

Language-related gamma EEG frontal reduction is associated with positive symptoms in schizophrenia patients

ECAP6004 a critical review of the journal article
Language-related gamma EEG frontal reduction is associated with positive symptoms in schizophrenia patients



A critical review by Amba Tidley



Paper critically reviewed

- Language-related gamma EEG frontal reduction is associated with positive symptoms in schizophrenia patients.
- Spironelli, & Angrilli, (2015) who are both associated with the University of Padova in Italy.
- Published by Elsevier in the specialist Schizophrenia Research Journal.



Question of the research

- This leads to linking the research questions of the study. It helps the collection of data and conducting analysis as per the stated concept.
- The hypothesis expresses the evidence under which any research work must be read and understood. It articulates and de-limits the validity of the studies and frames the methodological landscape. Following this, the research questions are more detailed accounts of what is subject to study and point out appropriate research techniques and even possible outcomes. Preceding these the motivation of the research contains both the internal and external relevance of the research (Bang *et al.*, 2012)



Hypothesis

- Spironelli and Angrilli, (2015) hypothesized that patients' shortfall is irregular, for example, centered over the left frontal locations, associated with loss of language-related irregularity, and correlated with positive symptoms.
- Since there was no theoretical hypotheses on negative symptoms and gamma amplitude achieved from the left anterior and posterior sites during linguistic processing (i.e., Phonological and Semantic tasks), the researchers carried out an explorative correlation analyses on all negative symptom subscales.
- Concerning negative symptoms, no hypothesis was advanced in this investigation, but reviewers asked this information for completeness.

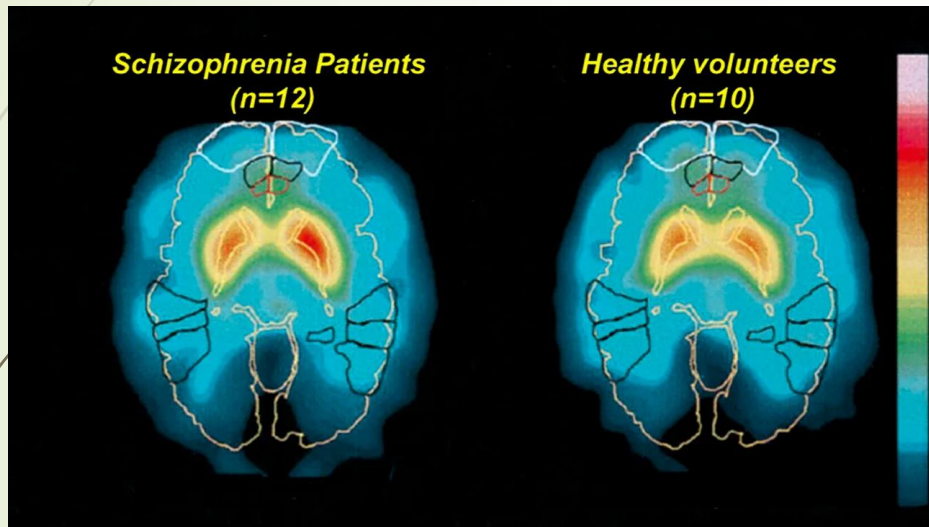


Hypothesis

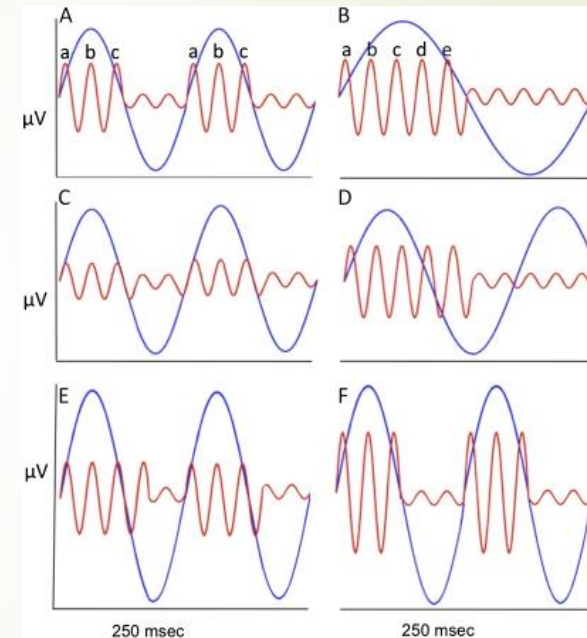
- This result is in line with current hypotheses postulating a lack of connectivity and monitoring of dominant frontal regions over posterior ones, that become relatively more activated, or better, disinhibited.
- A hypothesis is a clear statement of the information that the researcher intends to investigate. It is therefore a clear statement that is essential before conducting research (Toledo *et al.*, 2011).
- The significant relationship between lack of the left anterior asymmetry and increased positive symptoms is in line with Crow's hypothesis (Crow, 2000).



