-5 report that patients with schizophrenia jump from topic to topic without tying them together, this analysis shows slightly more nuanced results. While patients and controls use basic transitions at comparable rates, patients are much less likely to use complex transitions. That is, patients *are* using transitional discourse markers when moving on to a new topic, but they are less likely to provide this extra, nuanced information about *how* the new topic is related to the previous one. As a result, while patients are still using cohesive devices, they may not be making it clear enough as to how the topics are related. When a patient introduces a new topic without providing this extra information, their listener may not be able to make the same mental jump and follow the patient's train of thought. This could be contributing to the perception of incoherent speech and disorganized idea structure present in disorganized speech in schizophrenia.

The results from the analysis of "meta-" categories also show that patients and controls are equally likely to notice overarching patterns in the picture — for instance, noting everyone's emotional states or hair colors. The finding that both patients and controls notice the emotional states of the figures in the picture supports prior research showing that those with schizophrenia, while sometimes not expressing emotion themselves, are able to recognize emotion in others (Pomarol-Clotet, 2010). There was also no significant difference between how many times patients and controls noted the time left on the clock for them to describe the

picture, implying that both groups found it equally difficult at times to fill up the entire two minutes with speech.

Finally, the findings from the fourth-wall counters were not substantial enough to either support or refute prior research claiming that patients make loose associations to other topics, as too few participants made these kinds of connections. However, it should be noted that this research was very strict in what constituted this category — only personal information about other topics not pertinent to the picture were counted in this category. As a result, a number of strange utterances were excluded from counting towards fourth-wall breaks, such as imagining that the lighthouse in the picture was actually a guard tower conducting surveillance on all the figures below. While one might have a sense that this is indeed a strange interpretation of the picture, it was unfortunately very difficult to objectively categorize strange narratives like this, as it would be an attempt to quantitatively express subjective intuitions about what a picture description should be like. This research particularly wanted to veer away from the "you'll know it when you see it" definition of disorganized speech, and so very specific criteria were created to gauge whether or not an utterance was "abnormal." While the fourth-wall category was an attempt to get at this question, it may not have been robust enough to capture what we see happening in the data and leaves open avenues for further research.

5.0 Analysis 2: RELATIONSHIPS

5.1 How Do Patients and Controls Describe Relationships?

RELATIONSHIPS are an important facet of narrative speech to look at in patients with schizophrenia because of their reported tendency for loosened associations. If patients tend to make more or fewer connections than healthy controls, or if they make different kinds of connections, this could give insight into how they make associations between objects in the

world. As a result, a number of different questions were investigated within this domain: **(1)** On average, do patients and controls make the same number of connections? If not, what differentiates these patterns of connections? **(2)** Do patients and controls make connections of the same strength? Or is one group more likely to assume strong relationship ties between objects in the picture than the other?

5.2 Methodology

To answer these questions, a list of the 9 major objects often mentioned in relationships was created. This list included: girl, ice cream, boy, dog, woman, house, kids, boat, and background (including lighthouse). The lighthouse was included under the general "background" category, because very few connections were mentioned with the lighthouse specifically. After this list was created, each picture description transcript was examined and coded for whenever a relationship was mentioned between these objects. For example, "the boy is looking at the girl" would be coded as a connection between "boy" and "girl. The phrase "the mom is waving to the kids in the boat" would be coded as a connection between "woman" and "kids," but also a relationship between "kids" and "boat." Relationships between the kids and themselves and the background and itself were also included; for instance, "the kids in the boat look like they're dating" would be coded as a relationship between the kids and themselves. Duplicate connections were not recorded, along with connections made in the reverse order (e.g. boy + dog and dog + boy were counted as the same relationship), as this research was only interested in what unique connections subjects made when describing the picture. After each transcript was coded, the average number of connections for controls vs. patients was compared.

The final step of the RELATIONSHIPS analysis was to compare the strength ratings of relationships between patients' and controls' picture descriptions. To analyze the strength of

these connections, a ranking system was created on a scale from 0 - 2, describing how strong any given relationship was:

0: A tangential, positional relationship. An example of this would be “there is a woman to the left of the kids.” There is not a meaningful relationship between the woman and the kids, but rather they are only mentioned in connection with one another as a way of representing their positions in the picture.

1: A relationship that can be assumed based on visual information in the picture, involving a meaningful connection between objects. An example of this would be “the woman is waving to the kids in the boat.” There is a meaningful relationship here between the woman and the kids, as they are having an interaction.

2: A relationship between objects that includes additional information not present in the picture and shows a very strong connection between objects. An example of this would be “The *mom* is waving to *her* kids in the boat.” Here, there is an assumption that the woman is a mother to the people in the boat, therefore interpreting the picture in a way that gives additional information not present in the picture and presents a strong relationship between these figures.

