Published in final edited form as:
Perspect Neurophysiol Neurogenic Speech Lang Disord. 2008 June 1; 18(2): 45–54.

Theoretical Considerations for Understanding "Understanding" by Adults With Right Hemisphere Brain Damage

Connie A. Tompkins
Department of Communication Science and Disorders and Center for the Neural Basis of Cognition, University of Pittsburgh, Pittsburgh, PA

Abstract

This article reviews and evaluates leading accounts of narrative comprehension deficits in adults with focal damage to the right cerebral hemisphere (RHD). It begins with a discussion of models of comprehension, which explain how comprehension proceeds through increasingly complex levels of representation. These models include two phases of comprehension processes, broad activation of information as well as pruning and focusing interpretation of meaning based on context. The potential effects of RHD on each processing phase are reviewed, focusing on factors that range from relatively specific (e.g., how the right versus the left hemisphere activate word meanings; how the right hemisphere is involved in inferencing) to more general (the influence of cognitive resource factors; the role of suppression of contextually-irrelevant information). Next, two specific accounts of RHD comprehension difficulties, coarse coding and suppression deficit, are described. These have been construed as opposing processes, but a possible reconciliation is proposed related to the different phases of comprehension and the extent of meaning activation. Finally, the article addresses the influences of contextual constraint on language processing and the continuity of literal and nonliteral language processing, two areas in which future developments may assist our clinical planning

Adults with right hemisphere brain damage (RHD) are known to have a variety of language processing difficulties. In this article, I review and evaluate several leading accounts of comprehension deficits in the RHD population and address some areas in which future developments may assist our clinical planning. The discussion below focuses on frequently-documented difficulties in building, extracting, or applying the mental structures that guide discourse comprehension.

To preface the material below, I want to highlight the individual variability of adults with RHD. Clinicians are well aware of this, but the literature sometimes addresses this group as if everyone behaved in the same way. Other challenges for conducting and interpreting research with this population are reviewed elsewhere (Tompkins, 1995; Tompkins, Fassbinder, Lehman-Blake, & Baumgaertner, 2002).

Mental Structures in Discourse Comprehension

The term discourse can refer to any language unit that is longer than a single sentence. Like most of the research on discourse comprehension, the information below focuses on narrative discourse, or stories.

According to influential psycholinguistic frameworks (e.g., Gernsbacher, 1990, 1995; Kintsch, 1998; van Dijk & Kintsch, 1983), we create several, increasingly more elaborated mental structures (or representations) as we comprehend a narrative. For example, after a verbatim (or surface structure) representation of the story, our semantic analysis is represented in the text base. In the text base, the sentences, "Joanna kissed Kevin" and "Kevin was kissed by Joanna," are represented identically, because they mean the same thing. The text base also represents simple bridging inferences that connect consecutive clauses or sentences. Consider how we comprehend the sentence, "Wini reached for the sponge and dabbed at the coffee stain before it set." The sentence tells us that there is a coffee stain, but there is no explicit mention of coffee spilling. We are able to bridge this gap quickly, by inferring that such a spill occurred.

At the highest level of narrative representation, the situation model (sometimes called the mental model) represents what a story is about (e.g., Zwaan & Radvansky, 1998). It represents elements such as the protagonist's goal, the timeline, and the spatial framework, and draws on our background knowledge and other contextual cues. For example, given our knowledge about how difficult it can be to remove coffee stains, our comprehension systems might generate and include in the situation model a predictive inference about what would happen next, e.g., that Wini would keep working on the stain for a while. Comprehension would proceed undisturbed if the story continued in this manner. Our comprehension systems are also able to represent a revision of our expectations at this level. For example, Wini's goal might change suddenly if she hears her child scream in pain. Or the story might take us to a different point in time and/or a different place, when Wini is doing laundry and treating the stain with a stain remover. In any such case, we revise our situation model to fit the current circumstances of the story.

Pragmatic interpretation and social aspects of language processing, that are so relevant for adults with RHD, were not originally addressed by these text comprehension frameworks. However, these aspects can be considered as special cases of the construction of a situation model (Ferstl, 2007).

