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Language use and schizophrenia

An analysis of coherence relations and connectives in schizophrenia spectrum disorders

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1   Summary

Schizophrenia spectrum disorder is a disorder that affects several aspects of language and cognition are affected. In the present study we examined the usage of coherence relations expressed by a connective. A coherence relation is a conceptual relation between two phrases or two sentences. Earlier research found that some coherence relations are less complex than others. The question answered in this study is whether there are differences in the usage of coherence relations expressed by a connective between schizophrenia spectrum disorder subjects and healthy controls. We used transcripts of interviews of twenty participants from the PRAAT research for the present study. All connectives expressing a coherence relation were marked and for each connective we determined a coherence relation. After that, all total amounts of the different coherence relations were compared between the two groups. The percentage connectives of all words is 3.63% in the schizophrenia spectrum disorder group and 3,71% in the healthy control group. Relations containing the primitive 'negative', 'positive', 'temporal' and 'objective' differ significantly between the two groups. Relations which contain the primitive negative are used more often by healthy controls, in contrast to relations which contain the primitive positive, which are used more frequently by subjects with schizophrenia spectrum disorder. Relations which are temporal are used more often by the subjects with schizophrenia spectrum disorder as are relations which contain the primitive objective. The differences in the use of the negative, positive and objective connectives were as expected. The difference in the use of temporal connectives was, however, contrary to our expectations. It is not clear how this could be explained. If we look at the combinations of different primitives, only the combinations of 'positive-temporal-objective-basic order' and 'negative-non causal' differ significantly. The first combination is used more often by subjects with schizophrenia spectrum disorder and the second combination by healthy controls. Schizophrenia spectrum disorder subjects probably use the first combination more often because they use more temporal connectives in general. For the 'negative-non causal' this is presumably because of the fact that the combination negative and non-causal is less complex than the combination negative and causal. Therefore the latter finding is as expected.

2 Introduction

Schizophrenia spectrum disorder is a disorder whereby several aspects of language are affected (Covington et al., 2015). The present study will take a closer look at the use of one of the aspects of human language, namely coherence relations and connectives. A coherence relation is an abstract relation between two phrases (Sanders & Noordman, 2000). In this study we will only look at coherence relations in which phrases are connected with a connective. Earlier research into coherence relations and connectives found that some coherence relations are less complex than others (Sanders, Spooren & Noordman,1992,1993). In this study we will investigate whether schizophrenia spectrum disorder subjects make relatively more use of the less complex forms of coherence relations and connectives than healthy controls.

The remainder of the introduction will provide information about schizophrenia spectrum disorder (section 2.1), the affected language in schizophrenia spectrum disorder (2.2), coherence relations (section 2.3) and the complexity of coherence relations (section 2.4)

2.1 Schizophrenia spectrum disorder

1% of the world's adult population suffers from the mental illness schizophrenia. The symptoms associated with schizophrenia spectrum disorders can be divided into two different types: positive and negative symptoms. Positive symptoms are often found in people with schizophrenia spectrum disorder, but not in those without the disorder. Negative symptoms, on the other hand, are usually present in people without schizophrenia spectrum disorder, but not in individuals with schizophrenia spectrum disorder. Examples of positive symptoms are hallucinations, delusions and positive thought disorder, while examples of negative symptoms are absent of a voluntary way of behaving or drive, dullness, flat or unsuitable affect and reduced speech and language (Kuperberg, 2010). Positive symptoms are typical of the acute phase of the disease, while negative symptoms are more typical of the chronic form of the disease (Deth, 2017). Schizophrenia spectrum disorders are a heterogenous group of disorders, so two people with schizophrenia spectrum disorder can have different symptoms and the symptoms of one person can also change over time.

Several aspects of cognition are impaired in people with schizophrenia. Krabbendam (2001) gives a detailed description of these impairments, namely disturbances in attention, memory and planning ability. These impairments are present during and after a psychosis and, in some cases, also before the onset of a psychosis (Fusar-Poli et al., 2007). Additionally,

cognitive impairments are present in non-schizophrenic first-degree relatives with a high risk for schizophrenia. This suggests that the cognitive impairment in psychosis is not only an outcome of the psychosis, but that it can even be a predisposing factor (Snitz, Macdonald, & Carter, 2006).