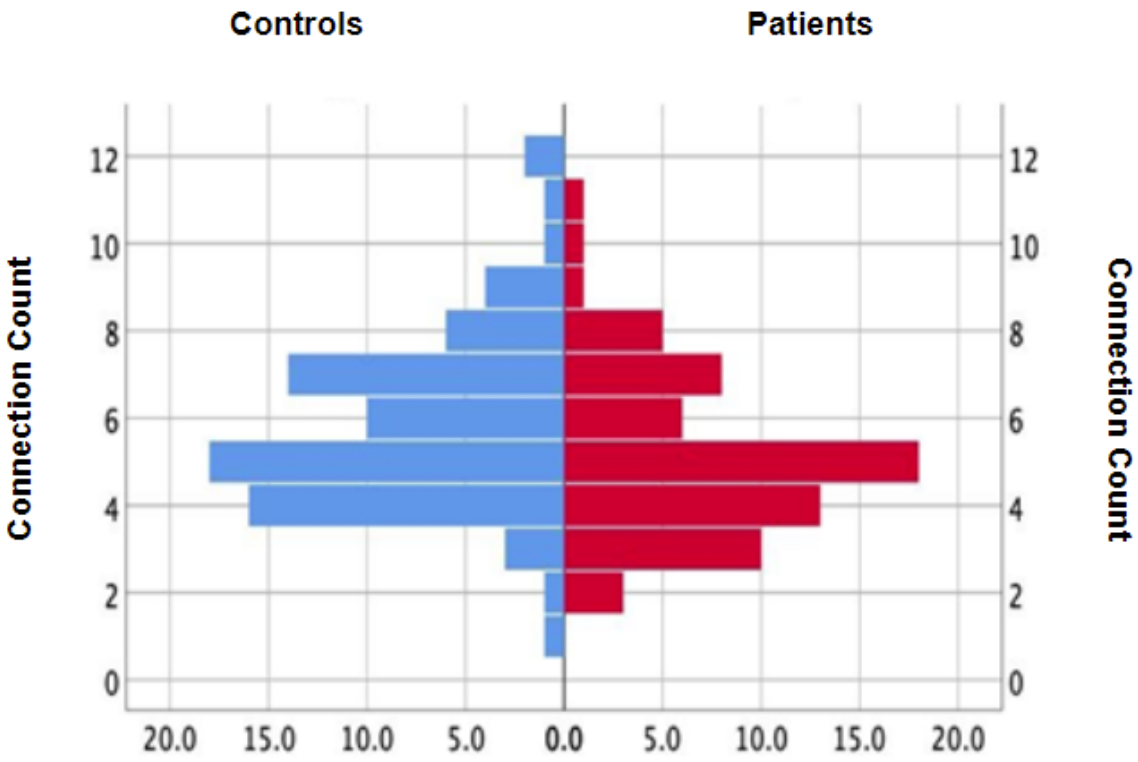
Each relationship coded in the first section of the RELATIONSHIPS research (detailing the unique relationships included in each transcript) was given a corresponding “strength” code based on the metric above. Because duplicate relationships were not tallied, if a subject mentioned the same relationship more than once, only one strength rating for the relationship

was coded. As a result, if in one transcript the same relationship was mentioned multiple times with varying degrees of strength, only the strongest of these was recorded in the coding.

5.3: Results

By comparing the average number of unique relationships mentioned in each transcript between patients and controls, two significant results were found. First, controls mentioned a greater number of unique relationships than patients. On average, controls noted 5.83 relationships in their respective picture descriptions, compared to patients with 5.12. While this may not seem like a large difference, it was found to be a statistically significant predictor of patient/control status (Independent Samples t-test, two-tailed, t_{144}=2.183, p=0.023). The graph below shows the distribution of these relationships, with both patients and controls most likely to mention 5 relationships on average. The graph also shows that both groups display similar distributional patterns. However, the tail ends reveal that patients are much more likely to make fewer than 5 connections, whereas controls are much more likely to make more than 5, with only controls making as many as 12 total relationships. This likely accounts for why these findings were statistically significant.

Figure 3: Relationship Counts for Patients and Controls



As a follow up, this research investigated where this difference in relationship counts was coming from. If patients were mentioning fewer relationships than controls, how was this manifesting in the descriptions themselves? To answer this question, a list of the most common relationships was made, based on the criteria that over 50% of controls had to mention the relationship in their descriptions. Six relationships met this bar: kids + boat (n=137), boy + dog (n=133), girl + ice cream (n=129), woman + kids (n=99), woman + house (n=68), and girl + boy (n=62). The results showed that patients mentioned significantly fewer of these relationships in their descriptions than controls (Independent Sample t-test, $t_{144} = 3.412$, $p < 0.001$). As a result, this research shows that not only do those with schizophrenia make fewer connections on

average, but also the kinds of relationships they notice are significantly different from those that controls do.

To follow up on this finding, the most common of the rarer relationships were analyzed. These were relationships made much less frequently, but not just by 1 - 2 people. A list of relationships mentioned by 5 - 20 participants was created, including the following: boy + woman, girl + dog, ice cream + boy, girl + kids, boy + kids, girl + woman, house + background, and kids + themselves (i.e. the relationship between the two kids in the boat, as in “they are a couple on a date.”). Similarly to the analysis of the most common relationships, these less common connections were analyzed to see if patients and controls noted them at different rates. The results showed that these two groups made references to these less common connections at comparable rates (t_{144} = -0.186, p = 0.853). This shows that patients were not more likely to make more abnormal connections between figures in the picture than people without schizophrenia.

Finally, the average strengths of these various connections were compared. The results showed that both groups made relationships of comparable strengths at the same rate (Independent Samples t-test, t_{44}= -1.673, p= .101) That is, patients were not any more likely to make strong relationships between objects in the picture than controls.

5.4: Analysis 2 Conclusion

As the first part of the RELATIONSHIPS study shows, patients made fewer connections on average than controls. This is a very interesting finding, which even seems to contradict existing research. Many previous studies have found that patients tend to make *more* associations than controls do (Deutsch-Link, 2016; Maher, 2005). However, the concepts found in these associations often have nothing to do with the context at hand, but rather connect with the

patient's own personal life or a tangential subject (Harrow et al., 1983; Maher, 2003). As a result, I hypothesize that perceived disorderliness of speech could be connected with a patient making fewer connections within the subject at hand and more connections with less pertinent subjects. That is, if patients are making fewer connections within the topic at hand, but rather making associations with other ideas, listeners may have difficulty following their train of thought and deciphering their meaning.

The follow-ups to this study, looking at common and uncommon relationships, also show that the two groups notice different kinds of relationships when describing the same picture, as patients were much less likely to mention the top 6 relationships noted by controls. This could potentially support the hypothesis that disorganized speech is indeed indicative of disorganized thinking, as patients give less common groupings, much like the findings of Harrow's (2003) sorting study. That is, not only do patients group objects in different ways from controls, but they also make mental connections between people and narratives in different ways. However, the other follow-up study looking at the prevalence of less-common relationships also shows that patients are no more likely than controls to make more abnormal connections in their picture descriptions. All the same, the results from this section of the RELATIONSHIPS analysis suggest that some differences in mental connections and thinking could be reflected in the speech of those with schizophrenia. This difference in thought process could also be contributing to a perception of disorganized speech, by patients making fewer connections and particularly not making the ones most apparent to a listener without schizophrenia.

