



# Alogia and formal thought disorder: Differential patterns of verbal fluency task performance<sup>☆</sup>

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## ABSTRACT

**Background:** There is evidence that alogia and formal thought disorder (FTD), two prominent speech symptoms in schizophrenia, are associated with different patterns of verbal fluency task deficits. Verbal fluency is thought to involve several cognitive mechanisms, including controlled retrieval, semantic memory, and context processing.

**Methods:** The current research examined whether alogia and FTD were associated with different patterns of verbal fluency performance and whether these patterns of verbal fluency performance would implicate deficits in controlled retrieval, semantic memory, or context processing. In the current research, 34 people with schizophrenia completed letter and category fluency tasks and detailed ratings of alogia and FTD symptoms were made from typed transcripts.

**Results:** Overall, alogia was associated with increased response latency between each word on the category fluency task, suggesting an association between alogia and poor controlled retrieval. In contrast, FTD was associated with a decreased proportion of semantically-related words on letter fluency, suggesting an association between FTD and poor context processing.

**Conclusions:** Alogia and FTD appear to be associated with unique patterns of fluency performance, implicating separate cognitive mechanisms.

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## 1. Introduction

People with schizophrenia can exhibit multiple speech symptoms. One set of speech symptoms is alogia, which can involve decreased verbal productivity, increased latency of verbal response, and decreased syntactic complexity (Andreasen, 1979a, 1982; Berenbaum et al., 2008). A second set of speech symptoms is formal thought disorder (FTD), which involves speech that is difficult to understand or is disorganized (Andreasen, 1979a). Previous factor analytic research suggests that alogia and FTD may be distinct symptoms (e.g., Andreasen, 1979b; Berenbaum et al., 1985; Harvey et al., 1992; Liddle, 1987). Negative and disorganization symptoms, such as alogia and FTD, have been associated with poorer prognosis (Fenton and McGlashan, 1991, 1994), can be treatment refractory (Erhart et al., 2006; Carpenter, 2004), are associated with functional impairment (Green, 2006), and are elevated in relatives of people

with schizophrenia (Docherty and Sponheim, 2008; Snitz et al., 2006). Understanding cognitive deficits associated with alogia and FTD could help to improve treatments for these symptoms and could also help us to understand the nature of liability for these symptoms.

Although alogia and FTD appear to be distinct symptoms, psychopathologists have suggested that similar cognitive deficits might underlie alogia and FTD. In particular, it has been suggested that either alogia or FTD might be related to problems in controlled retrieval, semantic memory, or context processing (Alpert et al., 1993; Barch and Berenbaum, 1997; Cohen et al., 1992; Cohen and Servan-Schreiber, 1992). *Controlled retrieval* reflects one's ability to retrieve information from memory when the information is not automatically retrieved and when there is competition from other activated information (Badre and Wagner, 2007; Unsworth and Engle, 2007). *Semantic memory* refers to the component of long-term memory containing stored representations of the meanings of words and knowledge about the world (Rogers et al., 2004). *Context processing* is the representation and maintenance of important situational information, such as goals or recently processed information that is critical for current behavior (Cohen et al., 1996). It has been thought that problems in controlled retrieval,

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semantic memory, or context processing could contribute to speech symptoms in schizophrenia. For example, a problem with controlled retrieval could lead to restricted speech output and alogia. A problem with semantic memory could lead to incorrect or tangential speech and FTD. A problem with context processing and with poor goal maintenance may lead to goalless and disconnected speech, as seen in FTD.

One task that is thought to involve controlled retrieval, semantic memory, and context processing is the verbal fluency task. Importantly, previous research has suggested that differential deficits in controlled retrieval, semantic memory and context processing might result in different types of performance deficits on verbal fluency tasks (Aloia et al., 1998; Kerns et al., 1999; Randolph et al., 1993; Rohrer et al., 1995). In addition, there is previous research (discussed below) suggesting that alogia and FTD might be related to different patterns of verbal fluency task deficits (Allen et al., 1993; Joyce et al., 1996). The current research examined whether alogia and FTD were associated with different patterns of verbal fluency performance and whether these patterns of verbal fluency performance likely implicate deficits in controlled retrieval, semantic memory, or context processing.

On the verbal fluency task (Benton, 1968; Lezak, 1995), people are given a production rule, such as producing words that begin with a certain letter (i.e., letter fluency) or words that belong to a certain category (i.e., category fluency). Participants then have a certain period of time in which to produce words. One type of deficit on the verbal fluency task is reflected by a decrease in the number of words produced. However, researchers have identified a number of other aspects of verbal fluency performance which could implicate deficits in different types of cognitive processes.