Discourse Structure Building Deficits

Adults with RHD may do quite well when a discourse unit is consistent, either internally and/or with other aspects of context (see Tompkins et al., 2002). For example, it may be quite easy for these individuals to process a text in which a character's mood and statements are congruent (e.g., a character wins the lottery and says it's been a fantastic day). But when the language input contains or triggers some incongruity (e.g., a character has an awful day, but says – sarcastically or ironically – that it's been a fantastic day), adults with RHD may have difficulty bringing the pieces together to build a coherent mental model of the input. Along the same lines, these individuals may have trouble comprehending expressions that can be taken both literally and figuratively (e.g., the potential direct vs. indirect requests conveyed by a question like "Are you able to see that house number?;" Weylman, Brownell, Roman & Gardner, 1989). Jokes that hinge on unexpected elements similarly may present a comprehension challenge (e.g., when the neighborhood borrower asks Mr. Smith to borrow a lawnmower, Mr. Smith deflects the request by saying he is using the lawnmower. Then in a surprising turn, the borrower says he'll just borrow Mr. Smith's golf clubs since Mr. Smith won't be using them; Brownell, Michel, Powelson, & Gardner, 1983). And other kinds of input that require an initial interpretation to be revised may be difficult for adults with RHD, as well (e.g., a character is described as being tired of a history book. We infer that he has been reading the book – until we learn that he is in the process of writing it; Brownell, Potter, Bihrle & Gardner, 1986).

Cognitive Resource Factors and Comprehension Difficulty

Adults with RHD have more trouble interpreting texts with conflicting elements like these when the attentional demands of the task are high (see Tompkins & Lehman, 1998, for summary) and/or when working memory resources are low (e.g., Tompkins, Bloise, Timko & Baumgaertner, 1994). “Attentional demands” here refers to the total amount of “mental fuel” we need to perform all of the processes that a task involves, including language comprehension processes. “Working memory capacity” refers to our ability to simultaneously process and store information during comprehension (Just & Carpenter, 1992). Our attentional or working memory resources are limited in capacity, and when overtaxed, comprehension difficulty can occur, even for people without brain damage. Thus, resource factors should be considered in any account of comprehension deficits.

What, beyond attentional or working memory demands, might account for such deficits in comprehension? To address this question some further background information is necessary.

Multiple Phases of Comprehension

Major accounts of comprehension propose multiple processing phases (e.g., Gernsbacher, 1990, [1995]; Kintsch, 1998; van Dijk & Kintsch, 1983). The initial phase, called the Construction phase by Kintsch and colleagues, involves highly automatic, context-independent processes. In this phase, incoming words trigger background knowledge and activate concepts that are independent of – and may have nothing to do with – the broader context of what we are listening to or reading. Consider a sentence like “He saw spiders and roaches and many other bugs in the room.” Although counterintuitive, we are briefly ready to interpret “bugs” to mean either ‘”insects”or “spying devices,” independent of the clear reference to insects (Swinney, 1979). This context-independent activation also occurs when we encounter words like ‘apple,’ that are not obviously ambiguous. Our brains are ready to process a number of properties of apples – for example, that they may be crunchy, or even rotten, perhaps (Atchley, Burgess, & Keeney, 1999). Thus, the Construction phase prepares us to make various interpretations of language input.

The second phase of such accounts, dubbed the “Integration” phase by Kintsch and colleagues (Kintsch, 1998; van Dijk & Kintsch, 1983), is context-dependent. In this phase, aspects of context are brought to bear on our emerging interpretations. Among the processes that occur in this phase are the bridging inference and inference revision processes exemplified above, that help to combine incoming text with prior text information and with what we know about the world. Or, as another example, think back to Wini, the sponge, and the coffee stain. If “Wini’” were replaced by “the surgeon,” our background knowledge about surgeons reaching for sponges would trigger a surgical scenario as an interpretive framework. Once the coffee stain was mentioned, however, context-dependent revision processes would be needed to override that initial interpretive “surgical” mindset. Other kinds of inferences, such as theory of mind (TOM) inferences, may occur in this stage as well. Reasoning from a TOM involves making inferences about the thoughts, beliefs, intentions, and actions of another person. TOM and social inferences will be discussed more in a bit.

A more general mechanism in this context-dependent Integration phase is suppression (Gernsbacher, 1990; 1995), that prunes away contextually-irrelevant concepts like the ‘spying devices’ meaning of “bugs” or the operating room scenario in the case of a surgeon and the coffee stain. With the possible exception of simple bridging inferences (McKoon & Ratcliff, 1992), most processes in the Integration phase require us to devote some of our attentional processing resources.