2.2   Schizophrenia spectrum disorder and language

Research has shown that the language of people with schizophrenia is affected by the disease. Several aspects of human language are affected in schizophrenia, among which are phonology, syntax and semantics. However, the cause of this is still unclear. It could be a deficit in the language itself, but it could also be a deficit in cognitive processes that are necessary for language, among which planning, execution, and memory. In their review, Covington et al (2015) give a detailed description about the deficits in the different linguistic levels. In the following citation the different linguistic levels are briefly explained:

> "The levels interact largely through the lexicon (*vocabulary*), which tells us, for instance, that the sound sequence /maen/ (*phonology*) forms the word man, which is the singular of men (*morphology*), a noun (*syntax*) that signifies a male human being (*semantics*) and is relatively unrestricted as to style and connotations (*pragmatics*)" (Covington et al, 2015).

The next section will shed a light on these deficits mentioned by them.

According to Covington et al, the segmental phonology seems to be normal in people with schizophrenia, as well as morphology. However, disturbances are seen in the comprehension and production of prosody, and the timing and intonation of speech. For instance, people with schizophrenia spectrum disorder and healthy controls differ in terms of intonation and loudness and the interpretation of intonation (Cutting, 1985). In general, both intonation and loudness are more constant in people with schizophrenia spectrum disorder.

Morice and Ingram (1982), Morice and McNicol (1985), and Morice and McNicol (1986) claimed that although the syntactical complexity of people with schizophrenia spectrum disorder is reduced, syntactic reduction is not a specific indication for syntactic impairment. Explanations for this reduction in syntactical complexity might be found in an overall cognitive deficit, a difficulty in concentrating, being easily distracted or a preference for expressing simpler ideas (Covington et al,, 2015). Thomas, King, Fraser, and Kendell

(1987) and Thomas (1990) suggest that people with negative symptoms showed a significant greater reduction of syntax than people with positive symptoms.

Pragmatics is another linguistic field that is clearly impaired in most of the people with schizophrenia spectrum disorder. Pragmatics is also known as the relationship between language and context. People suffering from schizophrenia spectrum disorder often do not make the right connection between language and context. For example, people with schizophrenia spectrum disorder "have trouble with presumed information and indirect references" (Covington et al., 2015, pp. 92).

There are several theories that explain the language abnormalities in schizophrenia spectrum disorder, two of which shall be discussed here. The first suggests that the abnormalities in language come from abnormalities in the structure and function of semantic memory (Aloia, Gourovitch, Missar, Pickar, Weinberger, & Goldberg, 1998; Spitzer, Braun, Hermle, & Maier, 1993). The second suggests that the language abnormalities are caused by difficulty in building up and using 'context' (Cohen & Servan-Schreiber, 1992). These troubles are caused by a deficit in working memory and deficits in general executive functions. Language dysfunction could also be explained by a deficit in both systems (Kuperberg, 2010).

2.3   Coherence relations
The present study will take a closer look at the use of one of the aspects of human language, namely coherence relations and connectives.

Two clauses can have a 'coherence relation'. A coherence relation is a conceptual relation which can be expressed by a linguistic marker, such as a connective (Sanders & Noordman, 2000). They are called coherence relations "because the essential property of these relations is that they establish coherence in the cognitive representation language users have or make of a discourse" (Sanders & Noordman, 2000, p. 38). Sanders et al (1992,1993) developed a cognitive approach to coherence relations, where coherence relations were categorized with a limited set of cognitive primitives. The theory states that complex relations are learned after the simpler ones. Two clauses are mainly connected by the prototypical linguistic markers of coherence relations, i.e. connectives.

2.4 The cognitive primitives

Evers-Vermeul and Sanders (2009) propose that coherence relations can be seen as cognitive entities and that a coherence relation can be characterized according to multiple conceptual primitives. The cognitive primitives given by Evers-Vermeul and Sanders are called 'basic operation', 'polarity', 'source of coherence' and 'order'. The next section will elaborate on these four different primitives.