An image of a MRI and EEG



Hersh, (2022)



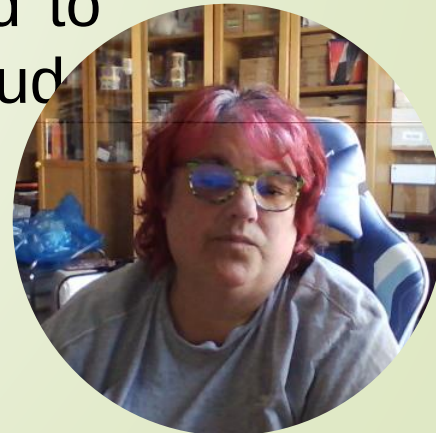
(Moran & Hong, 2011)



Benefits of conducting this research

In a validated language example, the present study examined functional alterations in the locality in language in schizophrenia patients by analysing gamma amplitude, an index of cognitive functioning and integration mechanisms (Herrmann and Demiralp, 2005), which is generated by high-level cognitive processing neurons that fire simultaneously at very high frequency and low amplitudes (Herrmann and Demiralp, 2005).

The benefits of this research found that individuals with schizophrenia, who were presented with activities that related to language, found that in their frontal areas the gamma amplitude was considerably minimised and spread respectively.

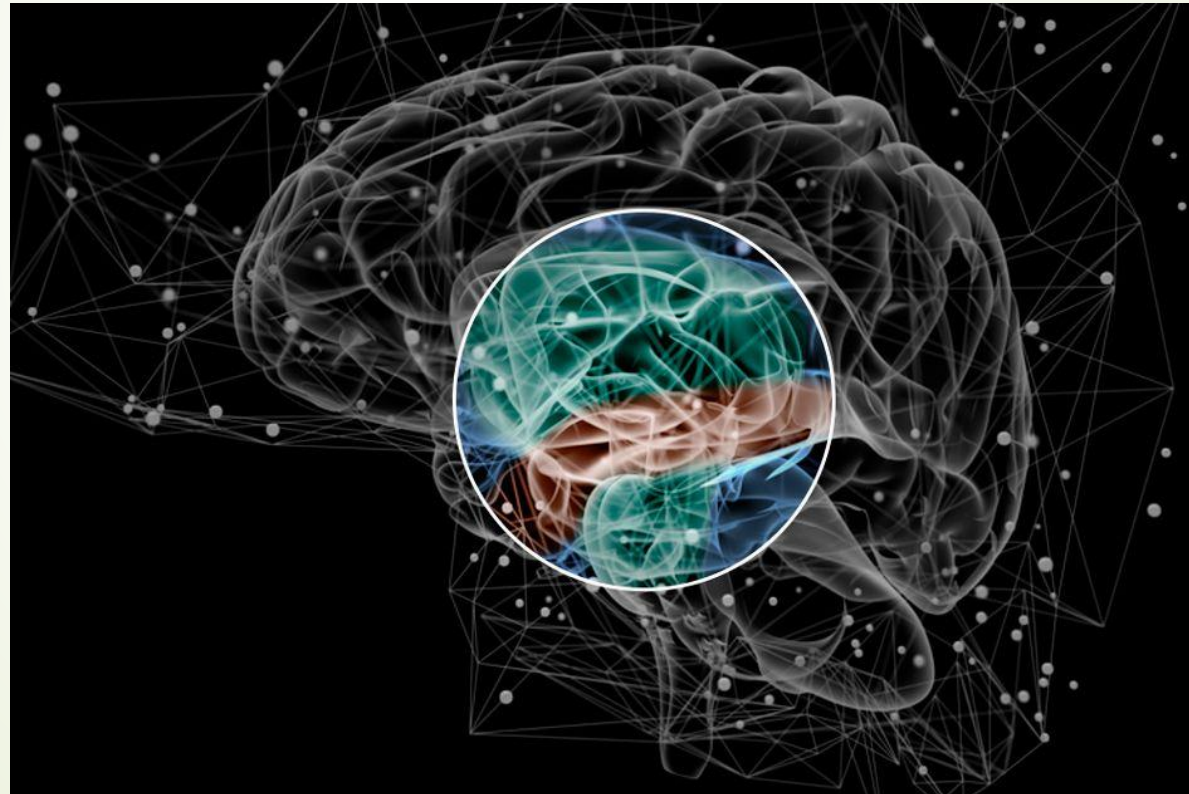


Why is it important to understanding schizophrenia

- It is important to make an early and accurate diagnosis because early diagnosis can lead to prompt set up of a community health team to help the sufferer (Ride *et al.*, 2020) which is costly and can consist of:
- social workers
- community mental health workers
- occupational therapists
- pharmacists
- counsellors and psychotherapists
- psychologists and psychiatrics



Earlier diagnosis may enable neuroscientists to find abnormal brain connections that can predict onset of psychotic episodes. (Trafton, 2018)



Ethical considerations

- The nature of this study required the authors to discuss the associated ethical issues in a considerable amount of detail.
- Patients and adults, who were in good health, gave written confirmation of their permission to be part of this study which was agreed by the “Ethics Committee of the Department of General Psychology”
- According to (Komić *et al.*, 2015) professional codes of ethics are social agreements between professionals to promote ethical behaviour and avoid misconduct, including research and publishing.





What is the design of the study?