Finally, this study shows that patients and controls describe relationships between figures in the picture with about the same amount of strength and inferred information. That is, patients are not more likely to assume stronger relationships between figures without evidence to back it up. This is an important finding, because previous research has found that patients

with schizophrenia have a predisposition to take seemingly unrelated things and perceive meaningful relationships between them, such as events or objects (Rominger, et al., 2011). However, this analysis of RELATIONSHIPS shows that, when presented with a picture description task, not only do patients describe fewer relationships, but they are also no more likely to extrapolate and describe more meaningful relationships between these objects than controls. This provides an important and complementary nuance to previous research, which has mainly analyzed personal narratives of patients and controls, rather than standardized tasks like describing a picture. As a result, making extrapolations and connections between seemingly unrelated ideas could be context dependent, with these observations happening more when patients are looking at their own personal life experiences. Conversely, it is possible that this study lacks robust enough data to capture this phenomenon. Regardless, this finding presents compelling evidence for future research to build from, looking at how patients and controls connect ideas in different contexts and tasks.

6.0 Analysis 3: COMPLETENESS

6.1 How Much Detail Do Patients and Controls Use When Describing Pictures?

The final study investigates COMPLETENESS, or how detailed subjects' picture descriptions are. This is important, because if patients mention more or fewer details than controls, then they could unconsciously be transgressing Gricean maxims of information, giving too much or little information, and therefore contributing to perceived unnatural speech patterns (Grice, 1975). In addition, it grants a peek into the cognitive processes of those with schizophrenia and what they notice and interpret when confronted with this picture. To investigate these questions, this section of the research analyzes how detailed patients' picture descriptions are when compared to controls'.

6.2 Methodology

To answer this question of “do patients and controls describe a picture with the same level of detail?”, a list of 10 major objects in the picture was created, including: girl, ice cream, boy, dog, woman, house, kids, boat, lighthouse, and background/overall statements about the scene (e.g. sunny day, at the beach, etc). Here, in contrast to Analysis 2 (see Section 5.2), the lighthouse was listed as a discrete object, as it has distinct qualities from the general background. These 10 major objects were then broken down into their details or associated actions and qualities. Figures in the background had vague detail, with categories like clothing, hair, emotion, and other actions, such as waving or rowing. Figures in the foreground had much more fine detail, with clothing broken down into separate items (e.g. sandals, shirt, shorts, etc.). A full list of the objects with their respective characteristics is included in the appendix of this paper. Based on this list, each transcript was coded for how many of these unique details were mentioned. Duplicates were not counted, as the goal for this research was simply to find any mention of these details, not find how many times they were mentioned. The average number of details included in patients’ descriptions was then compared to the controls’ average.

6.3 Results

Comparing patients and controls in this domain of COMPLETENESS revealed a contrast between the two groups. Controls gave more detailed descriptions than patients, providing on average 23.19 details per picture description, compared to patients with 19.44. This was a statistically significant predictor of patient/control status ($t_{144} = 4.077$, $p<0.001$).

I also examined how many major objects (of the 10 total mentioned earlier) patients and controls mentioned. That is, rather than counting up how many details (e.g. short hair, sandals,

shirt, etc.) were mentioned, the goal was to see if both groups mentioned the objects in general at comparable rates, or if one was more likely to omit major figures (e.g. boy, dog, girl, etc) altogether. While most participants mentioned all 10 groups, patients mentioned statistically significantly fewer ($t_{36.736}$ = 2.125, p=0.040). As a result, not only did patients give less detailed picture descriptions, but they also were more likely to miss major figures and concepts in the picture altogether.

However, patients also tend to speak much less than controls do, in terms of word count (t_{144}=3.864, p<0.001), which leads to the question: is completeness still a predictor of patient/control status when transcription length is taken into account? To answer this question, the word count of each transcription was tallied up and compared with completeness to see if that had any effect on the statistical significance. The results from this show that both completeness and word count are marginally significant independent contributors predicting patient vs. control status when both are taken into account:

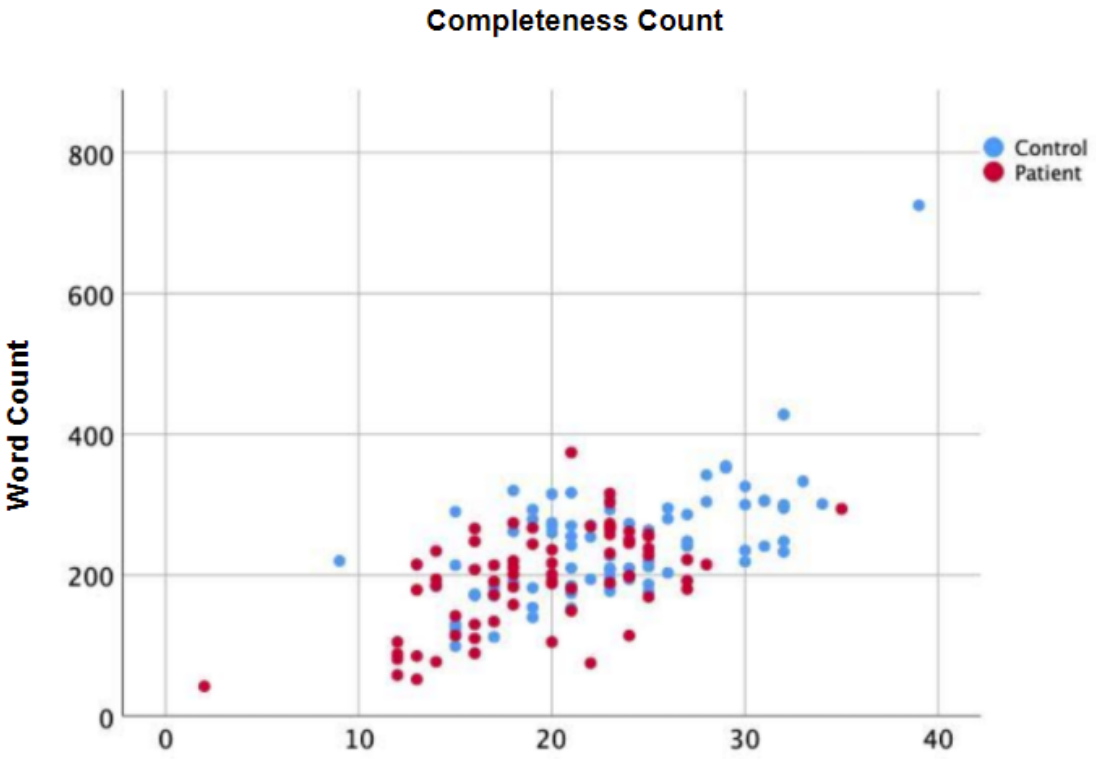
Logistic Regression, DV=patient/control, IVs = completeness count, word count

Completeness count: Wald(1) = 3.758, p = 0.053

Word count: Wald(1) = 3.585, p = 0.058.