2.4.1 Basic operation

The first cognitive primitive, the principle of basic operation contains three kinds of relations: additive relations, causal relations and temporal relations.

A causal relation constitutes a strong connection, whereas additive and temporal relations constitute a weak connection. In an additive relation the two segments are connected by a logical conjunction (P&Q), whereby P and Q stand for the phrases of a coherence relation. Below one can find examples of an additive, causal and temporal relation. Sentence (1) is an example of an additive relation.

In a causal relation there is an implicit relation of causality between the two segments. Causal relations contain more information than additive relations and are therefore seen as more complex (Evers-Vermeul & Sanders, 2008). Therefore, a causal connective will only appear after an additive connective has appeared in child language. An example of a causal relation is the sentence below (2).

In a temporal relation the relation is also additive, but the two events are ordered in time. Relations that show a temporal ordering of phrases are seen as more complex and occur later in child language (Scholman, Evers-Vermeul, & Sanders, 2016). Sentence (3) is an example of a temporal relation

(1) [The quality of this fuel with bio component is completely similar to Shell's regular Euro 95] **and** [the price at the pump is the same as well.] (Scholman et al., 2016)

(2) [The athletics union was forced to emigrate to Belgium,] **because** [there was no accommodation available in the Netherlands.] (Scholman et al., 2016)

(3) [Next Thursday a second meeting will follow.] [The unsatisfied RET-employees will decide after this meeting if they deem it necessary to continue protesting.] (Scholman et al., 2016)

2.4.2 Polarity

Primitive polarity, the second conceptual primitive, contains two kinds of relations: positive and negative relations. A positive relation is a relation whereby the two propositions or segments in a relation are linked without a negation of one of the two propositions or

segments. A negative relation objects a relation between the segments and is because of that seen as more complex than a positive relation. Therefore, positive relations appear earlier in child language. See (4) for an example of a positive relation and (5) for an example of a negative relation.

(4) [The stocks can decrease tremendously in value] **and** [thereby result in a loss for the investor]. (Scholman et al., 2016)

(5) [The biofuel is more expensive to produce,] **but** [by reducing the exise-tax the government makes it possible to sell the fuel for the same price.] (Scholman et al., 2016)

2.4.3   Source of coherence

The third conceptual primitive, the primitive source of coherence, contains two categories: objective and subjective relations. An objective relation contains two segments that both describe situations in the real world, or in which the real world is being described. The speaker gives a description, but is not part of the situation. When the speaker is part of the situation, the relation is a subjective relation. This is when speakers are reasoning or when they perform a speech act in one or both of the segments. Relations whereby the speaker is part of situation are seen as more complex, so an objective relation appears earlier in child language than a subjective relation (Scholman et al., 2016). Example (6) shows an objective relation, example (7) shows a subjective relation.

(6) [The plaintiff received his car,] **because** [the advertisement was formulated ambiguously.] (Scholman et al., 2016)

(7) [Drugs destroy people's lives,] **so** [drugs have to be battled judicially.] (Scholman et al., 2016)

Subjective relations can also be stated as CLAIM-ARGUMENT relations and objective relations can also be described as CONSEQUENCE-CAUSE relations (Canestrelli, Mak and Sanders, 2013). Subjective relations and subjective connectives, for example *want ('because')* in Dutch, trigger a subjective mental state interpretation of the first segment of the relation. An objective connective, like *omdat ('because')* in Dutch, triggers the construction of an objective CONSEQUENCE-CAUSE relation.

2.4.4   Order

The last primitive is order**,** in which a distinction between basic order and non-basic order of the segments is made. In a relation with a basic order there is an antecedent that is followed

by a consequent. The antecedent is a cause or an argument, the consequent is the consequence or the claim from the cause or argument. A basic order is less complex than a non-basic order considering that it inverse the iconic order of a coherence relation (Hoek, Zufferey, Evers-Vermeul, & Sanders, 2017). Relations with basic order are acquired earlier than non-basic order relations (Evers-Vermeul and Sanders, 2009). See (8) for a basic order relation and (9) for a non-basic order relation.