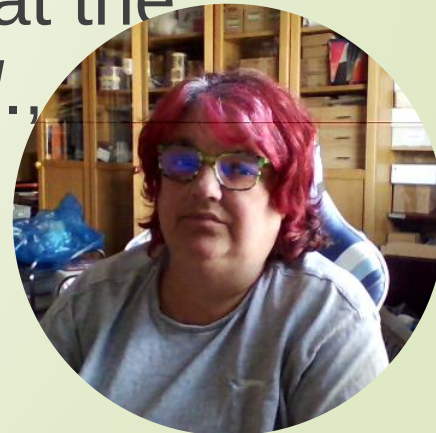
Is this considered a strong design in clinical research?

- Although the design of the paper was not clearly written (Asenahabi, 2019) states that the design should be planned by the researcher prior to the collection of data in order to obtain the objectives of the research in a justifiable manner.
- This paper does not do this effectively as it only gives a minimal amount of information and does not mention in the paper the actual design as evidenced in the method section (Mehalik and Schunn 2006).



Participants

- There were 18 Schizophrenia inpatients; 4 were female the rest were male. This unequal gender participation may not have been advised as evidence by Starkman, (2022) showed that both genders get this brain disorder in about the same numbers. Slightly more men get diagnosed with the condition. Women often get diagnosed later in life than men.
- In general, the clinical signs of schizophrenia are less severe for women (Li *et al.*, 2016). Some research suggests that the course of the disease tends to be worse in men (Li *et al.*, 2016).



- According to (Singh & Masuku, 2014) if the sample size is too small, the hypothesis or predictions may not be supported. Sathian *et al.*, (2010) state that research needs to take into account of cost which could reflect the size of the sample. In this case the cost of doing EEGs on all patients as well as giving out the prescribed drugs would be costly.
- Six patients were treated with typical antipsychotic drugs six patients with atypical anti-psychotic drugs and six patients with both typical and atypical anti-psychotic drugs. There was an equal mix of drugs being taken by the 18 participants however this has to be considered against the earlier comments relating to gender



Gender differences in schizophrenia (Pistoia, 2022)

	Women	Men
more severe positive symptoms	✓	
more severe negative symptoms		✓
younger age of onset		✓
better social functioning	✓	
higher rate of substance use		✓
worse overall course of illness		✓



Evaluation of equipment

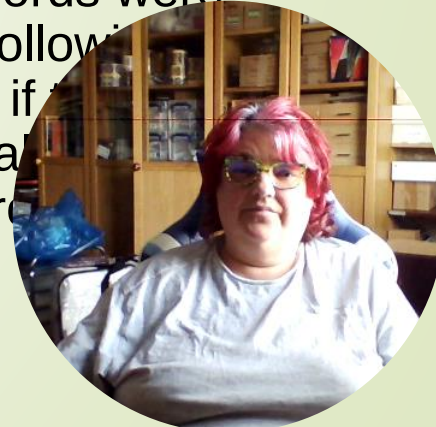
- The study by Spironelli, & Angrilli, (2015) used EEG to identify any neurological differences.
- Kim *et al.*, (2020) obtained good results diagnosing Schizophrenia using an EEG. They found in people with Schizophrenia compared to the Normal Control group there was an 80.66% accuracy for diagnosing patients with schizophrenia.
- EEGs were used on people with Schizophrenia and Normal Control and between people with high and low Schizophrenia in the positive, negative, and cognitive/disorganisation symptoms.
- After testing the low and high groups they found that in positive there was 88.10%, the negative, 75.25%, and cognitive/disorganization symptoms there was an 77.78% accuracy Kim *et al.*, (2020).
- Measurements using EEG and MRI have shown that schizophrenia is associated with severe abnormalities within the temporal lobe, with the effects being most pronounced on the left hemisphere (McCarley *et al.*, 2008)



Testing procedures – stimuli and task used

Stimuli

- The stimulus was made up of two or three syllables in Italian which were chosen from a dictionary containing 5000 Italian words that were written down. They were displayed on a 17" computer screen individually with a long side inter-stimulus interval (ISI) in twos. Therefore word-1 stayed on the monitor for a second and following a space of 2 seconds the word-2 featured on the screen only when the subject made a response which was within 5 seconds, by touching a button on the keyboard.
- Pairs of words were directed in three individual areas which were in line with three tasks of linguistic nature relating to the Hillyard Principle (Hillyard *et al.*, 1973). Identical words were showed as word one but in a varying irregular sequence throughout the activity. Following presentation of the second word contributors were compelled to choose to decide if the words were rhyming and if the focus word was in the same group as word one and if pairs of words were recorded similarly in lower or upper case as previously (Spirelli, Angrilli, 2015)



Testing procedures –stimuli and task used

- Hillyard Principle assesses effects of selective attention, by comparing responses to the same physical stimuli (Stevens & Bavelier, 2012)
- In a study by (Martinez *et al.*, 2008) MRI was used to explore neurophysiological visual processing deficits in people with schizophrenia
- Any issues that were anticipated were addressed such as putting in place mitigation measures after identifying changes in the EEG frequencies due to surges in high frequency activity (Martinez *et al.*, 2008)