This can also be seen in the following graph, with word count in the y axis and completeness count in the x axis:

Figure 4: Word count vs. COMPLETENESS



While most of the dots in this graph are clumped together in the middle, we see a separation at the ends. There are many more blue (control) dots higher up on the completeness scale than red (patient) dots, even when they have the same word count. We also see many more red dots at the bottom of the completeness scale. This means that even when patients' lower speech production is taken into account, they still produce less complete picture descriptions than controls do.

6.4 Analysis 3 Conclusion

The results from this analysis show that patients with schizophrenia give statistically significantly less detailed picture descriptions than controls do. However, this then begs the

question: do patients notice fewer objects and details, or do they simply fail to mention them in their speech because they are saying fewer things? The follow-up analysis comparing completeness to word count answers this question somewhat, showing that even when word count is included in the analysis, completeness is still a marginal predictor of patient/control status. However, marginal significance is less concrete than the original results were without factoring in alogia. Regardless, it seems as though patients with schizophrenia notice fewer details when describing a picture than controls do. This could mean that patients with schizophrenia are perceived as disregarding important information when speaking, transgressing Gricean maxims and possibly leading to less intelligibility.

7.0 Alogia Effects

7.1 How Much of an Effect Does Word Count Have on These Findings?

The analysis of COMPLETENESS showed that giving detailed descriptions was a significant predictor of patient vs. control status. While completeness remained a marginally significant predictor of patient/control status when word count was accounted for (Wald(1) = 3.758, p=0.053), this was still a great change from the significant p-value for completeness alone, without factoring in word count (t_{144} = 4.077, p<0.001). If including word count in the statistical model could alter the results for COMPLETENESS in this way, then I wanted to investigate if it would also have an effect on the other areas of NARRATIVE STRUCTURE and RELATIONSHIPS. That is, if patients and controls were matched for word count, what effect would this have on the results?

7.2 Methodology

To answer this question, the original set of 68 patients and 78 controls was narrowed down to a smaller subset based on word count. Each patient was matched with a control with

the closest number of words in their respective transcript. For example, a patient with 212 words in their transcript might be matched with a control with 217 words. The resulting subset of matching patients and controls included 112 total subjects (56 each of patients and controls). As a result, 34 of the original 146 subjects were excluded in this part of the study, due to incomparable word counts and uneven numbers of patients and controls. By matching patients and controls via word count, the data became much more comparable: patients now had a mean word count of 215.3 words per transcript, and controls had 212.7. This is a marked difference from the disparity of the original dataset, where patients had a mean of 193.84 words per description, compared to controls with 244. With the transcripts successfully matched to have comparable length, the 3 analyses of NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS were rerun on on this smaller subset to see if word count had any confounding effects.

7.3 Results

When the subset of these 112 transcripts was analyzed through the methodologies of NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS, a stark difference was found in comparison to the original analyses with the full set of data. The findings of the prior analyses – that patients had less complex discourse markers, made fewer relationships, and gave less detailed picture descriptions – were not upheld with this new dataset. Instead, all of the p-values were not statistically significant. This implies that alogia had a significant impact on the NARRATIVE STRUCTURE and RELATIONSHIPS in patients' transcripts, and that perhaps these measurements were due to less speech being produced.

These findings inspired splitting the data further to gain additional information. Now that the participants were matched for word count, analyses could be run on how more lengthy

picture descriptions varied from shorter ones. To accomplish this, the subset of 112 matched patients and controls was split down further into two groups: Group A, whose transcripts had 200 words or less (47 total: 23 patients and 24 controls), and Group B, whose transcripts had 200+ words (65 total: 33 patients and 32 controls).

When Group A (whose transcripts had 200 words or less) was analyzed, it was found that patients in this group mentioned statistically significantly fewer of the most common relationships (mentioned by over 50% of controls) than controls did ($t_{47} = 2.525$, *p=0.015)*. This shows that, even when the lengths of their descriptions are the same, patients with fairly short transcripts fail to mention the same relationships as controls. Consequently, patients are much less likely to connect their observations into a cohesive narrative similar to controls when they produce shorter picture descriptions.

Finally, in Group B (whose transcripts had 200+ words) patients gave marginally statistically significantly less detailed picture descriptions than controls did ($t_{65} = 1.961$, p=0.054). This shows that even when patients are speaking more words, they are not being more detailed with their picture descriptions, which supports prior observations that those with schizophrenia exhibit “poverty of content”; that is, even if they are speaking a lot, the extra words are not contributing to any new information, but rather are often repeating previous sentiments.

7.4 Conclusion

The findings from the analysis of alogia’s effects on speech add an interesting extra level to the previous studies of RELATIONSHIPS and COMPLETENESS. While the whole set of 112 individuals did not yield any significant results, both Groups A (200 words or less) and B (200+ words) did. The analysis of Group A shows that patients indeed fail to mention the most common relationships pointed out by controls, even when the two groups are matched for word

count. This means that patients are not simply missing these relationships because they are speaking less, but because they omit mentions of them. This supports the prior takeaways from the RELATIONSHIPS analysis conclusion (section 5.4).

The analysis of Group B shows that patients still give less complete picture descriptions than controls do, even when their descriptions are the same length. This supports prior research showing that patients with schizophrenia, when not experiencing alogia, can exhibit a poverty of content. That is, they may be saying the same number of words, but the amount of information being conveyed through those words is less than what is present in controls' descriptions. This evidence of lower density of information supports the claims of "poverty of content" in disorganized speech.

Unfortunately, though, the effects of alogia still present some problems for the prior findings of this research. While many differences still remain between patients and controls, many of the earlier findings are either eclipsed or made only marginally significant. A likely reason for this could simply be that there is not enough data in these smaller subgroups to solidify the significance of the previous findings. With more subjects in these subgroups, these results may become more significant and replicate the findings of the prior 3 analyses. However, for now, more research is needed to address these remaining concerns and questions. Regardless, there do seem to be differences in the speech of patients and controls in terms of NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS. This analysis simply shows that these differences may be more a result of alogia than disorganized speech.