The notion of a two-phase model—broad initial activation with later pruning and refining—has been generalized to cognitive realms other than language (Kintsch, 1998). However, there is a dispute over how much context-insensitive processing occurs in language comprehension, and in what conditions (e.g., Nieuwland & van Berkum, 2006; Otten & van Berkum, 2007). There is also still much to learn about when and how these phases of comprehension interact.

Construction and Integration Deficits

The Construction Phase of Comprehension

One prominent theory about the Construction phase of comprehension is that word processing engenders differences in semantic activation in the two brain hemispheres (e.g., Beeman, 1993; Beeman, Friedman, Grafman, Perez, Diamond, & Lindsay, 1994; Jung-Beeman, 2005). The intact right hemisphere (RH) is proposed to "coarsely code'" linguistic input. This means that the RH (superior temporal and inferior parietal regions; Jung-Beeman, 2005) activates extensive semantic fields of words, including distantly-related, peripheral meanings and features (Chiarello, Liu, Shears, Quan, & Kacinik, 2003; Coulson & Williams, 2005; Faust & Lavidor, 2003) that may not be activated in the left hemisphere. Consider again the word "apple." The RH, but not the left, activates and sustains distant semantic features such as "rotten" (Atchley et al., 1999), that are incompatible with our dominant image of an apple but that could be highly relevant in some situations. Thus, coarse coding provides input that may be important for updating and revising interpretations in the Integration phase of comprehension (see also Faust, Barak, & Chiarello, 2006). Coarse coding also has been proposed to underpin our ability to derive figurative meanings (Beeman et al., 1994) and draw inferences that depend on remote but overlapping semantic fields (Beeman, 1993, Beeman, Bowden, & Gernsbacher, 2000). For instance, understanding a metaphor such as "Her skin is silk'" requires us to disregard the central or dominant aspect of the concept "silk'"—its membership in the category of fabrics—and highlight a quality that is relatively peripheral—its smoothness.

Adults with RHD can have problems in each of these areas, which has led some to propose that typical RHD comprehension difficulties reflect a coarse coding deficit (Beeman, 1993; Brownell, 2000; McDonald et al., 2005). A coarse coding deficit was recently documented for a group of adults with RHD (Tompkins, Fassbinder, Scharp, & Meigh, 2008). A few prior studies found no evidence of coarse coding impairment (Klepousniotou & Baum, 2005; Tompkins, Baumgaertner, Lehman, & Fassbinder, 2000), but the semantic distance (Maki, McKinley, & Thompson, 2004) between concepts in those studies may not have been sufficient to detect a coarse coding deficit.

Semantic distance reflects the relatedness, or meaning overlap, of concepts. Returning to the concept "apple," the feature "crunchy'" is quantifiably closer to, or more overlapping with, the dominant sense of "apple" than is "rotten." In Tompkins, Fassbinder and colleagues (2008), a control group of adults without brain damage activated both types of these semantic features, but adults with RHD only activated the more closely related features like "crunchy." Most individuals (60%) with the most obvious coarse coding deficits had lesions that involved right inferior parietal tissue, but there were too few cases to draw firm conclusions about feature activation and site of lesion.

Overall, the results of Tompkins, Fassbinder, and colleagues (2008) lead to the suggestion that a coarse coding deficit may occur for sufficiently remote features or meanings of words. We are currently evaluating the hypothesis that a reported selective deficit in processing metaphoric word meanings (e.g., "famous" for "star;" Klepousniotou and Baum, 2005), may rather be a special case of a coarse coding deficit. We calculated semantic distances for the metaphoric stimuli in this latter report, and found them to be similar to those for stimuli like “apple – rotten.”

Another study documented a variation of the postulated link between coarse coding and discourse comprehension in RHD. In this study, adults with RHD who were poor at sustaining activation for particularly distant semantic features of nouns (e.g., “rotten” for “apple”) were also relatively poor comprehenders of implied information from narratives (Tompkins, Scharp, Meigh, & Fassbinder, 2008).

To better understand comprehension in adults with RHD, we will need to know much more about whether and under what circumstances they might have a coarse coding deficit. One recent challenge to the RH–coarse coding account is that interpretations that depend on distant semantic relations can be kept active in the left hemisphere when strongly invited by context (Coulson & Severens, 2007). We also need to learn what types of comprehension processes might be affected by a coarse coding deficit.