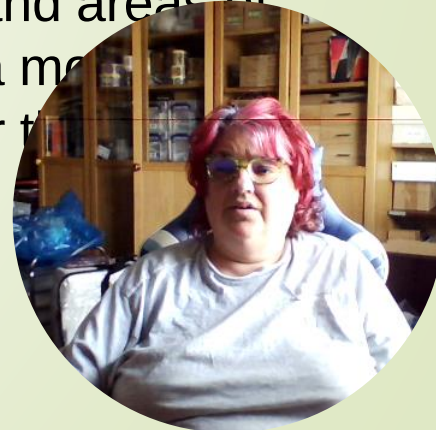
Results

- The result is in line with prior research carried out with a different method (Slow Evoked Potentials) on another sample of patients.
- Patients with schizophrenia demonstrate impairments in filtering incoming sensory information and are assessed using evoked potentials. Evoked potentials are mostly recorded with an EEG and represent neural activity in response to stimulation of the auditory, visual, or somatosensory system (Xiao et al., 2022).
- This research highlights an important functional link between the left frontal reduced integration mechanisms and positive key symptoms of schizophrenia.
- These findings are apparently in contrast with past literature on working memory studies carried out using different version of N-back tasks, in which greater levels of gamma oscillations were found in schizophrenia patients than controls (Basar-Eroglu et al., 2007; Barr et al., 2010).



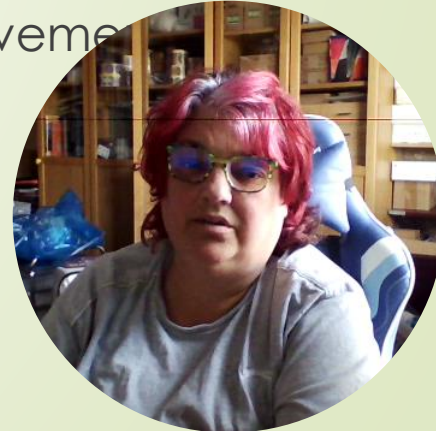
Limitations and Future research considerations.

- Issues were shown when there were reduced constant results for gamma, or part of it, had an increased probability of confusion due to movement from surges in high frequency activity
- To mitigate this the researchers conducted extra evaluation of an elevated frequency EEG band which detected primarily activity of a muscular nature.
- However, the results of the MRI in the study by Iliuta *et al.*, (2021) revealed brain abnormalities were evident at the onset of the disease, and areas of the brain affected were the same detected in individuals with a more chronic form of the illness. Some abnormalities get worse over time



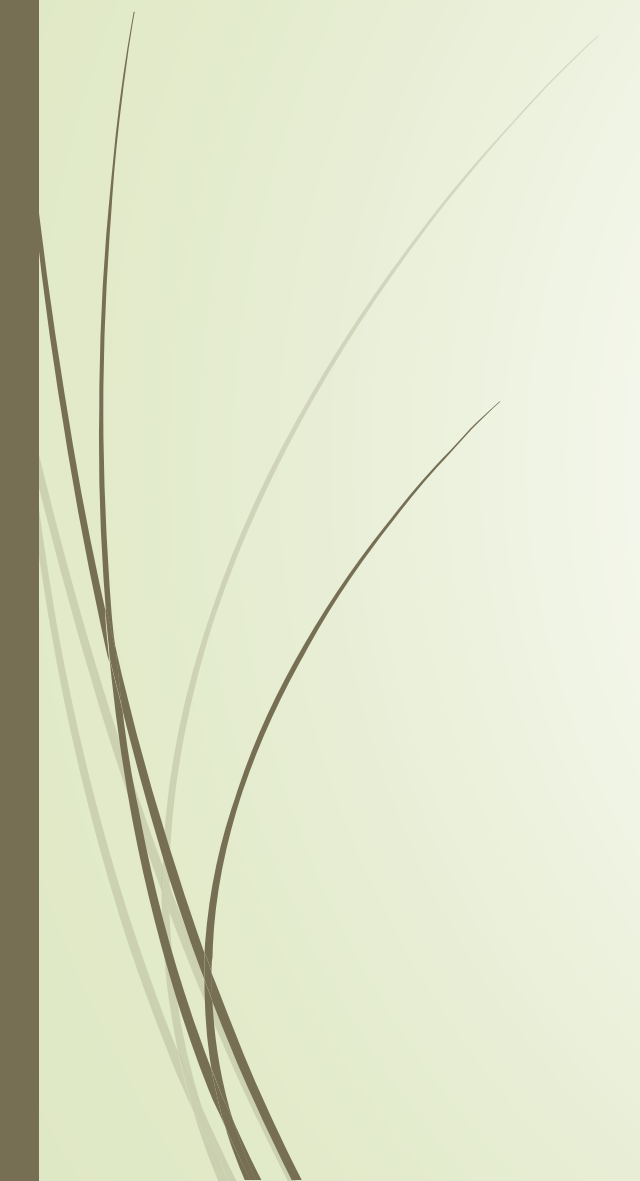
Conclusion

- Clear hypothesis
- Identified benefits of research
- Did not specifically identify practical implications of research for people with schizophrenia
- Research developed from work by Hillyard *et al.*, (1973)
- Results were explored against previous research
- Clear identification of considerations to be taken into account for future researchers (specifically potential confusion due to muscle movement)