8.0 Prompting for Additional Speech

8.1 Does Prompting for Additional Speech Affect Participants' Data?

One methodological problem that this paper's analysis has not yet addressed lies in the set-up of the picture description task itself. While all participants were given 2 minutes to complete the picture description task and prompted to continue if they finished early, with the goal of obtaining a sufficient amount of speech, this could also have created problems in the data. As mentioned in Analysis 1: NARRATIVE STRUCTURE (section 4.2), participants regularly made comments about how much time they had left in the task and worried about how they would fill that time up. When these remarks were made in the middle of the picture description, participants often broke their descriptions into two halves. In the first half, there was an initial, complete description of the picture. After this, though, the participant realized they still had time to fill or were even prompted to speak more, and so often recapped their previous observations, along with new ones occasionally, in a second description. This means that additional details were often added in the second part of the descriptions, and that topics were repeated during this second description phase. Based on this, I wanted to see what would happen if I analyzed a cut version of these descriptions, including information only up to the first mention of them being done with the task or remarking on how much time they had left to fill.

8.2 Methodology

Transcripts in which participants mentioned that they were done with the task or remarked on the time left on the clock were collected for this analysis. While participants often said they were done with the task and did not continue to speak afterwards, there were 47 transcripts (25 patients, 22 controls) where this happened in the middle of the picture description, creating a "before" and "after" picture description. For these 47 transcripts, I went

back through the previously coded data for NARRATIVE STRUCTURE and COMPLETENESS and adjusted the measurements to only count for the speech uttered up until the first mention of the participant being done with the task. For NARRATIVE STRUCTURE, all previous measurements were collected aside from “time/done” (bins, 4 types of transitions, metas, fourth-wall). As for COMPLETENESS, both the number of distinct, unique details mentioned in the description and the highest number of details mentioned total were tabulated. For example, if a participant said, “The man is walking the dog. The man is holding a leash,” this would have been coded as (man, walk, dog, man, holding, leash) in the data. There are 6 objects in this list, but because the man is mentioned twice, there are only 5 unique details. These separate values were collected to try and assess the content density of speech and assess if poverty of content could be detected in participants’ speech. Relationships were not tabulated for this part of the data, as most relationships were mentioned in the first section of these two-part descriptions, and it was thought that there were too few unique relationship codes to find a distinction.

8.3 Results

First, these transcripts were analyzed for differences in NARRATIVE STRUCTURE up until the first mention of “time/done.” When all transcripts (n=144) were compared in terms of NARRATIVE STRUCTURE up until the first mention of “done,” similarly to the initial analysis of NARRATIVE STRUCTURE with all 144 picture descriptions *without* considerations of mentions of “time/done,” only complex transitions were found to be significantly different between patients and controls (t_{47} = 2.192, p = 0.03). While this is a somewhat less robust finding than the full analysis (t_{144} = 2.419, p = 0.017), that is to be expected from the decreased amount of data. The fact that the results of NARRATIVE STRUCTURE were fully replicated with this dataset before the first mention of

“time/done” is very promising, showing that prompting for additional speech from these participants did not adversely affect the findings of the full dataset.

The consistency of the results was also upheld when comparing the narrative structure of the 47 split transcripts both before and after the “time/done” mention. That is, the transition types were tallied up for these transcripts both before and after the “time/done” mention and compared to one another. No significant differences in transition usage were found between the before and after “done” sections of the transcripts in patients and controls, showing that prompting for more speech did not disrupt the regular discourse style of these participants.

Next, these shortened transcripts were analyzed in terms of completeness. First, the completeness levels of all 144 transcripts were recorded up until the first mention of “done,” and patients and controls were compared to each other. Similarly to the original analysis, controls were found to have statistically significantly more details in their picture descriptions than patients ($t_{144} = 3.724$, $p < 0.001$). The average difference in how detailed the picture descriptions were also changed very little: the difference in means between patients and controls when considering the entire transcripts was 3.78, compared to 3.66 when only counting up until the first done. This shows that prompting for additional speech did not have a significant impact on the detailedness of descriptions by participants.

A further analysis investigated whether patients and controls mentioned different amounts of new, unique details in the second half of their picture descriptions. That is, when they continued past their first mention of “done,” did they simply repeat the same details from the first half of the description, or did they mention new details? Furthermore, how much of the transcript was made up of these new details? To answer these questions, I tallied up how many unique details were mentioned after the first mention of “done” that had not been mentioned beforehand. I then also divided this number for each transcript by the total number of objects

mentioned in the second half of the transcript, and then I compared patients and controls. No statistically significant difference was found in the average amount of new details between these two groups (t_{47} = 1.695, p = .097), showing that both patients and controls have similar levels of completeness in their descriptions after the first mention of “done.” However, the averages for how densely packed new information was in the second half of these transcriptions differed between the two groups (controls = 0.32 vs. patients = 0.22). While this difference turned out not to be statistically significant (t_{47} = 0.900, p = 0.953), it seems likely that this is due to the reduced size of the dataset, and that we could expect to see a difference with a larger sample size.

8.4 Conclusion

While at first we might be concerned that prompting for additional speech could compromise the data, in fact the results show that prompting for more speech does not change the discourse patterns of either patients or controls in terms of NARRATIVE STRUCTURE and COMPLETENESS. As a result, I would like to suggest that prompting for additional speech in tasks like this could be useful, as it provides more data to analyze in research and does not seem to affect the distinctive speech patterns of participants. Therefore, this research shows quantitative evidence supporting the use of longer time intervals and prompts to continue speaking, at least in picture description tasks.

9.0 Correlation with Psychiatric Assessment Scales

9.1 Do Psychiatric Assessment Scales Correlate with This Paper’s Findings?

While a number of linguistics-based methodologies were developed in this paper’s analyses to compare the speech of patients and controls to find and assess any abnormalities, psychological battery tests also attempt to do this impressionistically. Psychiatric rating scales

such as the SANS, CAINS, and PANSS scales (introduced in section 2.2) help clinicians to rate their patients' symptoms like apathy, attention, and blunted affect, but also some linguistic symptoms as well, including alogia. Alongside the results gained from this research and conclusions in the fields of NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS, this paper also seeks to ascertain if there exists a correlation between the linguistic abnormalities shown in the speech of patients in these studies and clinicians' ratings of linguistic symptom severity in these psychiatric interview evaluations.