(8) Sometimes children tease me. [**But** I don't reply,] that's why [they don't do it anymore.] (Scholman et al., 2016)

(9) [Universities supposedly cancel subscriptions to scientific journals more often] **because** [there is more information available through the internet.] (Scholman et al., 2016)

The four cognitive primitives and the combinations that they can occur in describe a coherence relation. Each primitive contains two or more values, whereby one value is less complex than the other and there is no set order for the acquisition of the primitives. Scholman et al (2016) developed a model to classify coherence relations according to these primitives. Step one is deciding whether the relation is positive or negative. After that, the basic operation must be determined. When a positive relation is determined, the basic operation can be causal, additive and temporal. In case the relation is negative, a distinction can only be made between causal and non-causal. The third step is classifying a source of coherence, determining whether the relation is an objective or a subjective relation. Temporal relations can only be objective because it contains a description of two events that are always ordered in time. In non-causal relations there cannot be made a distinction for the source of coherence. The last step is determining the order of the relation. The order cannot be determined for additive relations and non-causal relations, because the segments in those relations are logically symmetric. The order of temporal relations can be basic order, non-basic order or not applicable, which means the segments describe events that occur simultaneously. After having discussed the different coherence relations, Theory of Mind deficit in schizophrenia spectrum disorder will be discussed in the next section.

2.5   Theory of mind and psychosis
Theory of mind "refers to the cognitive capacity to represent one's own and other persons' mental states, for instance, in terms of thinking, believing or pretending" (Brüne, 2005, pp.1).

Frith (1992) proposes that delusions in schizophrenia arise from a deficit in the Theory of Mind. Individuals with schizophrenia generally perform worse than non-psychiatric controls on theory of mind tasks. Theory of mind deficits also correlate with negative symptoms, though not with positive symptoms in schizophrenia (Livingstone, 1998). Garety and Freeman (1999) concluded that a Theory of Mind deficit occurs more often in the more symptomatic people with schizophrenia spectrum disorder.

The most important difference between subjective and objective coherence relations is that only subjective relations involve mental states (Knott, 2001). In a subjective relation the claim of the relation is a claim from the speaker itself, albeit based on the real word of the second segment of the relation. In objective relations only facts from the real world are being used in the segments of the relation; the speaker is not part of the construction of the causal relation, but is only informing about the situation in the two segments of the causal relation in the real world.

The knowledge which is necessary to establish a subjective relation, is connected to the abilities of Theory of Mind (Zufferey, 2010). To make or understand a subjective relation, you need to be able to make a representation of other people's beliefs and conclusions. Subjective relations are therefore seen as more complex than objective relations. Deficits in Theory of Mind might therefore lead to problems with subjective relations. The next two sections explain the aim and relevance of the study.

Aim of the study

This study aims to investigate whether there are differences in the use of connectives which represent a coherence relation in schizophrenia spectrum disorder subjects and healthy controls. In order to do so we will look at differences in the number of connectives and cognitive primitives used by the two groups, as well as the different combinations they can occur in.

This leads to the following two research questions:

1. Is there a difference in the total amount of connectives which represent a coherence relation between schizophrenia spectrum disorder subjects and healthy controls?
2. Is there a difference in the use of the different coherence relations between schizophrenia spectrum disorder subjects and healthy controls?

We expect that the subjects with schizophrenia spectrum disorder use relatively more of the less complex connectives, due to the fact that schizophrenia spectrum disorder subjects have cognitive disorders.

Furthermore, we specifically expect that schizophrenia spectrum disorder people use less subjective than objective connectives when compared to controls, since schizophrenia spectrum disorder is associated with deficiencies in their Theory of Mind

Relevance

The present study is exploratory in nature and is the first to provide an insight in the use of connectives and coherence relations in schizophrenia spectrum disorder subjects. Better understanding of connectives and coherence relations can contribute to schizophrenia spectrum disorder and language research.

