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Hemispheric processing of idioms: The influence of familiarity and ambiguity

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ABSTRACT

Recent findings suggest that the right hemisphere plays a key role when readers comprehend figurative language. However, it is currently unclear how specific types of figurative language, such as idioms (e.g., "to bury the hatchet"), are processed in the right and left cerebral hemispheres. Prior research suggests that a reader's previous exposure to an idiomatic phrase (i.e., the level of familiarity) and the plausibility of an idiom (i.e., the level of ambiguity) influence how idioms are processed. To investigate how familiarity influences the hemispheric processing of idioms (Experiment 1), participants read texts containing familiar or less familiar idioms and made lexical decisions to related target words presented to the left visual field-right hemisphere or to the right visual field-left hemisphere. To investigate how ambiguity influences the hemispheric processing of idioms (Experiment 2), participants read texts containing high or low ambiguity idioms and completed a lexical decision task to related target words presented to each visual field-hemisphere. For both familiar and less familiar idioms, greater facilitation was evident in the left hemisphere than in the right hemisphere. Additionally, greater facilitation was evident in the left hemisphere for low ambiguity idioms than for high ambiguity idioms, and greater facilitation was evident in the right hemisphere for high ambiguity idioms than for low ambiguity idioms. These findings suggest that the right hemisphere has an advantage when readers process ambiguous idioms, whereas the left hemisphere has an advantage when readers process low ambiguity idioms, and both familiar and less familiar idioms.

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1. Introduction

Successful text processing often requires readers to go beyond a text's literal meaning. For example, readers may encounter idioms or verb phrases that must be interpreted figuratively, such as "to bury the hatchet" (i.e., to reconcile) (Gibbs, 1999; Titone & Connine, 1999). It is essential that readers correctly interpret idioms so they can successfully understand the intended meaning of a text (Dews et al., 1996; Rankin et al., 2008; Winner, Brownell, Happe, Blum, & Pincus, 1998). For example, if readers misinterpret the idiomatic phrase "Stacy is in hot water," then they may incorrectly infer that Stacy is literally submerged in hot water rather than correctly inferring that she is in trouble. Because idioms are ubiquitous in everyday communication (Antaki, 2007; Billig & MacMillan, 2005; Lim, Ang, Lee, & Leong, 2009), it is important to investigate how specific characteristics of idioms influence how readers comprehend idioms. Previous research has shown that a reader's familiarity with an idiomatic phrase (i.e., the level of familiarity; Cronk, Lima, & Schweigert, 1993) and the plausibility of an idiom's literal interpretation (i.e., the level of ambiguity; Titone & Connine, 1994) influence how idioms are processed during text comprehension (Giora & Fein, 1999; Titone & Connine, 1999). Further, previous studies have found hemispheric differences when readers process texts that differ in familiarity (Faust & Mashal, 2007) or ambiguity (Grindrod & Baum, 2005; Tompkins, Lehman-Blake, Baumgaertner, & Fassbinder, 2001), but have yet to investigate hemispheric processing of ambiguity and familiarity during idiom comprehension. In addition, theories of hemispheric processing of text (Beeman, 1998; Beeman & Chiarello, 1998) suggest that ambiguity will likely influence how the cerebral hemispheres process idioms during text comprehension. In the current study, we used the divided visual field paradigm to examine how the cerebral hemispheres process idioms that differ with regard to the level of familiarity and ambiguity. In Experiment 1, participants read texts with familiar idioms, less familiar idioms, or non-idiomatic (neutral) texts and made lexical decisions to related target words presented to either the left visual field-right hemisphere or to the right visual field-left hemisphere. In Experiment 2, participants read texts with high ambiguity idioms, low ambiguity idioms, or non-idiomatic (neutral) texts and made lexical decisions to related target words presented to either the left visual field-right hemisphere or to the right visual field-left hemisphere.

Studying idiom comprehension can provide valuable insight into how the hemispheres process nonliteral meanings during text comprehension. Although the right hemisphere is thought to be dominant during the processing of many types of figurative language (e.g., sarcasm and puns) (Briner, Motyka Joss, & Virtue, 2011; Coulson & Severns, 2007; Shami & Stuss, 1999), it is unclear how idioms are processed in the left and right cerebral hemispheres. Several studies have found a right hemisphere advantage during idiom processing; however, other studies suggest that the left hemisphere may play a dominant role during idiom comprehension. For example, individuals with right hemisphere damage are less apt to accurately comprehend idioms than individuals with left hemisphere damage (Myers & Linebaugh, 1981; Van Lancker & Kempler, 1987), which suggests that the right hemisphere may have an advantage when readers process idioms. However, when repeated transcranial magnetic stimulation (rTMS) is applied to the left hemisphere of normal participants, idioms are more difficult to understand than when rTMS is applied to the right hemisphere (Oliveri, Romero, & Papagno, 2004). This finding suggests that under some circumstances, the left hemisphere may have an advantage in idiom comprehension. In addition, studies show that individuals with left hemisphere damage comprehend idioms less accurately than individuals with right hemisphere damage (Papagno, Curti, Rizzo, Crippa, & Colombo, 2006). Currently, it is unclear exactly why previous studies have produced seemingly conflicting findings about how the cerebral hemispheres process idioms during text comprehension.

Although well-established theories attempt to explain how the hemispheres process language, there is still much debate regarding how the left and right hemispheres each contribute during idiom comprehension. For example, the Fine-Coarse Semantic Coding Theory proposes that the right and left hemispheres process semantic information differently during text comprehension. This theory states that differences in the neuronal connections in the left and right hemispheres influence how the hemispheres process language (Beeman et al., 1994). Specifically, the left hemisphere neuronal connections are denser and more closely connected to each other, whereas the right hemisphere neuronal connections are less densely connected. Based on the structure of the neural connections in the