9.2 Methodology

All patients who took part in the picture description task had been evaluated on the SANS, CAINS, and PANSS scales, all of which include some evaluation of patients' linguistic faculties. The SANS scale evaluates patients on 25 different criteria, on a scale of 0 - 5, where 0 indicates no symptoms, and 5 indicates severe symptoms. Patients can also be measured as "unknown" (UNK) on the scale if the clinician can not rate them. There are three criteria on the SANS scale which are pertinent for this analysis (Andreasen, 1989):

1. SANS-9: Poverty of Speech: The patient's replies to questions are restricted in amount, tend to be brief, concrete, unelaborated.
2. SANS-10: Poverty of Content of Speech: The patient's replies are adequate in amount but tend to be vague, over concrete or over generalized, and convey little in information.
3. SANS-13: Global Rating of Alogia: The core features of alogia are poverty of speech and poverty of content.

The CAINS scale assesses patients on 13 criteria on a scale of 0 - 4, where once again 0 indicates no impairment, and 4 indicates severe symptoms. The CAINS-13 measurement

assesses patients' "Quantity of Speech," and was recorded for all patients who participated in the study (Kring et al., 2013). Finally, the PANSS scale assesses patients on 40 different criteria on a scale of 1 - 7, where 1 indicates no symptoms and 7 indicates extreme symptoms. The PANSS-N6 measures "Lack of Spontaneity and Flow of Conversation," which is defined as "Reduction in the normal flow of communication associated with apathy, avolition, defensiveness or cognitive deficit. This is manifested by diminished fluidity and productivity of the verbal interactional process" (Kay et al., 1989).

These 5 measurements on the SANS, CAINS, and PANSS scales were compared with the statistically significant measurements of NARRATIVE STRUCTURE (number of complex transitions), RELATIONSHIPS (number of relationships and number of most common relationships), COMPLETENESS (number of details), and alogia (word count). This was done through a Spearman's Rho Bivariate Analysis, comparing these measurements with each other and seeing if a correlation existed between the ratings.

9.3 Results

The results from the Spearman's Rho Bivariate Analysis show a number of significant correlations between the psychiatric measurement scales and this paper's assessments of linguistic abnormalities in the speech of patients with schizophrenia. The following table shows the results of this analysis:

Figure 5: Spearman's Rho Bivariate Analysis

		Complex Transitions	Relationships	Common Relationships	Completeness	Word Count
CAINS-13	Correlation Coefficient	-0.034	-0.137	-0.112	-0.078	-0.144
	Sig. (1-tailed)	0.391	0.132	0.181	0.264	0.121
	N	68	68	68	68	68
SANS-9	Correlation Coefficient	-0.089	-0.103	-0.098	-0.021	-0.097
	Sig. (1-tailed)	0.236	0.204	0.214	0.434	0.218
	N	67	67	67	67	67
SANS-10	Correlation Coefficient	-0.266*	-0.229*	-0.146	-0.206*	-0.187
	Sig. (1-tailed)	0.015	0.031	0.118	0.047	0.065
	N	67	67	67	67	67
SANS-13	Correlation Coefficient	0.067	-0.107	0.036	-0.116	0.070
	Sig. (1-tailed)	0.294	0.194	0.386	0.175	0.287
	N	67	67	67	67	67
PANS-N6	Correlation Coefficient	-0.267*	-0.221*	-0.352**	-0.076	-0.250*
	Sig. (1-tailed)	0.015	0.036	0.002	0.271	0.021
	N	67	67	67	67	67

* = significant, $p < 0.05$
** = significant, $p < 0.01$

Because higher ratings on all the psychiatric scales indicate more extreme symptoms, we would expect to find negative numbers in the cases where these ratings and this paper's linguistic analyses correlate with each other (e.g. if high ratings on the SANS10 correlate with patients having fewer details in their picture descriptions, we would expect this to give us a negative number in the chart). Indeed, the SANS10 and PANSS N6 ratings show a number of statistically significant correlations. Higher ratings on the SANS10 (poverty of content) correlate with fewer complex transitions, relationships, and details in patients' picture descriptions – consistent with all three areas linguistically examined of NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS. The correlation with the SANS10 makes sense; if patients are not providing a great amount of information in their speech due to poverty of content, we would expect to see fewer relationships and details in their picture descriptions. In addition to these SANS10 results, this analysis showed that higher ratings on PANSS N6 (lack of spontaneity and flow in conversation) correlated with fewer relationships and common relationships, low word count, and fewer complex transitions. These results also make sense, as if flow of conversation is impaired, then we should also see fewer information-rich transitions and connections being made in picture description narratives. As a result, we see that this paper's linguistic measurements of patients' speech correlates with certain assessments of patients' speech by clinicians. However, this was only for 2 out of 5 such ratings; the SANS9, SANS13, and CAINS13 did not correlate with any of the linguistic measurements in this paper.

There is another, unexpected finding that these results show: the absence of any correlation with alogia ratings. The SANS9, SANS13, and CAINS13 are all supposed to rate patients' alogia, or lack of speech overall. However, these ratings did *not* correlate with any of the linguistic measurements used in this paper, including word count. This is very surprising;

after all, if there is anything we would expect alogia ratings to correlate with, it would be the number of words a patient is saying. However, we do not see this in the statistical analysis.

9.4 Conclusion

We seem to get mixed results from the Spearman's Rho Bivariate Analysis comparing this paper's linguistic measurements to clinicians' ratings of patient symptom severity. On the one hand, we do see some correlation between these ratings, particularly in the fields which measure aspects of disorganized speech – rating flow of conversation and poverty of content of speech. This paper's linguistic assessment of patients' speech abnormalities does correlate with how clinicians rated their linguistic symptoms on these scales, which is reassuring. However, there are equally troubling results from this analysis as well: that alogia ratings by clinicians seem to have no correlation with any of these linguistic measurements, including word count. Given that word count had such an impact on the significance of this paper's findings, as shown in section 7, we know that how much a participant speaks has a great impact on how cohesive, connected, and detailed their picture descriptions are. In addition, we also already know that patients on average have much shorter picture descriptions than controls, to a statistically significant degree. As a result, the fact that the psychiatric evaluations for alogia do not seem to correlate with any of the linguistic measurements is concerning.