3   Method

3.1   Participants
The study sample included twenty participants: ten participants with schizophrenia spectrum disorder and ten healthy controls. The participants were collected from the PRAAT study at the University Medical Center of Utrecht. All participants had the diagnosis 295.x or 298.9 from DSM IV. 295.x entails schizophrenia, schizophreniform disorder or schizoaffective disorder and 289.9 psychosis NOS (Not Otherwise Specified). All participants with schizophrenia spectrum disorder used antipsychotics, albeit in different forms and doses. The control participants were healthy controls from other studies from the department of Psychiatry at the University Medical Center of Utrecht. All controls were checked for neurological and psychiatric disorders during the other studies. Inclusion criteria for the PRAAT research were that the native language of participants was Dutch, that they were 18 years or older and that they had no uncorrected hearing loss or speech or language disorder. Participation was on a voluntary basis and all participants signed an informed consent forms before participating in the research. This study was approved by the medical-ethical board of the University Medical Center of Utrecht.

3.2   Procedure
A semi-structured interview, based on a list with informal and open ended questions, was used to collect fifteen minutes of spontaneous speech. To collect natural and spontaneous like speech, participants were not informed about the aim of the study beforehand. Instead, the participants were told that the research was about general experiences of subjects of different clinical groups, not about the clinical illness itself. The participants were told that they could skip questions if they felt uncomfortable with them. Before the questions were asked, it was confirmed that the participants met the inclusion criteria. Afterwards, questions were asked about demographic information and musical experience. In total the interview lasted approximately thirty minutes for each participant. All researchers and interns involved in conducting the interviews followed a training customized for the interview of the PRAAT research.

3.3   Materials
The interview was digitally recorded on a TASCAM DR-40 V2 4-channel digital audio recorder. After the interviews were held, the audio files were transcribed in CLAN by various researchers and interns from the research team of PRAAT. Audio files were anonymized for

transcription in order to prevent disease related bias in transcribing. Transcribers were thus not aware of a participant's group status.

After the transcription, all connectives that express a coherence relation in the transcript were marked. Connectives in Dutch can also be used as an interjection without describing a coherence relation. These connectives were not analyzed for the purpose of this study. In order to determine whether there was a coherence relation, the following five criteria were used based on Evers-Vermeul and Sanders (2008). Unlike Evers-Vermeul and Sanders, we also included incorrect sentences since spontaneous speech often includes incomplete or incorrect sentences.

1. The connective needs to connect two phrases, both phrases need to consist of at least a verb and a subject.
2. The phrases can be grammatically correct or incorrect
3. The connective needs to express a coherence relation
4. The connective can't be used as a fixed expression, for example songs, expressions or other things based on memory
5. There is an exception for criterium 1 when there is topic drop.

An exception for criterium 1 is added in criterium 5 because of the fact that topic drop is frequent in (spoken) Dutch. An example of topic drop in Dutch spoken language is shown below (10).

(10).   Waar   is Jan? (Die)   is al   naar huis.
             Where is Jan   that   is already   to home
             'Where is Jan? He has gone home already.' (Broekhuis and Corver, 2018)

After determining which connectives describe a coherence relation, the coherence relations were classified according to the tool developed by Scholman et al (2016), see Figure 1.

Figure 1. Flowchart

Scholman, M. C., Evers-Vermeul, J., & Sanders, T. J. (2016). A step-wise approach to discourse annotation: Towards a reliable categorization of coherence relations. Dialogue & Discourse, 7(2), 1-28.

3.4   Data analysis

All the transcripts were analyzed according to the five criteria mentioned in section 3.3, in this process all connectives were marked. After the connectives were marked, the classification tool of Scholman et al (2016) was used in order to determine which coherence relation was expressed for each connective of each participant.

Subsequently, all total amounts of the different coherence relations were compared between the two groups, using statistical analysis in IBM SPPS software, version 25.0. An Independent-Samples T Test was used for all statistical tests.

4   Results

This chapter will discuss the results of the analysis. It will show three different tables. The first one is about the demographics of the participants. The second one shows the percentages of the cognitive primitives and the total percentage of connectives. The third one show the percentages of the different coherence relations.

