How does the brain respond to photographs?

Allyson Stutzman1, Dr. Krista Wilkinson1, Andrea Seisler2

The Pennsylvania State University Department of Communication Sciences and Disorders1
Human Electrophysiology Lab2

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Introduction

Why are we doing this research?
• Schools often use visual supports to help students learn
• A visual scene display (VSD) is a type of visual support in which a photograph is displayed with hotspots under the targets to allow students to communicate
• Children learn language in context, therefore VSDs may be easier for the child to learn language than the more traditional grid-based design
• However: Will the physical resemblance of the photograph to its referent cause the child to rely on the perceptual similarity, thus interfering with understanding or use of it as “symbolic”?
• Our goal was therefore to find out if the brain responds to pictures in the same way as other symbols.

Hypotheses
• We expected the brain to respond to photographs in the same manner it responds to other forms of language (N400 wave)
• If our hypothesis is supported, it would suggest VSDs are processed by the brain in the same way as demonstrably “symbolic” stimuli such as written or spoken words.

Methods

What is EEG?
• EEG – electroencephalography
  • A recording of electrical activity in the brain
• How is it measured?
  • A net of electrodes is placed on a subject’s head
  • The net is soaked in a solution mixed with baby shampoo to allow for a good connection to the scalp
  • Electrical activity is recorded and amplified and appears as a continuous waveform
• What is the N400 wave?
  • The N400 wave is a negative deflecting wave that occurs around 400ms following a semantically mismatched stimulus

Semantic Mismatch
• Occurs when a semantically appropriate item is replaced with a semantically inappropriate item
• In other words, you are expecting something to “make sense” and then are “surprised” when it doesn’t make sense at all.
  • Eg. I drink coffee out of a mug vs. I drink coffee out of a shoe
• This is the basis for which our study was designed

Procedure

Subjects: 20 paid volunteers (16 males, 4 females) between the ages of 18-26
• 4 subjects were removed from the final analysis as a result of too much noise in the data or not enough useable trials
• 1 subject was removed because of a later effect as compared to the others

Stimuli: 56 pairs of photographs and spoken phrases
• Pairs verified by 30 students involved in the National Student Speech Language and Hearing Association (NSSLHA) as either matches or mismatches.

Conditions:
1. Matched Condition: The spoken phrase accurately described the photograph displayed
2. Mismatched Condition: The spoken phrase did not accurately describe the photograph displayed

Results

Visual Inspection

Matched
Mismatched
The girl is riding.
The girl is sleeping.

We expected to see an N400 brainwave in response to the mismatched condition

Discussion/Future Directions

Discussion
• N400 was present in the mismatched condition between 400-500ms
• There were significantly larger differences between each condition for the left hemisphere which is consistent with where language processing occurs
• There were significantly larger differences between each condition for the parietal lobes, which is consistent for where the N400 wave is often seen in semantic mismatch studies
• The brain responded to photographic/auditory stimuli in a semantic mismatch much the same way it does to other forms of language (eg. written and spoken words)

Future Directions
• Complete a similar study using children with developmental disabilities to see if the task elicits a similar response
• Continue to support the use of visual scene displays as educational aids and communicative devices for young children

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