FLUENCY PATTERNS OF ADULT FEMALES

WITH FOCAL EPILEPSY

By

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Abstract: The purpose of this study was to determine the fluency patterns in female adults diagnosed with focal epilepsy. This study used a two-group parallel quasi-experimental design. Standard scores from the Montreal Cognitive Assessment (MoCA) were collected in addition to a two-hundred-word narrative production and a semantic verbal fluency task from each of the nineteen adult female participants between 18 and 35 years of age. Six participants with focal epilepsy and thirteen non-epileptic peers were included. Narratives were recorded and analyzed for variations in speech fluency, while the MoCA and semantic verbal fluency task were used to analyze cognition and verbal fluency. The results indicated a significant difference in phonemic verbal fluency and cognition between those with focal epilepsy and the control group. No significant differences were observed for speech fluency or semantic verbal fluency between the two groups although trends were in the hypothesized directions. Additionally, family history of epilepsy and suspected diagnoses of TLE or FLE did not appear to affect speech, language, or cognitive outcomes.

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CHAPTER I

INTRODUCTION

According to the Epilepsy Foundation, there are approximately 3.4 million people in the United States living with epilepsy (Shafer, 2014). Epilepsy is a neurological condition characterized by uncontrollable seizures of unpredictable occurrence. Such seizures arise when diseased neurons fire random action potentials. When it comes to diagnosing, epilepsy can be divided into groups based on the seizure loci of occurrence in the brain. Two examples include temporal lobe epilepsy (TLE) and frontal lobe epilepsy (FLE). Both are classified as focal epilepsy since the seizures initially affect only one of the two cerebral hemispheres. Since speech and language originate in the brain, it would be anticipated that deficits in one or both functions could be observed in those with epilepsy. Specifically, Broca's area which is largely responsible for planning motor speech, the prefrontal cortex, and the premotor cortex are all located in the frontal lobe, while Wernicke's area which is largely responsible for language comprehension and expression is located in the temporal lobe. As such, speech deficits in frontal lobe epilepsy and language deficits in temporal lobe epilepsy might be expected.

Unfortunately, there are limited options when treating epilepsy. Two of the most common include medication and surgery. Initially, medication is used in an attempt to

control seizures, but not all individuals respond well to the anticonvulsant drugs. If seizures are intractable (i.e. cannot be controlled by medication) often surgery is recommended. Surgical options are dependent on the type and localization of seizures but can be as invasive as a craniotomy for focal resection of the temporal lobe or more minimally invasive procedures that do not involve opening the skull (Cascino & Britton, 2018). For example, neurostimulators such as vagus nerve stimulation (VNS) and deep brain stimulation (DBS) both require surgery but implantation of the devices does not require a craniotomy. In general, TLE is typically more severe and requires surgical treatment, while FLE is more often controlled by medication (Kellinghaus & Lüders, 2004).

Most of the available research on patients with epilepsy has been collected on language in pre- and post-surgical patients (Chaudhary et al., 2017; Eichstaedt et al., 2014; Gleissner & Elger, 2001; Gül et al., 2017; Metternich, Buschmann, Wagner, Schulze-Bonhage, & Kriston, 2014; N'Kaoua, Lspinet, Barsse, Rougier, & Claverie, 2000; Pirmoradi et al., 2015; Puka & Smith, 2016; Sarkis et al., 2013; Tröster et al., 1994). Since the majority of individuals with FLE are not treated surgically, there is a lack of available research and a void in understanding the characteristics of FLE when compared to TLE. Anecdotal reports and rare documentation in the scientific literature may indicate that those with TLE experience word finding difficulties and semantic fluency deficits (Tröster et al., 1994). Unfortunately, though, there is sparse information available on the speech and language deficits, if they do indeed exist, in FLE.

One study published on pre-surgical patients with TLE and FLE was conducted using magnetoencephalography to localize language functioning in the brains of those

with epilepsy. They discovered that frontal lobe activation occurred when the participants were given a verbal fluency task (Pirmoradi et al., 2015). Verbal fluency is when individuals are asked to produce as many words as possible in a set amount of time given a specific category. Verbal fluency can be subcategorized into semantic and phonemic verbal fluency. Semantic verbal fluency includes using objects as targets for naming, while phonemic verbal fluency uses specific letters as targets for naming. The information provided by Pirmoradi et al. (2015) indicated that the frontal lobe was important in verbal fluency tasks, and therefore, verbal fluency may be affected in people with FLE.