One cognitive process thought to be involved in verbal fluency tasks is controlled retrieval. Controlled retrieval is thought to be involved in verbal fluency because although some words on this task may be automatically retrieved (e.g., for animals, retrieving the words 'cat,' 'dog'), many other words are not automatically retrieved from the given retrieval cue (Wagner et al., 2001). Controlled retrieval is also thought to be involved because of strong competition from other words in memory and from other retrieved words, such as words which have already been produced (Rosen and Engle, 1997). Previous research suggests that a controlled retrieval deficit specifically affects the latency between words produced on category fluency tasks, with poor controlled retrieval resulting in longer latencies between words (Rohrer et al., 1995; Unsworth and Engle, 2007). For example, performance of a dual task thought to diminish controlled retrieval resources results in longer latencies between produced words on the category fluency task (Rohrer et al., 1995).

A second cognitive process affecting verbal fluency performance is semantic memory. Semantic memory is thought to be involved in verbal fluency tasks as people are thought to rely on semantic stores in order to access and produce words. It has been argued that semantic memory deficits may contribute to a number of different verbal fluency deficits. For instance, on the category fluency task, there is evidence that semantic memory loss results in shorter latencies between produced words. This is because decreased semantic memory results in a smaller and less competitive pool of information from which participants are then able to more quickly retrieve and produce words (Rohrer et al., 1995). Consistent with this, although people with Alzheimer's Disease produce a smaller total number of words, they actually exhibit significantly shorter latencies between produced words than controls on category fluency (Rohrer et al., 1995). So although a controlled retrieval deficit is thought to result in a longer latency between words, a semantic memory loss is thought to result in a shorter latency between words on category fluency.

In addition to shorter latency between words, semantic memory deficits have also been argued to produce other patterns of deficits on verbal fluency tasks. For instance, it has been argued that a loss of semantic memory should result in decreased stored associations between concepts (Kerns et al., 1999). Thus, it has been argued that semantic memory loss should result in a decrease in the number of semantically-related clusters of words on a letter fluency task (Kerns et al., 1999). Finally, it has also been argued that a loss of semantic memory should produce relatively poorer performance on category fluency than on letter fluency. This is because with intact semantic memory, one can take advantage of the semantic category production rule (e.g., animals) to retrieve semantically-related words (Goldberg et al., 1998; Randolph et al., 1993). Consistent with this, nonpsychiatric controls typically exhibit better category than letter fluency (Goldberg et al., 1998). However, with semantic memory loss, participants may exhibit relatively poorer performance on category fluency than would be expected based on their letter fluency performance, as seen in studies of Alzheimer's patients (e.g. Clark et al., 2009; Rascovsky et al., 2007; Jones et al., 2006; Rogers et al., 2006; Sherman and Massman, 1999).

A third cognitive process affecting verbal fluency performance is context processing. Context processing is thought to be involved in verbal fluency because people maintain contextual information, specifically the maintenance of previously produced words, to help them retrieve and produce additional words. It has been argued that a deficit in context processing could result in the generation of fewer semantically-related clusters of words on the letter fluency task (Kerns et al., 1999), because poorer representation and maintenance of previously produced words (e.g., 'stamina,' 'sports') can make people less likely to produce contextually and semantically-related new words (e.g., 'soccer,' 'skiing'). However, in contrast to semantic memory loss, poor context processing does not seem likely to result in either shorter latencies between produced words or poorer category rather than letter fluency.

Given that previous research suggests that different cognitive deficits can produce unique patterns of verbal fluency performance, it is possible that examining verbal fluency performance could implicate particular cognitive deficits associated with language symptoms in schizophrenia. Previous research has repeatedly found that alogia is associated with decreased verbal fluency output (e.g., Allen et al., 1993; Stolar et al., 1994; Melinder and Barch, 2003; Pantelis et al., 2004; Twamley et al., 2006). However, to our knowledge previous research has not examined whether alogia is related to distinct patterns of verbal fluency performance, such as longer or shorter latencies between produced words on category fluency, fewer semantically-related word clusters on letter fluency, or poorer category relative to letter fluency performance. Examining the relationship between alogia and patterns of verbal fluency performance would indicate whether alogia is likely related to deficits in controlled retrieval, semantic memory loss, or context processing.

Some previous research has examined the relationship between FTD and some aspects of fluency performance. FTD has generally been unassociated with overall number of words produced in letter fluency tasks (for a review see Kerns and Berenbaum, 2002); however, FTD has been associated with other characteristics of verbal fluency performance. In one study, FTD was associated with producing fewer contextually-related semantic word clusters on a letter fluency task (Kerns et al., 1999). As discussed earlier, this suggests that FTD might be associated with poor semantic memory or with poor context processing. Another study found that FTD was associated with relatively poorer performance on category than on letter fluency (Aloia, 1998), which might also implicate poor semantic memory in people with FTD. The current research further

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