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Schizophrenia and Error Processing: A Meta Analysis

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Introduction

- The error-related negativity (ERN) is a response locked Event-Related Potential component that peaks approximately 50 ms after an incorrect response. (Ehring, 1993)
- In a general sense the ERN seems to play a role in error detection and monitoring that occurs in the anterior cingulate cortex (ACC)
- The ERN is modulated by affective variables as well as by psychopathology.
- It is thought that deficiencies in the internal monitoring systems of individuals with schizophrenia may be related to the expression of symptoms typical to schizophrenia.
- Studies of the ERN and individuals with schizophrenia have revealed significant results that support these assumptions. No work has been done to determine the overall effect of ERN amplitude and schizophrenia. This study determined the average effect size of ERN amplitude for patients with schizophrenia.
- It was hypothesized that a large average effect size of ERN amplitude attenuation in participants with schizophrenia would be found.

Method

- A comprehensive search of the literature on the ERN and schizophrenia resulted in the inclusion of eight studies.
- Inclusion criteria were:
  - The study must have measured the ERN
  - Participants must have had a diagnosis of schizophrenia
  - When available (three studies) the means and standard deviations of ERN amplitude were used to determine the effect size. In the absence of the means and standard deviations, F values of the group x accuracy interaction were used to estimate the effect size using established methods (Shadish, R. W., Robinson, L. & Lu, C., 1999).
  - The average effect size was then calculated using a random effects model.

Results

- The average effect size was then calculated using a random effects model.
- The average effect size was calculated using established methods (Shadish, W. R., Robinson, L. & Lu, C., 1999).
- Used to estimate the effect size using established methods (Shadish, R. W., Robinson, L. & Lu, C., 1999).
- The average effect size was then calculated using a random effects model.

Discussion

- As hypothesized, a large average effect size of ERN amplitude attenuation was found in individuals with schizophrenia.
- According to prevailing theories, ERN amplitude attenuation reflects a deficiency in error processing.
- The results of the influence plot suggest that several of the studies had a substantial impact on the average effect size.
- The influence plot reveals that the removal of the Bates 2004 study substantially decreases the average effect size. This study had a very large effect size (d = 1.94) with a very small sample size (n = 10). It is likely that the small sample size is contributing to this finding.
- The influence plot also reveals that the Morris 2006 (speed) study is influencing the average effect size. The participants in this condition were told to complete the task as quickly as possible. The participants in all other studies were told to respond as quickly and as accurately as possible. The exclusion of this study yields a much larger average effect size (d = 0.74). This is likely a result of the affective variables which modulate ERN amplitude. Under a speeded condition accuracy is of less importance and therefore errors are less salient.
- All of the studies had participants with differing diagnoses (paranoid, non-paranoid, undifferentiated and schizoaffective). Further research evaluating the effect of subtype of schizophrenia would likely provide greater insight to the processes which modulate ERN amplitude.
- The large effect size of ERN amplitude attenuation for individuals with schizophrenia strongly suggest that the ERN may be a significant marker of schizophrenic symptoms.
- As a result of this study it is clear that schizophrenic symptoms are likely influenced by a deficiency of error processing.

References

- To prevent potential publication bias of cited research resulting in potential misinterpretation, the influence plot also reveals that the removal of the Bates 2004 study substantially decreases the average effect size. This study had a very large effect size (d = 1.94) with a very small sample size (n = 10). It is likely that the small sample size is contributing to this finding. The influence plot also reveals that the Morris 2006 (speed) study is influencing the average effect size. The participants in this condition were told to complete the task as quickly as possible. The participants in all other studies were told to respond as quickly and as accurately as possible. The exclusion of this study yields a much larger average effect size (d = 0.74). This is likely a result of the affective variables which modulate ERN amplitude. Under a speeded condition accuracy is of less importance and therefore errors are less salient. As a result of this study it is clear that schizophrenic symptoms are likely influenced by a deficiency of error processing. 

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