4.1   Demographics

Demographics are shown in Table 1.

Characteristics	Total subject sample	Participants with schizophrenia spectrum disorder	Healthy controls participants
Number of participants	20	10	10
Mean age (y)	26.1	25.5	26.7
Female participants (%)	40	50	30
Mean years of education parents (y)	13.05	12.44	13.65

Table 1. Demographics

y = years

For one schizophrenia spectrum disorder participant, the mean of the years of education of the parents is unknown, so the mean is calculated with the other nine participants of the group. In the participants with schizophrenia spectrum disorder 50 percent of the group was female, while in the healthy control participants 30 percent was female. For the years of education we have chosen to use the mean of the years of education of the parents of the subjects instead of the subjects themselves, since a lot of schizophrenia spectrum disorder subjects drop out of school early due to their illness (Kessler, Foster, Saunders and Stang, 1995). The mean of the years of education for the participants with schizophrenia spectrum disorder is 12.44 and for the healthy controls 13.65.

After having discussed the demographics, we will now turn to table 2 and table 3 which contain multiple percentages that help to answer the two research questions.

4.2 Percentages of the cognitive primitives and coherence relations

Table 2 shows the percentages of the cognitive primitives and the percentage connectives from the total words used by each participant. This table helps in answering the first research question, which is: "Is if there is a difference in the total amount of connectives which represent a coherence relation between schizophrenia spectrum disorder subjects and healthy controls?". The total amount of connectives used by each participant is corrected for the total amount of words in each transcript. The mean used words for the transcripts of the schizophrenia spectrum disorder subjects is 1480 and for the healthy controls 1850. The percentage connectives of all words is 3.63% in the schizophrenia spectrum disorder group and 3,71% in the healthy control group.

The other percentages in table 2 are the percentages of the different primitives and the percentages in table 3 are percentages of the possible combinations of the primitives (coherence relations), which together help to answer the second research question, which is: "Is there a difference in the use of the different coherence relations between schizophrenia spectrum disorder subjects and healthy controls?". All totals are corrected for the total amount of connectives used by each participant.

Cognitive primitive	Percentage schizophrenia spectrum disorder subjects	Percentage healthy controls	P-value
Polarity			
Negative coherence relations (%)	19.38	25.96	.026*
Positive coherence relations (%)	80.62	74.04	
Basic operation[a]			
Causal coherence relations (%)	30.53	35.10	.168
Additive coherence relations (%)	47.43	39.89	.148
Temporal coherence relations (%)	10.39	4.69	.015*
Source of coherence[a]			
Subjective coherence relations (%)	54.09	57.34	.522
Objective coherence relations (%)	34.27	24.54	.034*
Order[a]			
Basic order coherence relations (%)	22.66	24.83	.572
Non basic order coherence relations %)	7.78	8.17	.866

Percentage connectives from total words (%)		3.63	3.72	.084

Table 2. Percentages cognitive primitives.

Legend: a = these percentages do not add to 100% because not all coherence relations have basic operation, a source of coherence or a determined order according to the classification model in Figure 1.

Coherence relation	Schizophrenia spectrum disorder	Healthy controls	P-value
Positive Causal Objective Basic order (%)	0,83	0,25	.242
Positive Causal Objective Non-Basic order (%)	1,50	1,24	.778
Positive Causal Subjective Basic order (%)	14,18	21,04	.097
Positive Causal Subjective Non-Basic order (%)	0,06	0,07	.883
Positive Additive Objective (%)	20,06	17,17	.326
Positive Additive Subjective (%)	27,37	22,72	.343
Positive Temporal Objective Basic order (%)	7,64	3,54	.037*
Positive Temporal Objective Not applicable (%)	2,75	1,14	.157
Negative Non-causal (%)	11,65	18,12	.038*
Negative Causal Objective (%)	1,48	1,20	.750
Negative Causal Subjective (%)	6,25	6,64	.833

Total percentage (%)	100	100	100

A T-test was used to assess whether subjects with schizophrenia and healthy controls differ in their usage of coherence relations. Relations containing the primitive 'negative', 'positive', 'temporal' and 'objective' differ significantly between the two groups. Relations which contain the primitive negative are used more often by healthy controls, in contrast to relations which contain the primitive positive, which are used more frequently by subjects with schizophrenia spectrum disorder. Relations which are temporal are used more often by the subjects with schizophrenia spectrum disorder as are relations which contain the primitive objective.