Furthermore, the Epilepsy Foundation (2014) reported that adults with epilepsy often complain that they have difficulties with language. Frequently, though, these problems are not severe enough to be categorized as aphasia. Instead, they are often explained as problems due to attention deficit, memory impairment, or medication interaction (Epilepsy Foundation, 2014). When experienced, though, these deficits could lead individuals to seek speech and language services.

An additional feature to consider is quality of life. In a study conducted by Giovagnoli et al. (2014), the Multiple Ability Self-Report Questionnaire (MASQ) was used to measure perceived cognitive abilities of participants with epilepsy. The areas assessed in the MASQ included language, visual-perceptual abilities, verbal and visual memory, and attention/concentration. The results indicated that cognitive functioning deficits, including deficits in language abilities, influenced the quality of life in people with epilepsy. This further supports the treatment of speech and language difficulties for the purpose of improving overall quality of life for people living with focal epilepsy.

CHAPTER II

LITERATURE REVIEW

Temporal lobe epilepsy (TLE) and frontal lobe epilepsy (FLE) are two types of one disorder distinguished by the location of occurrence in the brain. As indicated by their labels, TLE occurs in the temporal lobe, while FLE occurs in the frontal lobe. In TLE, auras are a common experience. Auras can include feelings such as experiencing déjà-vu, visual or auditory hallucinations, and sometimes fear (Holmes, Sirven, & Fisher, 2013). Distinguishing characteristics of FLE include brief seizures, no aura, abrupt on- and off-set of seizures occurring predominately during sleep, and lack of postictal symptoms. The characteristics can be self-reported and used to aid in the diagnosis of FLE (Rai et al., 2014).

Interestingly, these two disorders may demonstrate different symptoms based on gender. According to Eichstaedt et al. (2014), there may be differences in lateralization of language based on gender. They reported a significant difference in lateralization of semantic verbal fluency between males and females with TLE, suggesting that females demonstrate a greater degree of bilateral language organization than males. As such, it is important to take gender into consideration when making a diagnosis based on self-report.

According to the Epilepsy Foundation, TLE is the most common type of focal epilepsy with FLE being a close second (Holmes, Sirven, & Fisher, 2013). Individuals with TLE often experience intractable seizures and surgery is the best option for treatment of their seizures (Kellinghaus & Lüders, 2004). As such, those with TLE are more commonly seen on surgical rotations and more readily involved in research studies. Since medical treatment is often more effective for people with FLE, they comprise only ten to twenty percent of surgical patients and appear more commonly among the epileptic population who do not receive surgical treatment (Kellinghaus & Lüders, 2004).

Although treatment sometimes looks different for these two epilepsy types, complaints of speech and language deficits are similar in both TLE and FLE (Epilepsy Foundation, 2014). Individuals have reported clinically and in the course of research that they experience word finding difficulties irrespective of the category of epilepsy with which they have been diagnosed. Additionally, cognitive deficits in the areas of attention and memory are common (Epilepsy Foundation, 2014). The specific cause of these difficulties continues to be debated. It is unknown as to whether they should be attributed to the disorder, the side effects of anticonvulsant drugs, or both. Regardless, individuals with TLE and FLE have self-reported difficulties with speech and language which may affect their quality of life.

Despite the paucity of published research in FLE, there have been several studies published in TLE. Specifically, researchers have reported impairments in semantic verbal fluency in this population (Gleissner & Elger, 2001; Jaimes-Bautista, Rodríguez-Camacho, Martínez-Juárez, & Rodríguez-Agudelo, 2015; Tröster et al., 1995; Zalonis et al., 2017). Narenmandula et al. (2016) also identified diminished neuropsychological

performance. For those with TLE, they found significant differences in brain activation related to confrontational naming tasks when compared to the control group. Specifically, they reported that confrontational naming scores were significantly affected by fractional anisotrophy of the right fornix and mean diffusivity of the left unicate fasciculus in those with TLE. Consistent with these findings, other studies have uncovered impairments in memory, naming, executive functioning, and verbal fluency in their participants with TLE (N'Kaoua et al., 2001; Rai et al., 2014). Gonzálvez et al. (2016) had similar findings but additionally identified that auditory and picture naming tasks caused even greater activation in the temporal lobe and thus might be more highly impaired in TLE.