There are a number of ways to try to explain this discrepancy. First, it is important to note that patients were measured on these psychiatric evaluation scales separately from the picture description task and the following battery of tasks participants were asked to complete in this study. As a result, it is possible that patients' ratings of alogia simply would not be well reflected in this single, short task. Another possible explanation lies in the nature of these psychiatric assessments themselves. While many different psychiatric rating scales have been developed

to assess severity of symptoms in patients, their efficacy has been criticised (Park et al., 2018). For one, the format of these tests requires the clinicians complete a 1 - 2 hour long interview and then write down their assessment of the patient after the fact on a small numerical scale. In addition, previous studies have suggested various modifications to these, claiming that the current iteration does not consistently assess patients (Walsh-Messinger, et al., 2018). Other studies have shown that these scales are lacking in certain areas, such as assessment of how women and men are affected differently by schizophrenia and thus present in various ways when assessed by clinicians on these scales (Walsh-Messinger, et al., 2018) Without more research and data, though, it is difficult to tell what the cause of this discrepancy is, which presents possible future avenues for further research.

10.0 Discussion

10.1 Discussion

The three studies of NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS have all produced new and interesting findings, along with the follow-up studies of Alogia Effects, Prompting for Additional Speech, and Correlation with Psychiatric Assessment Scales. The analysis of NARRATIVE STRUCTURE revealed that, while both patients and controls use basic transitions at the same rate, patients use significantly fewer complex discourse markers when transitioning between topics. The analysis of RELATIONSHIPS showed that patients mention fewer relationships than controls, and particularly did not mention the most common relationships noted by controls. Finally, the analysis of COMPLETENESS found that patients give less detailed picture descriptions than controls.

While all these results can stand on their own, they can also form a more comprehensive picture when considered together. The results from NARRATIVE STRUCTURE showed that patients

use less context and information when introducing new topics. When this is combined with the results from the RELATIONSHIPS analysis, we see an even greater pattern: when describing a picture, patients categorically perform poorly compared to controls when connecting ideas and figures to one another. Not only do patients make fewer connections when describing the picture, but they use less information to explain how these things are connected to one another in terms of complex discourse markers. This is a significant finding and could help to explain why patients with disorganized speech are often described as making loose associations. While they may be making connections, they make fewer connections within the topic at hand than expected, and they connect their topics with less cohesion. While this is somewhat different from other research showing that patients make more associations than controls (Andreasen & Grove, 1986), it adds nuance to the assertion that patients make loose associations.

In addition, by looking at the intersection of the analyses of RELATIONSHIPS and COMPLETENESS, we can see that patients give less complete picture descriptions in a number of ways. Not only do they provide fewer details about the picture, but they also fail to explain how the figures in the picture are related to each other as robustly as controls. Combined with the earlier observation about the lack of cohesion in patients' speech, we can see that a major characteristic of the speech of patients with schizophrenia is a lack of information and explanation of how the information is connected. While scholars and clinicians have noticed that patients tend to not connect their ideas in a coherent fashion, this analysis shows how these qualitative observations of patients' speech can be backed up by linguistic, quantitative evidence in terms of discourse markers used, relationships described, and details voiced.

While the follow-up analysis of alogia's effects on patients' speech does present some problems for this analysis, the findings from the three studies of NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS still stand; they simply might be more reflective of the way

alogia presents in the speech of those with schizophrenia, rather than disorganized speech itself. Even with this distinction, some findings remained after alogia was taken into account: patients tended to notice fewer of the most common connections, and still often gave less complete picture descriptions. While more research is needed to determine the causes of patients' abnormal speech, this analysis still presents consistent findings and shows specific linguistic ways in which patients' speech differs from that of controls.

Indeed, many of the characteristics found in this paper's analysis have been described by previous literature. The DSM-5 describes switching randomly between topics as one of the characteristics of disorganized speech, which we see reflected in the analysis of NARRATIVE STRUCTURE (American Psychiatric Association, 2013). Observations of this phenomenon have been noted by many clinicians and researchers and are also reflected in Chaika's (1974) assessment of one of her patients. Much research has also shown that language impairment in schizophrenia often exists primarily at the macrolinguistic level, including narrative structure (Marini et al., 2008; Minor et al., 2019;). While little research has been conducted on how cohesion, and in particular discourse markers, vary in the speech of patients with schizophrenia, the results of these analyses are promising and support other research in the field.

The analyses of RELATIONSHIPS and COMPLETENESS also expand our understanding of findings from prior literature. Many researchers have addressed the topic of "loose associations" and found that patients with schizophrenia have a tendency to veer off topic and inappropriately insert non-pertinent information (Harrow et. al, 1983; Harrow & Prosen 1978, 1979; Harrow & Miller 1980; Lanin et al. 1981; Andreasen & Grove, 1986). While this paper did not find that patients veer off topic, it did uncover a complementary finding: that patients with schizophrenia tend to say less about the topic at hand, both in terms of word count and poverty of content. If patients make loose associations and have difficulty staying on topic, then it would follow that

they speak less about said topic; in the picture description task, results consistently found that patients were worse at making pertinent connections between objects and figures, and they also produced less detailed descriptions than controls.

This paper's conclusions on the linguistic characteristics of the speech of patients with schizophrenia also seem to have some correlation with psychiatric rating scales used by clinicians, namely the SANS, CAINS, and PANSS scales. In particular, the SANS10 (poverty of content of speech) and the PANSS N6 (lack of spontaneity and flow in conversation) ratings for patients who took part in this study reflected this paper's findings in the abnormalities in NARRATIVE STRUCTURE, RELATIONSHIPS, and COMPLETENESS exhibited by patients. Not all the results were positive, though: the clinical measurements of alogia on this scale did not correlate with any of this paper's linguistic assessments. In addition, only 2 out of 5 of these ratings correlated with this paper's findings. Despite these discrepancies, the results of this paper suggest that certain linguistic elements are captured well by these rating scales.

Finally, the methodology of the current study is also promising for future research. By giving participants a task to describe a picture, this research was successfully able to mitigate other confounding variables, such as topic and variations in personal narrative. In addition, analyzing topic jumping and associations through the lens of coherence and cohesion revealed solid results in differences between the speech of patients and controls, revealing a measurable linguistic difference in the speech of patients with schizophrenia. Finally, the analysis of prompting for additional speech (section 8) showed evidence that prompting for additional speech from participants does not adversely affect their regular discourse patterns. This means that researchers can feel more assured when prompting for more data to analyze later on. As a result, this paper adds not only new findings to the intersectional field of how language and

schizophrenia are related, but it also presents methodologies through which to measure the speech of those with schizophrenia.