If we look at the combinations of different primitives, only the combinations of 'positive-temporal-objective-basic order' and 'negative-non causal' differ significantly, the first combination is used more often by subjects with schizophrenia spectrum disorder and the second combination by healthy controls.

Figure 2 depicts distributions of the coherence relations for the two groups. The blue bars represent the coherence relations used by healthy controls, the orange bars represent the coherence relations used by subjects with schizophrenia spectrum disorder.
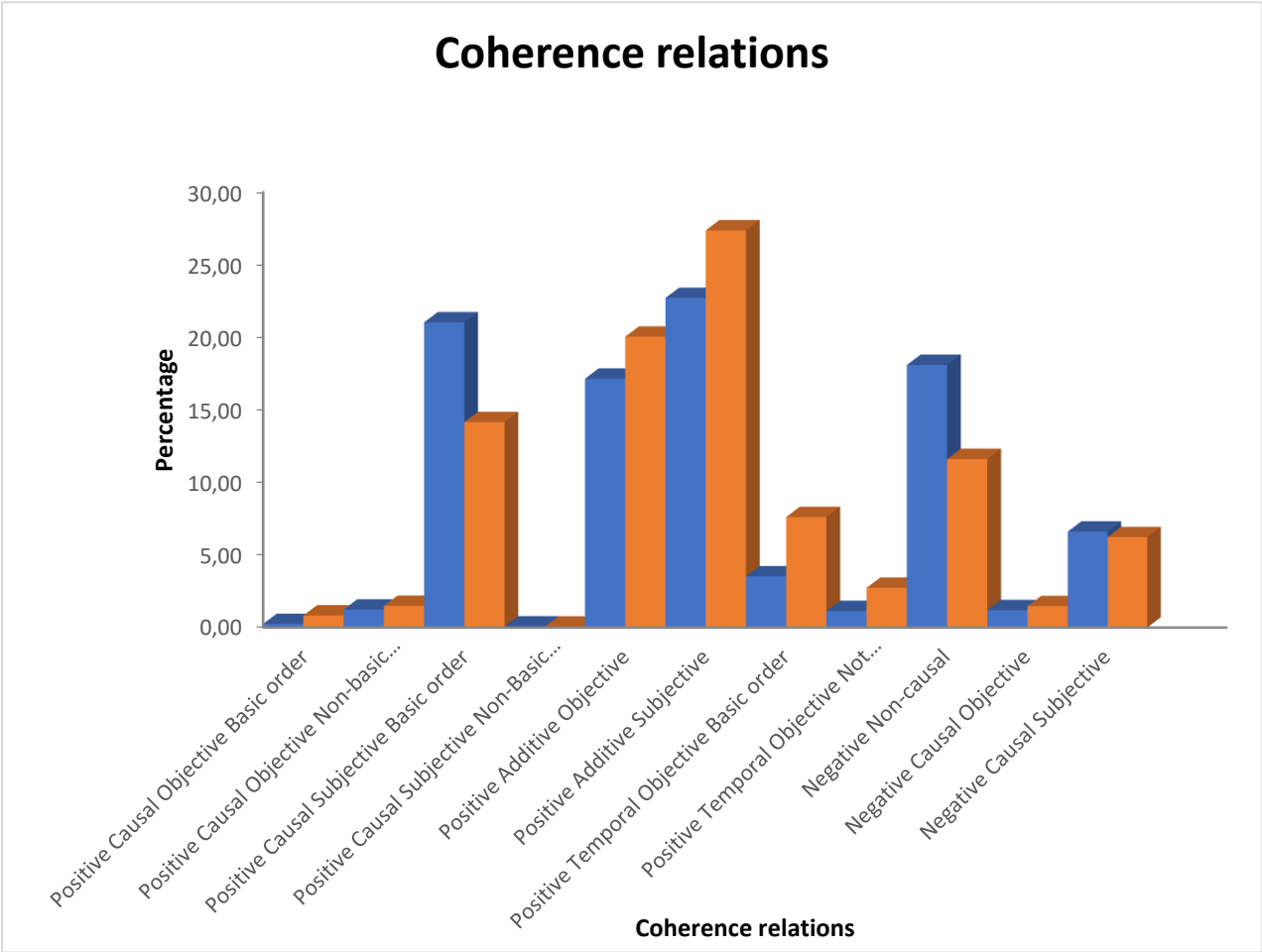
Figure 2. Distributions coherence relations