A recent meta-analysis and systematic review conducted by Metternich et al. (2014) compiled research articles about the differences in verbal fluency between non-epileptic controls and pre-surgical adults with focal epilepsy. According to their findings, only one study compared semantic verbal fluency between adults with FLE and non-epileptic controls, but it yielded no significant effect size (Piazzini, Turner, Vignoli, Canger, & Canevini, 2008). Additionally, one study has been conducted that examined lateralization of FLE. No significant difference was found in executive functioning skills between right FLE and left FLE (Upton & Thompson, 1996). They also reported no significant difference for semantic verbal fluency between TLE and FLE. The only participants included in the studies, though, were those who were pre-surgical patients. This may have caused the results of the studies to be biased.

An important study by Steinberg, Ratner, Gaillard, and Berl (2013) investigated speech fluency in the narratives of children with a mean age between seven and ten years. The researchers included one group of children with focal epilepsy and one group of non-

epileptic, age- and gender-matched peers. The children were asked to make up a story based on a wordless picture book, and each narrative was analyzed for mean length of utterance (MLU) and percentage of disfluencies. The researchers found that children with epilepsy scored poorly on language measures and were significantly more disfluent than the control group during their narrative productions. The results indicated that speech fluency was affected in children with epilepsy. In the typically developing children, the researchers reported that a mean of 4.6% disfluencies in the narrative productions, while the children with epilepsy had a mean of 6.0% disfluencies, a significant difference in speech fluency.

Examination of the literature seems to reveal equivocal findings with regard to fluency in individuals diagnosed with FLE. These equivocal findings can be attributed to several variables such as participants' medical history, age, co-morbidity, as well as the specific assessment tools employed. An additional factor to consider is the number of participants. Unlike people with TLE, FLE patients are not frequently treated by surgical procedures. People with FLE account for only ten to twenty percent of surgical patients, but these individuals appear to comprise greater than twenty percent of the epileptic population (Kellinghaus & Lüders, 2004). As reported by the Epilepsy Foundation, FLE is the second most common form of focal epilepsy, second only to TLE (Holmes & Fisher, 2013). This poses a problem because TLE has been fairly extensively investigated while FLE has received relatively little attention since researchers typically study their surgical patients (Kellinghaus & Lüders, 2004). Although non-surgical epilepsy is often milder or viewed as milder because seizures occur primarily at night and do not disrupt

daily functioning, it is frequently treated with medication and may as yet result in notable deficits that would improve with therapeutic intervention.

Based on anecdotal report of difficulties and those documented in the literature, it would be anticipated that individuals with either TLE or FLE would experience identifiable speech and language deficits. As such, further research is necessary to ensure that evidence-based therapy can be offered to individuals with focal epilepsy, whether it be TLE or FLE. It is imperative to conduct well-controlled prospective experiments to determine speech and verbal fluency skills in individuals diagnosed with focal epilepsy. The current study focuses on the fluency differences between females diagnosed with focal epilepsy and their non-epileptic peers.

CHAPTER III

METHODS

The overarching theme and primary purpose of this study was to determine if the frequency of speech and verbal disfluencies differs significantly between adult females diagnosed with focal epilepsy and their non-epileptic peers. An additional question was whether they are significant differences in speech and verbal fluency in those who suffer with TLE when compared to those who have FLE. However, most individuals with focal epilepsy have been given no specific diagnosis as to the subtype from which they suffer or have not retained that information. People with focal epilepsy typically only know that they have epilepsy. As such, the current study focused on focal epilepsy and used a self-report questionnaire in an attempt to provide a suspected diagnosis of FLE or TLE. This study employed a two-group parallel quasi-experimental design. The participants were divided into two groups: one diagnosed with focal epilepsy (both TLE and FLE were expected to have been included) and one of non-epileptic controls.

The specific research questions included:

(1) Does speech fluency differ between young females who have epilepsy when compared to age and gender-matched controls?

(2) Do semantic and phonemic verbal fluency differ between young females who have epilepsy when compared to age and gender-matched controls?

(3) Does cognitive performance as measured by the Montreal Cognitive Assessment (MoCA) differ between young females who have epilepsy when compared to age and gender-matched controls?