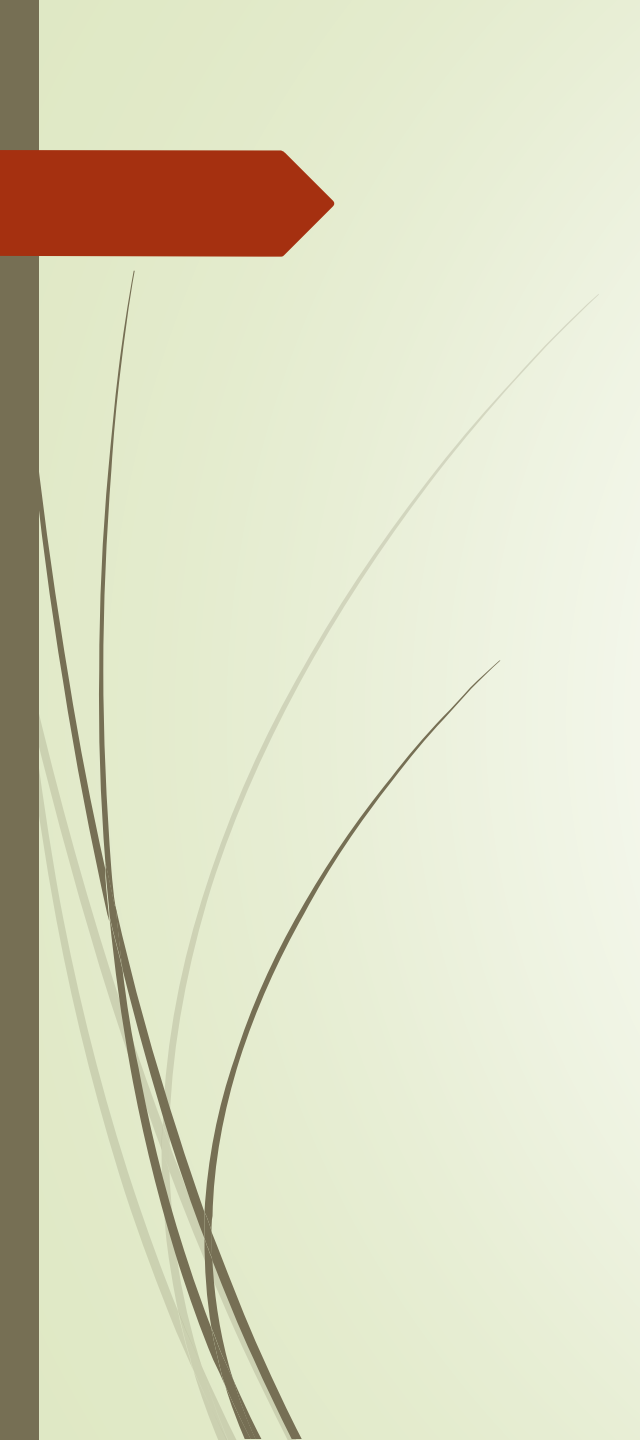




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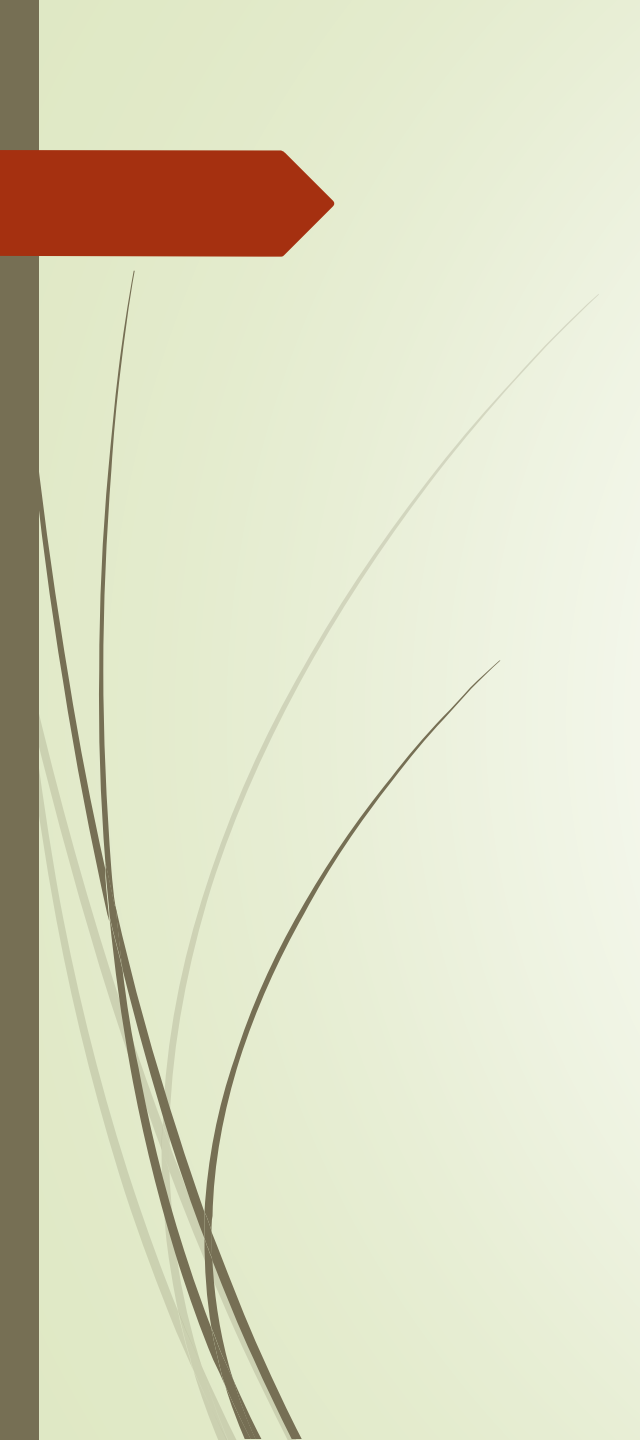
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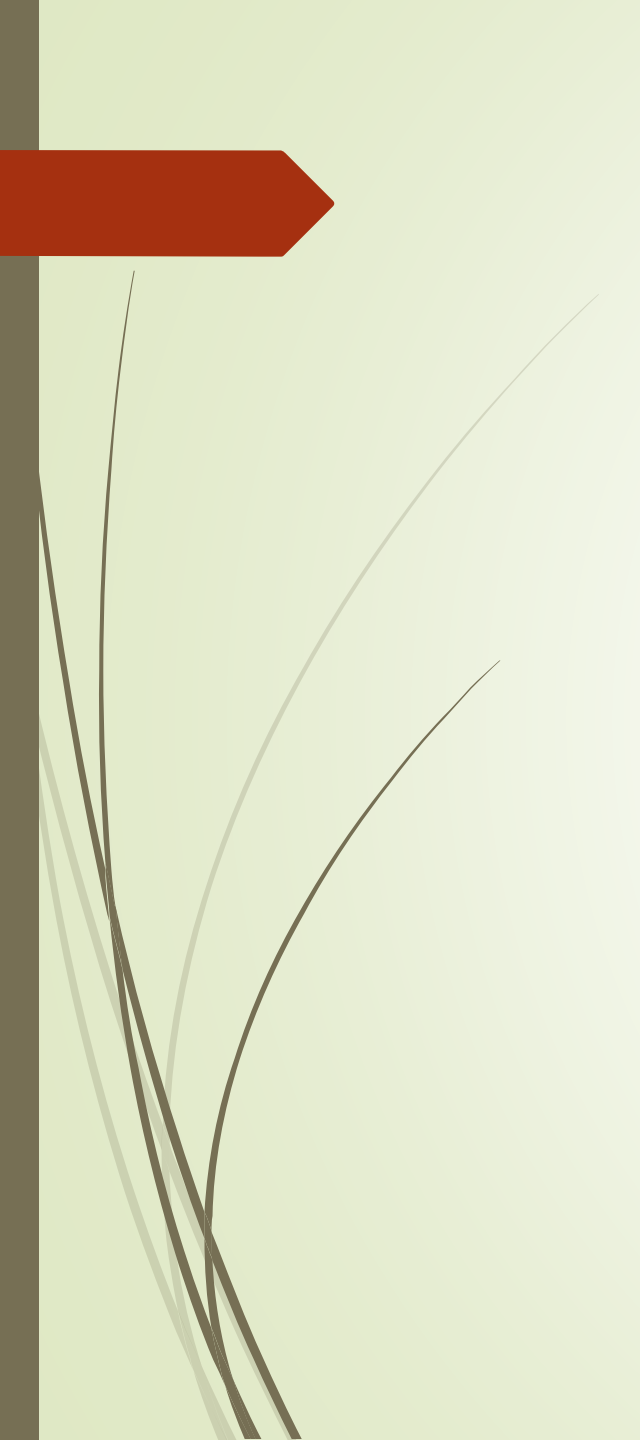
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Good afternoon my name is Amba Tidley student number 1903119 and I will be providing a critical review of a journal article.

Slide 2

The title of this article is Language-related gamma EEG frontal reduction is associated with positive symptoms in schizophrenia patients.

This was written by Spironelli and Angrilli in 2015.

The paper I will be critically reviewing was written in 2015 and published by Elsevier for the Schizophrenia Research Journal.

Both authors are associated with the University of Padova in Italy.

Slide 3 Question of the research.

This leads to linking the research question of the study where it helps with the collection of data and conducting analysis as the stated concept. The hypothesis expresses the evidence under which any research work must be read and understood. It articulates and de-limits the validity of the studies and frames the methodological landscape. Following this, the research questions are more detailed accounts of what is subject to study and point out appropriate research techniques and even possible outcomes. Preceding these the motivation of the research contains both the internal and external relevance of the research (Bang et al., 2012).

Slide 4 – hypotheses

The authors hypothesized that in schizophrenia patients' neurological shortfall is uneven centrally over the left frontal locations. This is directly associated with the loss of language related correspond with positive symptoms.

Since there was no theoretical hypotheses on negative symptoms and gamma amplitude achieved from the left anterior and posterior sites during linguistic processing the researchers carried out an explorative correlation analyses on all negative symptom subscales.