5   Conclusion and discussion

In this study we examined the usage of connectives in coherence relations between two groups, namely healthy controls and subjects with schizophrenia spectrum disorder. Based on the data, it can be concluded that the two groups differ in their usage.

The total amount of connectives used by the two groups differs, but not significantly. However, the use of positive versus negative connectives, temporal connectives and objective connectives revealed significant differences between the two groups. Negative connectives were used relatively more often by healthy controls. Positive, temporal and objective relation were used more frequently by schizophrenia spectrum disorder subjects.

The differences in the use of the negative, positive and objective connectives were as expected. The difference in the use of temporal connectives was, however, contrary to our expectations. Temporal relations, as well as causal relations, are more complex than additive relations, so the expectation was that the schizophrenia spectrum disorder subjects would use more additive connectives and less temporal and causal connectives. No explanation for this was found in the current literature, but further research could find an answer.

When we looked at combinations of different primitives, only the combination of 'positive-temporal-objective-basic order' and 'negative-non causal' differed significantly. Schizophrenia spectrum disorder subjects probably use the first combination more often because they use more temporal connectives in general. For the 'negative-non causal' this is presumably because of the fact that the combination negative and non-causal is less complex than the combination negative and causal. Therefore the latter finding is as expected.

5.1   Strengths and limitations

A strength of this explorative study is the new insight in the use of connectives in schizophrenia spectrum disorder population. This has, to my knowledge, not been done before in this population. This study contributes to the research of speech and language in this clinical population. The sample size of the present study is small, but the differences found in the two groups are interesting and could be a motivation to look further at the usage of connectives and coherence relations in this clinical population.

A number of restrictions of our study and areas for future research should be mentioned. First of all, it is beyond the scope of this study to examine the effect of theory of mind on the use of subjective versus objective connectives. Theory of mind could be an explanation for the difference in the use of subjective connectives between the two groups. However, there is no information of a deficit in theory of mind in these specific participants,

since no specific tests have been done on these participants. It was also not possible to look at the effect of severity of delusions on the use of subjective versus objective connectives.

A second limitation of this study is the small sample size. Due to the scope of this study, it was not possible to include more participants. It is difficult to draw conclusions from result gained from such a small sample size.

5.2   Suggestions for further research

This last limitation is also a point for further research. Further research should study a bigger sample size, this could show whether the differences found between subjects with schizophrenia spectrum disorder and healthy controls hold up in a lager sample. The differences found in the two groups indicate that it is interesting to look at the use of coherence relations and connectives in schizophrenia spectrum disorder subjects.

It could also be interesting to give each participant a 'complexity grade', so that not only the total amount of coherence relations can be compared, but also the total complexity of the coherence relations of each participant.

5.3   Conclusion

In conclusion, we can say that subjects with schizophrenia spectrum disorder and healthy controls differ in their usage of coherence relations with a connective as a connection of two phrases. Subjects with schizophrenia spectrum disorder have a tendency to use relatively more positive and objective relations than expected. Contrary to our expectations, subjects with schizophrenia spectrum disorder used more temporal relations. It is not clear how this could be explained. This study is exploratory in nature and has a small sample size, therefore further research is necessary to see whether this finding stands in a larger population. Nevertheless, the differences that are found indicate that it would be interesting to continue the research into connectives.

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