(4) Does family history of epilepsy impact speech fluency, verbal fluency, and cognitive performance when compared to age and gender-matched individuals with no family history of epilepsy?

(5) Does suspected FLE impact speech fluency, verbal fluency, and cognitive performance when compared to age and gender-matched individuals who display suspected TLE?

Participants

Twenty-six women between the ages of eighteen and thirty-five were recruited from the Oklahoma State University Stillwater campus. This research was conducted on females alone to eliminate the complications that may arise from including males and females. Participation in this study was voluntary. All participants were screened following the protocol approved by the International Review Board (IRB) at Oklahoma State University. For inclusion, the women were asked to provide a minimum of 200 words in their narrative samples. Nineteen women met the inclusion criteria: six women in the epilepsy group and thirteen in the control group.

The first group consisted of six female adults between the ages of eighteen and thirty-five diagnosed with focal epilepsy not acquired due to head injury. Each participant

diagnosed with epilepsy completed a questionnaire to provide further details about their epilepsy. Participants completed a questionnaire about experiencing auras, typical time of day or night when seizures occurred, duration of seizures, type of seizures, and any postictal symptoms. This information helped to provide a suspected diagnosis of FLE or TLE because FLE can be determined based on self-report of no aura, brief seizures that typically occur while sleeping, and no postictal symptoms. The control group consisted of thirteen non-epileptic age- and ethnically-matched females.

Measures

Standard scores on the Montreal Cognitive Assessment (MoCA) were collected to determine each participant's level of cognitive functioning (Nasreddine et al., 2005). To determine speech fluency, the number of words and number of disfluencies were collected from a narrative production using Story Cubes. Additionally, two verbal fluency tasks were completed by each participant, a phonemic verbal fluency task as part of the MoCA and a semantic verbal fluency task independent of the MoCA.

Procedures

Graduate students served as research assistants. Assistants were blinded as to those participants who were diagnosed with focal epilepsy while collecting the data from the MoCA, narrative productions, and verbal fluency tasks. Measurements were taken in the spring of 2018. The MoCA was administered prior to eliciting the narrative productions. Included in the MoCA was the phonemic verbal fluency task of naming as many words that began with the letter "f" as possible in one minute. During the narrative task, participants rolled six Story Cubes and were given thirty seconds to think. After

thirty seconds, the participant produced a story based on the pictures shown on the cubes. This was repeated twice to ensure a speech sample of at least 200 words. Narrative productions were recorded for later analysis. Lastly, the semantic verbal fluency task involved allowing the participant one minute to name as many animals as she could.

The research assistants, who remained blinded as to the status of the participants, scored the MoCA and semantic verbal fluency task independently of the researcher. The researcher conducted a reliability analysis on 20% of the data with 100% inter-judge reliability. After the narrative samples had been de-identified, the researcher analyzed the 200-word samples for disfluencies. The thesis director conducted a reliability analysis on 100% of data with 90% inter-judge reliability. For the narrative production, disfluent speech was defined as a disruption to the normal rhythm of word production and characterized by any of the following: repeated sound, syllable, or words, prolonged sounds, interjections (meaningless words irrelevant to the message), or interruptions (silent pauses of one second or longer) (Sechi, Cocco, D'Onofrio, Deriu, & Rosati, 2006). The frequency of speech disfluencies was calculated as follows: number of disfluencies/total number of words*100 = percentage of frequency of disfluencies. To determine semantic verbal fluency, the total number of words produced was compared across participants.

CHAPTER IV

RESULTS

The effects of epilepsy on speech and language remain largely untested and unquantified, especially in FLE. The purpose of this study was to measure the effects, if any, of epilepsy or family history of epilepsy upon objective measures of speech fluency, semantic and phonemic verbal fluency, and general cognition. In addition, an attempt was made to subcategorize epilepsy into FLE and TLE based upon signs and symptoms to determine if speech fluency, semantic and phonemic fluency, or cognition differed between the suspected categories.

Participants included nineteen age- and gender-matched females, six of whom had been diagnosed with epilepsy and thirteen who had no such diagnosis. Each participant completed the MoCA, created and told three stories using the story cubes provided, and performed semantic and phonemic verbal fluency tasks. The graduate assistants who collected the data were blinded to the status of the participants, and the researcher used de-identified data to determine speech fluency from the narrative productions. Due to a small sample size in the group diagnosed with epilepsy, non-parametric statistics were calculated on the results.

