Where In the Brain Is "It"? Does It Depend on What "It" Is?

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❖How does context influence the processing of words?
❖How are different types of words affected by context?

❖Why do concrete words (e.g., "kite") show a speed and accuracy advantage over abstract words (e.g., "love") *in isolation* but not in sentence context (e.g., Schwanenflugel & Shoben, 1983)?

Two theories:

1. Dual Coding Theory (e.g., Paivio, 1971)
   - Concrete words: verbal and imaginal codes in memory
   - Abstract words: only a verbal code

   In context, processed similarly because context surpasses or masks concreteness effects (e.g., Holcomb et al., 1999)

➢**Dual coding proposes differential processing of concrete and abstract words—a qualitative difference in separate brain systems (e.g., Chiarello et al., 1987; Coltheart, 1980)**

2. Context Availability Theory (e.g., Schwanenflugel & Shoben, 1983)
   - Easier to come up with a context for concrete words

   In context, these two word types are functionally the same

➢**Context availability theory (without additional assumptions) proposes a quantitative difference within a single brain system**

Most evidence: total-process measures (e.g., reaction time, accuracy)
➢Event-related brain potentials can elucidate characteristics of on-line processing

- Concrete words elicit more negative ERPs between 300-500 ms post-stimulus (an N400 ?) at anterior scalp locations (in lexical and concreteness decision, and in-sentence anomaly judgment; Kounios & Holcomb, 1994; Holcomb et al., 1999)
- Differences sometimes greater over RH locations (which has been taken as evidence for separate neural generators; Kounios & Holcomb, 1994)

➢However, there are several remaining questions:

1. Why would concrete be more negative than abstract? More cognitive effort is typically associated with greater negativity.
2. Is processing of concrete and abstract words in context really similar or a by-product of the measures used?
3. Do scalp distribution differences come from distinct neural generators for concrete and abstract words?

To answer these questions, we used an ERP variant of the lexical decision task used by Schwanenflugel and Shoben (1983)

Method: ERP/Lexical decision task

Participants: 18 Native English speakers who were right handed (final N=15); not exposed to a language other than English before age 13

ERP Methodology & Analysis

129-channel Geodesic Sensor Net; 1000 Hz sampling rate
30 Hz low-pass filtered (off-line); no eye movements or blinks
no >10 bad electrodes/trial; data from bad electrodes replaced
baseline corrected (100 ms)
no > 12 bad trials per cell (3 participants excluded)
referenced to Cz during recording; re-referenced to the average of all electrodes

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Block 1: 80 "words" in isolation
- 40 Real words
  - -20 Concrete nouns (e.g., bird, hotel)
  - -20 Abstract nouns (e.g., concept, rage)

  Matched for frequency & length
- 40 Nonwords created from nouns (e.g., joor, caracity)

Timing: item for 200 ms, blank for 500 ms (e.g., Kounios & Holcomb, 1994),? probe until response, see accuracy feedback

Block 2: 80 target "words" following sentence context
- -20 *concrete* sentence frames with *concrete* target words
- -20 *abstract* sentence frames with *abstract* target words
- -20 *concrete* sentence frames with *nonword* targets
- -20 *abstract* sentence frames with *nonword* targets

Targets matched for frequency & length; sentences for probability of targets

Timing: words for 200 ms, blanks between words 300 ms, final (target) item followed by 1300 ms blank (e.g., Holcomb et al., 1999), ? probe until response, see accuracy feedback

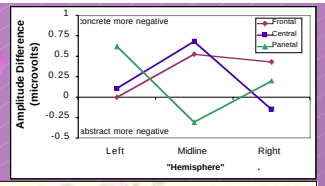
Frame	*Target*	*Sample Stimulus*
Concrete	Concrete	Sometimes alleys look like streets.
Abstract	Abstract	The anonymous tips were used with discretion.
Concrete	Nonword	In front of the arena, the fan purchased a peath.
Abstract	Nonword	Ingenuity was helpful in completing the chinge.

Do concrete words elicit larger negativities between 300 and 500 ms post-stimulus than abstract words (e.g., Holcomb et al., 1999; Kounios & Holcomb, 1994)?