Concerning negative symptoms, no hypothesis was advanced in this investigation, but reviewers asked this information for completeness.

Slide 5 hypotheses continued

This result is in line with current hypotheses postulating a lack of connectivity and monitoring of dominant frontal regions over posterior ones, that become relatively more activated, or better, disinhibited. A hypothesis is a clear statement of the information that the researcher intends to investigate. It is therefore a clear statement that is essential before conducting research (Toledo et al., 2011). The significant relationship between lack of the left anterior asymmetry and increased positive symptoms is in line with Crow's hypothesis (Crow, 2000). Crow explored a contradiction – schizophrenia is genetic in origin and people who develop the condition are much less likely than others to marry and have children however it persists in the population. Crow (2000) considered that schizophrenia is also an evolutionary variation specific to humans and relates to language development in the brain hemispheres.

Slide 6 MRI and EEG image

Here is an image of an MRI scan and the difference between a schizophrenia patient and a healthy patient. It affects 1% of the world's adult population. Why an MRI and not EEG? (McCarley et al., 2008) state that the images provide a snapshot however EEG provides continuous recording of brain.

Slide 7 - What are the benefits for conducting this research?

In a validated language example, the present study examined functional alterations in the locality in language in schizophrenia patients by analysing gamma amplitude, an index of cognitive functioning and integration mechanisms (Herrmann and Demiralp, 2005), which is generated by high-level cognitive processing neurons that fire simultaneously at very high frequency and low amplitudes (Herrmann et al., 2004).

The benefits for this research found that individuals with schizophrenia who were presented with activities that related to language found that in their frontal areas the gamma amplitude was considerably minimised and spread respectively.

Slide 8 – Understanding schizophrenia

It is important to make an early and accurate diagnosis because early diagnosis can lead to prompt set up of a community health team to help the sufferer (Ride et al., 2020) which is costly and can consist of: social workers, community mental health workers, occupational therapists, pharmacists, counsellors and psychotherapists, psychologists and psychiatrics.

Slide 9 – Image of brain

Earlier diagnosis may enable neuroscientists to find abnormal brain connections that can predict onset of psychotic episodes.

Slide 10 – Ethical considerations

The nature of this study required the authors to discuss the associated ethical issues in a considerable amount of detail. Patients and adults who were in good health gave written confirmation of their permission to be part of this study which was agreed by the "Ethics Committee of the Department of General Psychology". According to (Komić et al., 2015) professional codes of ethics are social agreements between professionals to promote ethical behavior and avoid misconduct, including research and publishing.

Slide 11 – Design of study

Although the design of the paper was not clearly written (Asenahabi, 2019) states that the design should be planned by the researcher prior to the collection of data in order to obtain the objectives of the research in a justifiable manner. This paper does not do this effectively as it only gives a minimal amount of information and does not mention in the paper the actual design. Ethics is important because, Schizophrenia affects language and communication, but its most severe symptoms are positive thinking disorder and disorganised, incoherent speech. So, it is likely some sufferers may not be able to give informed consent and would require an advocate. According to the mental health charity MIND (2023) friends, family or carers can be an advocate. The ethics committee did approve this research.

Slide 12 – Participants

There were 18 Schizophrenia inpatients; 4 were female the rest were male. This unequal gender participation may not have been advised as evidence by Starkman showed that both genders get this brain disorder in about the same numbers. In general, the clinical signs of schizophrenia are less severe for women. Some research suggests that the course of the disease tends to be worse in men.

Slide 13 – participants

According to (Singh & Masuku, 2014) if the sample size is too small, the hypothesis or predictions may not be supported. Sathian (2010) state that research needs to take into account of cost which could reflect the size of the sample. In this case the cost of doing EEGs on all patients as well as giving out the prescribed drugs would be costly. Six patients were treated with typical antipsychotic drugs six patients with atypical anti-psychotic drugs and six patients with both typical and atypical anti-psychotic drugs. There was an equal mix of drugs being taken by the 18 participants however this has to be considered against the earlier comments relating to gender.

Slide 14 Graph

This picture shows a gender differences in schizophrenia. This is important as the genders need to be an equal amount in the research rather than the amount that actually was in this paper.

Slide 15 - Evaluation of equipment

The researchers used EEG to identify any neurological differences.

Kim et al., (2020) obtained good results diagnosing Schizophrenia using an EEG. that they found in people with Schizophrenia compared to the Normal Control group. In this study, EEGs were used on people with Schizophrenia and Normal Control and between people with high and low Schizophrenia in the positive, negative, and cognitive/disorganisation symptoms. Measurements using EEG and MRI have shown that schizophrenia is associated with severe abnormalities within the temporal lobe, with the effects being most pronounced on the left hemisphere. When it comes to analysing brain function, the electrical activity in the EEG and the event-related potentials that are derived from the EEG give the highest temporal resolution. When paired with the high spatial resolution from the MRI.