Speech fluency

The means, standard deviations, and ranges of speech disfluency for participants across groups are presented in Table 1. The mean speech disfluency in those participants with epilepsy was 4.6%, standard deviation 3.3%, as compared with a mean speech disfluency of 4.2%, standard deviation 2.9%, in those participants who have not been diagnosed with epilepsy. Mann-Whitney U and Kruskal-Wallis (Chi-Square) Tests revealed no significant difference between speech disfluency for the two groups (see Table 1). In addition, speech disfluency did not differ significantly for any groups examined in this study including those with or without a family history and those participants diagnosed with epilepsy whose seizure history was more indicative of characteristics of FLE as compared with those with characteristics more consistent with TLE (see Table 1).

Table 1 Speech Disfluency

Group	Mean	SD	Range	*P* value (2-tailed)
Control	**4.154%**	**2.9466%**	**1.5% – 11.5%**	--
N = 13				
Family history	2.667%	1.6073%	1.5% – 4.5%	0.307
N = 3				
No family history	4.600%	3.1693%	1.5% – 11.5%	--
N = 10				
Epilepsy	**4.583%**	**3.3078%**	**1.0% – 10.5%**	**0.724**
N = 6				
TLE	2.250%	1.7677%	1.0% – 3.5%	--
N = 2				
FLE	5.750%	3.4278%	3.0% –10.5%	0.564
N = 4				

*No p values were significant at the 0.05 or 0.01 level

Semantic and phonemic verbal fluency

The means, standard deviations, and ranges of semantic verbal fluency for participants across groups are presented in Table 2. The mean semantic verbal fluency in

those participants with epilepsy was 23.5, standard deviation 5.1, as compared with a mean semantic verbal fluency of 25.9, standard deviation 4.8, in those participants who have not been diagnosed with epilepsy. Mann-Whitney U and Kruskal-Wallis (Chi-Square) Tests revealed no significant difference between semantic verbal fluency for the two groups (see Table 2). In addition, semantic verbal fluency did not differ significantly for any groups examined in this study including those with or without a family history, and those participants diagnosed with epilepsy whose seizure history was more indicative of characteristics of FLE as compared with those with characteristics more consistent with TLE (see Table 2).

Table 2 Semantic Verbal Fluency

Group	Mean	SD	Range	*P* value (2-tailed)
Control	**25.92**	**4.821**	**19 – 38**	--
N = 13				
Family history	23.00	4.583	19 – 28	0.270
N = 3				
No family history	26.80	4.756	21 – 38	--
N = 10				
Epilepsy	**23.50**	**5.128**	**18 – 30**	**0.403**
N = 6				
TLE	28.00	2.828	26 – 30	--
N = 2				
FLE	21.25	4.573	18 – 28	0.564
N = 4				

*No p values were significant at the 0.05 or 0.01 level

The means, standard deviations, and ranges of phonemic verbal fluency for participants across groups are presented in Table 3. The mean phonemic verbal fluency in those participants with epilepsy was 8.3, standard deviation 4.1, as compared with a mean phonemic verbal fluency of 14.5, standard deviation 4.2, in those participants who have not been diagnosed with epilepsy. Mann-Whitney U and Kruskal-Wallis (Chi-Square)

Tests revealed the difference to be significant at the 0.015 level (see Table 3). However, no such significant differences were observed in phonemic verbal fluency when comparing those with a family history who were not diagnosed with seizures when compared to those without a family history and no seizures. Neither were the differences significant when comparing participants diagnosed with epilepsy whose seizure history was more indicative of characteristics of FLE as compared with those with characteristics more consistent with TLE (see Table 3).