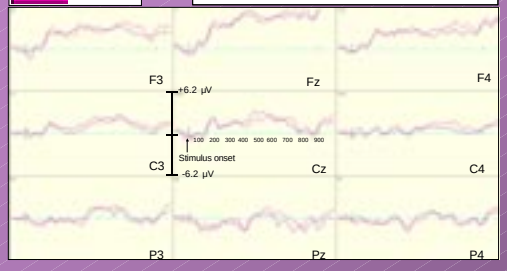
Repeated measure ANOVA with concreteness (concrete, abstract), "hemisphere" (left, midline, right), and "lobe" (frontal, central, parietal). As recommended by Picton et al. (2000), we corrected for latency jitter by adjusting the time window to extend 100 ms before and after the minimum amplitude (i.e., negative peak) between 300-500 ms.

We found no difference in the mean amplitudes elicited by concrete and abstract words--with or without latency jitter correction (e.g., Kounios & Holcomb, 1994)

Interaction between concreteness, "lobe", and "hemisphere" (p<.05) using a **minimum amplitude analysis**

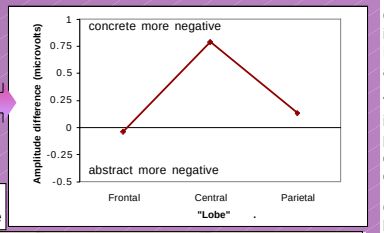


Abstract
Concrete

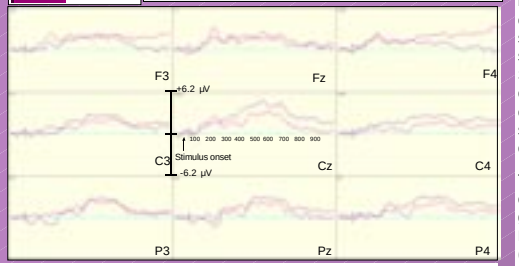


Are concrete and abstract words processed similarly in context?

Interaction between concreteness & "lobe" (p<.05) using **mean amplitude analysis**



Abstract
Concrete



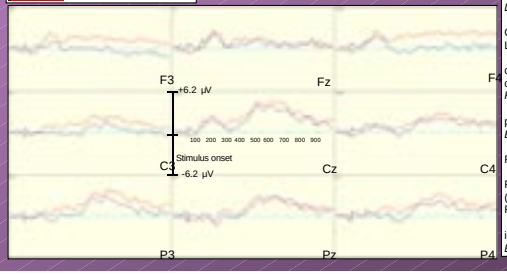
Do the source generators for the processing of concrete and abstract words differ?

Using LORETA, we found *no difference* in the brain locations used to process:
-Concrete and abstract words in isolation
-Concrete and abstract words in context
-Concrete words in isolation and context
-Abstract words in isolation and context

What does context do to the processing of words?
- Context helps to predict the upcoming words in a sentence, or
- Influences how upcoming words are comprehended

➢ Why would concrete and abstract sentence contexts affect nonword processing differently?

Abstract contexts
Concrete contexts



Conclusions

Our results are not consistent with the typical interpretation of the N400 but replicate those of Kounios and Holcomb (1994) and Holcomb et al. (1999).

These results are generally consistent with the idea that concrete and abstract words are processed differently both in isolation and in context, which is more consistent with a dual code theory than a single code theory.

Our results are not consistent with the behavioral evidence that suggests that concrete and abstract words are processed similarly in context, even though we used the same manipulation of context as Schwanenflugel and Shoben (using concrete contexts for concrete targets and abstract contexts for abstract targets). This finding suggests that similar total-process measures can result from distinct brain processing.

The nature of the increased negativity for concrete words remains unclear. The same group of participants demonstrated a standard N400 effect for high and low frequency words (low frequency more negative).

It is possible that, as suggested by Kounios and Holcomb, there are several effects that summate at the scalp, leading to an increased negativity for concrete words. However, it is unclear why this pattern would only be observed when concreteness is manipulated.

An unexpected result was that concrete and abstract contexts differentially affected nonword processing. At present, we have no explanation for this finding. However, it suggests that we are not entirely aware of how context affects language processing.

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