Slide 16 – Testing procedures - task and stimuli used

The stimulus was made up of two or three syllables in Italian which were chosen from a dictionary containing 5000 Italian words that were written down. They were displayed on a 17" computer screen individually with alongside inter-stimulus interval (ISI) in twos. Therefore word 1 stayed on the monitor for a second and following a space of 2 seconds the word-2 featured on the screen only when the subject made a response which was within 5 seconds, by touching a button on the keyboard. Pairs of words were directed in three individual areas which were in line with three tasks of linguistic nature relating to the Hillyard Principle (Hillyard et al., 1973). Identical words were showed as word one but in a varying irregular sequence throughout the activity. Following the presentation of the second word contributors were compelled to choose to decide if the pairs of words were rhyming and if the focus word was in the same group as word one also to see if pairs of words were recorded similarly in lower or upper case as previously (Spironelli & Angrilli, 2015).

Slide 17 - Stimulus

Hillyard Principle assesses effects of selective attention, by comparing responses to the same physical stimuli. In a study by (Martinez et al., 2008) magnetic resonance imaging (MRI) was used to explore neurophysiological visual processing deficits in people with schizophrenia. Any issues that were anticipated were addressed such as putting in place mitigation measures after identifying changes in the EEG frequencies due to surges in high frequency activity.

Slide 18 - Results

The result is in line with prior research carried out with a different method (Slow Evoked Potentials) on another sample of patients.

Patients with schizophrenia demonstrate impairments in filtering incoming sensory information and are assessed using evoked potentials. Evoked potentials are mostly recorded with an EEG and represent neural activity in response to stimulation of the auditory, visual, or somatosensory system (Drongelen, 2006; Waldman and Waldman, 2011).

This research highlights an important functional link between the left frontal reduced integration mechanisms and positive key symptoms of schizophrenia.

These findings are apparently in contrast with past literature on working memory studies carried out using different version of N-back tasks, in which greater levels of gamma oscillations were found in schizophrenia patients than controls (Basar-Eroglu et al., 2007; Barr et al., 2010).

Slide 19 – Limitations and future research

Issues were shown when there were reduced constant results for gamma, or part of it, had an increased probability of confusion due to movement from surges in high frequency activity.

To mitigate this the researchers conducted extra evaluation of an elevated frequency EEG band which detected primarily activity of a muscular nature.

However, the results of the MRI in the study by Iliuta et al., (2021) revealed brain abnormalities were evident at the onset of the disease, and that the areas of the brain affected are the same regions of the brain that are detected in individuals with a more chronic form of the illness. Some abnormalities, such as a decrease in the volume of the frontal and parietal lobes, the superior temporal gyrus, and the lateral ventricles, get worse over time.



Slide 20 – Conclusions

There was a clear hypothesis

It identified benefits of research

It did not specifically identify practical implications of research for people with schizophrenia.

Research developed from work by Hillyard et al., (1973)

Results - important that they explored results with previous research - in line with prior research by (Drongelen, 2006; Waldman and Waldman, 2011).

However, appeared in contrast with past literature on working memory studies where greater levels of gamma oscillations were found in schizophrenia patients than controls (Basar-Eroglu et al., 2007; Barr et al., 2010).

Clear identification of considerations to be taken into account for future researchers (specifically potential confusion due to muscle movement).

Slide 16 – Testing procedures - task and stimuli used

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Slide 18 - Results

The result is in line with prior research carried out with a different method (Slow Evoked Potentials) on another sample of patients.

Patients with schizophrenia demonstrate impairments in filtering incoming sensory information and are assessed using evoked potentials. Evoked potentials are mostly recorded with an EEG and represent neural activity in response to stimulation of the auditory, visual, or somatosensory system (Drongelen, 2006; Waldman and Waldman, 2011).

This research highlights an important functional link between the left frontal reduced integration mechanisms and positive key symptoms of schizophrenia.

These findings are apparently in contrast with past literature on working memory studies carried out using different version of N-back tasks, in which greater levels of gamma oscillations were found in schizophrenia patients than controls (Basar-Eroglu et al., 2007; Barr et al., 2010).

Slide 19 – Limitations and future research

Issues were shown when there were reduced constant results for gamma, or part of it, had an increased probability of confusion due to movement from surges in high frequency activity.

To mitigate this the researchers conducted extra evaluation of an elevated frequency EEG band which detected primarily activity of a muscular nature.

However, the results of the MRI in the study by Iliuta et al., (2021) revealed brain abnormalities were evident at the onset of the disease, and that the areas of the brain affected are the same regions of the brain that are detected in individuals with a more chronic form of the illness. Some abnormalities, such as a decrease in the volume of the frontal and parietal lobes, the superior temporal gyrus, and the lateral ventricles, get worse over time.



Slide 20 – Conclusions

There was a clear hypothesis

It identified benefits of research

It did not specifically identify practical implications of research for people with schizophrenia.

Research developed from work by Hillyard et al., (1973)

Results - important that they explored results with previous research - in line with prior research by (Drongelen, 2006; Waldman and Waldman, 2011).

However, appeared in contrast with past literature on working memory studies where greater levels of gamma oscillations were found in schizophrenia patients than controls (Basar-Eroglu et al., 2007; Barr et al., 2010).

Clear identification of considerations to be taken into account for future researchers (specifically potential confusion due to muscle movement).