Table 3 Phonemic Verbal Fluency

Group	Mean	SD	Range	*P* value (2-tailed)
Control	**14.46**	**4.294**	**8 – 21**	**--**
N = 13				
Family history	11.33	3.055	8 – 14	0.147
N = 3				
No family history	15.40	4.274	11 – 21	--
N = 10				
Epilepsy	**8.33**	**4.131**	**4 – 16**	**0.015***
N = 6				
TLE	11.00	7.071	6 – 16	--
N = 2				
FLE	7.00	2.160	4 – 9	0.564
N = 4				

*=Significant at the 0.05 level

Cognitive performance as measured by the MoCA

The means, standard deviations, and ranges of MoCA scores for participants across groups are presented in Table 4. The mean MoCA score in those participants with epilepsy was 25.7, standard deviation 3.4, as compared with a mean MoCA score of 29.2, standard deviation 1.1, in those participants who have not been diagnosed with epilepsy. Mann-Whitney U and Kruskal-Wallis (Chi-Square) Tests revealed the difference to be significant at the 0.004 level (see Table 4). However, no such significant difference was

observed in MoCA scores when comparing those with a family history who were not diagnosed with seizures when compared to those without a family history and no seizures. Neither was the difference significant when comparing participants diagnosed with epilepsy whose seizure history was more indicative of characteristics of FLE as compared with those with characteristics more consistent with TLE (see Table 4).

Table 4 MoCA Scores

Group	Mean	SD	Range	*P* value (2-tailed)
Control	**29.23**	**1.092**	**27 – 30**	**--**
N = 13				
Family history	29.67	0.577	29 – 30	0.513
N = 3				
No family history	29.10	1.197	27 – 30	--
N = 10				
Epilepsy	**25.67**	**3.386**	**20 – 28**	**0.004***
N = 6				
TLE	25.00	2.828	23 – 27	--
N = 2				
FLE	26.00	4.000	20 – 28	0.519
N = 3				

*=Significant at the 0.01 level

CHAPTER V

DISCUSSION

There is limited information in the current literature about how focal epilepsy affects fluency. This study aimed to help address the gap in research and allow speech-language pathologists to have a better understanding of the difficulties their patients with epilepsy face daily. The primary focus of this study was to determine the effects of focal epilepsy or family history of epilepsy on measures of speech fluency, semantic and phonemic verbal fluency, and general cognitive skills. Additionally, a suspected diagnosis of FLE or TLE was assigned to those with focal epilepsy based on self-report of signs and symptoms to determine if fluency measures differed based upon suspected site of occurrence.

This study was conducted using a two-group quasi-experimental design. There were nineteen female participants, six with epilepsy and thirteen in the non-epileptic control group. All participants completed the MoCA, provided narrative productions with a minimum of 200 words, and performed semantic and phonemic verbal fluency tasks. Graduate students assisted in the collection of data and remained blinded to the status of participants, and the researcher used de-identified data to determine percentage of speech disfluency from all narrative productions.

Non-parametric statistics were calculated on the results due to the small sample size. Cognitive performance as measured by the MoCA differed significantly between the participants with epilepsy and the non-epileptic control group. As hypothesized, the control group scores were significantly higher than those of the participants with epilepsy. The mean score for those with epilepsy was 25.67 and for the control group was 29.23 which was significant at the 0.004 level. A score of 26 or higher on the MoCA is considered normal. The mean score of the group with epilepsy, although rounding up to normal, may be consistent with anecdotal reports as well as (albeit limited) study findings of somewhat diminished cognitive performance in those with epilepsy.

In addition, phonemic verbal fluency differed significantly between those with epilepsy and the non-epileptic controls. Again, control group scores were significantly higher than those of the participants with epilepsy. The mean for those with epilepsy was 8.33 and for the control group was 14.46 which was significant at the 0.015 level. Many individuals with epilepsy have reported experiencing word finding difficulties, and this finding appears to support the veracity of that complaint.

Neither speech disfluency nor semantic verbal fluency differed significantly between the groups, although the trends were in the predicted directions. The mean semantic verbal fluency score for the non-epileptic control group (25.92) was higher than the participant group with epilepsy (23.5). In addition, the mean speech disfluency score for the group with epilepsy (4.6%) was higher than that of the non-epileptic control group (4.2%).

In contrast, those individuals in the non-epileptic control group with a family history of epilepsy did not perform significantly differently from those in the control

group without a family history of epilepsy on any of the measures. The scores for semantic and phonemic verbal fluency, speech fluency, and cognitive performance as measured by the MoCA did not provide significant results with regard to family history (see Tables 1-4). In addition, those participants with epilepsy whose characteristics may have been more indicative of one form of focal epilepsy than another, specifically TLE versus FLE, did not differ significantly on any of the measures. The scores for semantic and phonemic verbal fluency, speech fluency, and cognitive performance as measured by the MoCA did not provide significant results regarding localization of seizures in the brain (see Tables 1-4).