10.2 Methodological Difficulties

While this research was inspired by the need for more objective, linguistic-criteria based evaluations of patients' speech, there were many issues that could not be solved by this research or that arose as a result of this new methodology. As was outlined in the Background (section 2) of this paper, many descriptions of disorganized speech in schizophrenia are based on evaluations of patients' speech without comparing it to controls, or without a linguistic basis for what it means to randomly transition between topics, or other characteristics described by the DSM-5. As a result, this paper's methodologies to assess the disorganized nature of speech were developed to be as objective as possible, both standardizing the responses via the picture description task and holding controls and patients up to the same methodological criteria.

It was a challenge to balance capturing the abnormalities that were clear in certain transcripts while also not using subjective criteria to define them as "abnormal." As a result, there are some differences between patients and controls which could not be captured and analyzed in a quantitative manner through the methodology developed here. One major example would be the interpretations of the picture. As shown by an earlier example of a patient interpreting the lighthouse as a guard tower conducting surveillance on the people below, some patients did indeed make noticeably abnormal remarks in their picture descriptions. However, it was fairly common for subjects to make comments about the picture overall, and so differentiating these evaluations into "normal" and "abnormal" in a standardized way posed great difficulties. For instance, while participants would occasionally make off-color comments, such as "the woman who drops her ice cream cone looks like a hippie," there were a few stand-out

examples of strange speech, as in one participant who mentioned the boy and his dog and said, “Something is wrong with this picture. Something is wrong with the idea of him walking the dog, because he can't do it, something is getting in the way.” While one can feel a marked difference between these two examples, it was difficult to devise a methodology to objectively and quantitatively measure them. As a result, some of the distinctive patterns of speech between patients and controls, such as abnormal interpretations and digressions, were not tackled in this analysis and require further study.

Another methodological difficulty lies in the patients themselves: it is very difficult to find and recruit individuals with schizophrenia who are not on medication. Consequently, many, if not all, of the participants were on medication at the time of this study, which could have had a result on their speech production compared to how it might have been without the medication. In addition, patients were not separated into categories based on what kind of schizotypal disorder they were diagnosed with. As different kinds of schizophrenia have been noted as creating different kinds of disorganized speech (Andreasen & Grove, 1986), this could also have led to less complete and comprehensive results in this study. It could prove very useful for future research to separate different types of schizotypal disorders and see if similarities and differences exist between them to more robustly describe this umbrella of disorders.

Finally, it should also be noted that it is possible that cultural and background differences could have contributed to varying interpretations and descriptions of the picture. While patients and controls were matched for age, gender, ethnicity, and other background factors, patients with schizophrenia on average had lower levels of education. This, coupled with possible cultural differences in narration and picture descriptions, could have had an impact on the data. Indeed, prior research has shown that adults with lower levels of education give shorter and less detailed descriptions – which is what this paper also discovered, but attributed to schizophrenia

(Mackenzie et al., 2000; Mackenzie et al., 2007). In addition, other studies have shown that differences in cultural and linguistic background can influence the way a person recalls and describes a picture (Tajima & Duffield, 2012; Wong, et al., 2018). As a result, while the picture description task was chosen to mitigate differences in topic, there remain some confounding variables that this methodology was unable to subvert.

11.0 Conclusion

Overall, this paper has provided quantitative evidence for previous observations of the speech of patients with schizophrenia. Patients with schizophrenia tend to use more basic discourse markers when switching to a new topic, rather than using more complex ones, which controls use more frequently. This could help explain the long documented perception of rapid topic shifts, as information for how the topics are related to each other is missing. Patients with schizophrenia also provide less detail when describing a picture and are less likely to make connections between objects and topics in the picture. While alogia may have more to do with this difference in language than disorganized speech, this paper still presents specific ways in which the speech of controls varies from those with schizophrenia.

This research also provides quantitative evidence supporting the use of longer time intervals and prompts for additional speech during picture description tasks to obtain as much data as possible for this type of research. It additionally shows some correlation with current clinical methodology for diagnosing people with schizophrenia; while some correlations exist between my measurements of disorganized speech and the SANS, CAINS, and PANNS scales, there also exist inconsistencies and gaps — namely measurements of alogia. This suggests that perhaps the measurements for linguistic symptoms need to be reexamined and refined.

Finally, this paper also presents suggestions for future research, both in terms of topic and methodology. Discourse analysis concepts of cohesion and coherence seem promising in terms of rating topic shifts and disorganized speech in schizophrenia. The picture description task also upheld some previous observations and added nuance to others, showing promise as a method for analyzing speech. This paper presents a starting point for future research into disorganized speech through a quantitative linguistic analysis. I hope that these linguistic measurements can be informative to clinicians and other researchers when describing the discourse patterns of patients with schizophrenia and provide a more concrete evaluation of how these speech patterns differ from those of controls.

Appendix

List of details from picture for Analysis 3 (Section 6)

100	Weather/summertime
101	At beach/lake
102	clouds/bushes
110	Girl
111	She (girl)
112	Long/blond hair
113	Dress
114	Bare feet
115	sitting/crouching
116	sad
117	Dropped
120	Ice cream
121	It (ice cream)
122	(two) scoops
123	melting
124	cone
130	Boy/man
131	He (boy)
132	short/dark hair
133	T-shirt
134	Shorts
135	Sandals
136	concerned/emotion
137	walking
138	holding
139	leash/string
140	Dog
141	It (dog)
142	Collar/tag
143	big/breed
144	Panting/hot/tongue
145	Eyeing ice cream/emotion
150	Mother/woman
151	She (woman)
152	hair
153	clothing
154	Outside/in front of
155	Waving (goodbye)
160	House
161	It (house)
162	Shingle roof
163	chimney
164	windows
165	door

166 On hill
170 Kids
171 They (kids)
172 clothing
173 sailing (verb)
174 talking/emotion
180 boat
181 It (boat)
182 sail (noun)
183 rutter/steering
184 disturbed water
190 lighthouse
191 it (lighthouse)
192 On hill

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