In conclusion, the results of this study indicate that cognition was significantly different in those participants with focal epilepsy when compared to the non-epileptic control group. The control group scores were significantly higher on the MoCA than the scores of those with epilepsy. In addition, the specific score of phonemic verbal fluency was also significantly lower in the group with epilepsy when compared with the non-epileptic control group. These differences could be attributable to the disease itself, the medications used to treat the disease, or a combination of the disease and the medications used to treat. The mean MoCA score for the group with epilepsy was borderline, thus arguing for potential treatment for individuals with focal epilepsy who seek services from speech-language pathologists to improve their language and cognitive functioning skills.

Limitations

The results of this study were restricted due to several factors. The first was enrolling only female participants; the findings may not be generalizable to males. This was deemed necessary by the researcher due to earlier findings indicating that

lateralization of language may differ by gender (Eichstaedt et al., 2014). As such, future studies should include both male and female participants.

A potential explanation for the failure to observe a significant difference in speech fluency between the two groups may be that the participants were adults with fully developed (mature) speech mechanisms. It might be predictable that children with epilepsy who are still developing speech and language would experience a reduction in speech fluency due to epilepsy and/or the medications used to treat epilepsy.

Another limitation was the use of story cubes for narrative productions. Some of the participants appeared uncomfortable creating their own stories based on the images provided. As a result, they used a great number of pauses and interjections despite otherwise fluent speech. These pauses increased the disfluency scores to percentages that would otherwise be considered pathological.

There was also an innate limitation in the study design. The small sample size limited generalizability to a larger population, thereby limiting the scope of the results. Several of the variables examined, such as speech fluency and semantic verbal fluency, did not demonstrate the hypothesized significant differences. This may have been affected by the small and unequal sample size. As such, further investigation is warranted. The results of this study will hopefully lead to larger scale studies with larger and more equal participant groups.

Due to the population of interest, it was impossible to randomize participation. The diagnosis of focal epilepsy was an independent variable that could not be manipulated. As such, the control group and the group with epilepsy were determined

based on diagnosis instead of randomization into separate groups. Additionally, the diagnosis of FLE and TLE were tentative and based on self-report in the questionnaires used during data collection. Information including time and duration of seizures, as well as presence of aura, were used to make a suspected diagnosis. Diagnoses were not confirmed by imaging or doctor report. This was a first step in the attempt to identify the differences in speech, language, and cognition in those with FLE as compared to those with TLE and non-epileptic controls.

Application

Understanding the speech and language deficits in focal epilepsy will help speech-language pathologists to better serve this population in their clinical settings. The results of this study indicate that phonemic verbal fluency and cognitive functioning may be affected in individuals with focal epilepsy irrespective of localization. Currently, though, patients with focal epilepsy without concomitant issues such as cerebral palsy, traumatic brain injury, or stroke are not receiving cognitive or speech/language treatment. This study will hopefully lead to a change in that trend in the near future.

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APPENDICES

Oklahoma State University Institutional Review Board

Date:	Tuesday, February 6, 2018
IRB Application No	GC1719
Proposal Title:	Fluency patterns of adult females with focal epilepsy
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 2/5/2019

Principal Investigator(s):

Rebecca Walters
Booker 209B
Stillwater, OK 74077

Cheryl L. Giddens
042 Murray
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

VITA

Rebecca Walters

Candidate for the Degree of

Master of Science

Thesis: FLUENCY PATTERNS OF ADULT FEMALES WITH FOCAL EPILEPSY

Major Field: Communication Sciences and Disorders

Biographical:

Education:

Completed the requirements for the Master of Science in Communication Sciences and Disorders at Oklahoma State University, Stillwater, Oklahoma in May, 2019.

Completed the requirements for the Bachelor of Science in Communication Sciences and Disorders at Oklahoma State University, Stillwater, Oklahoma in 2017.

Experience:

Administered speech, language, cognitive, and swallowing evaluations to adult and geriatric patients with various medical conditions and provided subsequent treatment in post-acute medical setting.

Administered speech and language evaluations to children with varying disorders and levels of severity and provided subsequent treatment in numerous clinical settings.

Designed and orchestrated all aspects of the research process for the autonomic function variations in individuals with epilepsy as a Senior Honors Thesis.

Professional Memberships:

National Student Speech-Language-Hearing Association member