There are many potential clinical treatments for someone with a coarse coding deficit, such as asking clients with RHD to generate or identify alternative, especially remote, meanings of words or phrases (see Blake, 2007, for additional examples). Clinicians must be cautious about using such treatments based on the mere presumption of a coarse coding deficit. These treatments may be counterproductive for clients whose discourse comprehension problems have a different basis, such as a difficulty suppressing contextually incompatible interpretations (e.g., Tompkins & Baumgaertner, 1998).

The Integration Phase of Comprehension

In this later phase of processing, both strengths and multiple possible impairments have been identified for adults with RHD. As indicated below, some of the impairments are fairly specific, such as a difficulty generating certain kinds of inferences. Other deficits apply across domains, such as the suppression deficit hypothesis. The bottom line is that adults with RHD may have trouble synthesizing information and selecting from competing possibilities, especially when task demands are high and working memory resources are low (see Tompkins et al., 2002, for review).

Bridging inferences—One study describes a deficit in drawing simple bridging inferences to connect parts of a story (Beeman, 1993). An example concerns a character, who left the bathtub running and later began to mop up the mess on the bathroom floor. This leads us to infer that the bathtub must have overflowed. In this study, however, basic bridging inference processes were confounded by other memory and text integration requirements. With simplified stimuli and a reduction in task processing demands, adults with RHD drew similar bridging inferences without difficulty (Tompkins, Fassbinder, Lehman-Blake, Baumgaertner, & Jayaram, 2004). Bridging inferences that require a revision of an initial inference (e.g., the surgeon, sponge, and coffee stain) may be more problematic (Brownell et al., 1986), particularly for individuals with low working memory capacity for language (Tompkins et al., 1994).

Predictive inferences—A predictive inference (e.g., if you drop an egg, it will break) will facilitate comprehension when the prediction is upheld, but when not upheld (e.g., the egg was made of plastic), a prediction can create comprehension difficulty (Garrod, O’Brien, Morris, & Rayner, 1990; O’Brien, Shank, Myers & Rayner, 1988). Predictive inferences are not always drawn, even by young adults, but strong contextual support facilitates predictive inferencing. Blake’s work shows that adults with RHD can draw predictive inferences in supportive contexts (Blake & Lesniewicz, 2005; Lehman-Blake & Tompkins, 2001).

TOM and other social inferences—Some aspects of TOM inferencing have been reported to cause particular difficulty for adults with RHD (Happé, Brownell, & Winner, 1999; Winner, Brownell, Happé, Blum, & Pincus, 1998). As a reminder, TOM inferences are those that we make about the thoughts, beliefs, intentions, and actions of another person. We can easily infer that someone is being polite if they tell a "white lie'" (e.g., I love your new hat!). Other examples of TOM inferences include deciding when someone is probably bluffing (e.g., an older brother, who we know is a big tease, taunts a younger sibling about where to find a missing possession), or joking to make light of a minor transgression when confronted about it (e.g., as someone caught cheating on his diet might do).

Yet comparisons between TOM and non-TOM inferences have not always been well-controlled for difficulty. For example, the TOM narratives in one influential study (Happé et al., 1999) contained more characters and, thus, more characters' perspectives to consider than did the narratives that assessed non-TOM inferences. With these factors controlled, adults with RHD did not demonstrate any specific deficit in drawing inferences about a character's knowledge, beliefs, or intentions (Tompkins, Scharp, Fassbinder, & Meigh, 2008).

Brownell and colleagues (e.g., Brownell & Martino, 1998) emphasize that potential social inferencing deficits extend beyond TOM to include, for example, a tendency of adults with RHD to prefer protagonist-external reasons for story elements (e.g., someone can't find a file because he was given too much work to do) over character-internal attributions (e.g., because he is messy). Such tasks again involve stimuli with multifaceted and sometimes conflicting components, so it is hard to distinguish this kind of social attribution account from a more general difficulty with complex inference and discourse integration processes.

Suppression function—In many conditions, adults with RHD activate multiple meanings of words (Tompkins et al., 2000; Klepousniotou & Baum, 2005) and generate multiple potential inferences (Blake & Lesniewicz, 2005; Tompkins, Lehman-Blake, Baumgaertner, & Fassbinder, 2001; Tompkins et al., 2004). These same individuals, however, may be slower to suppress interpretations that become contextually-irrelevant (Klepousniotou & Baum, 2005; Tompkins et al., 2000, 2004), such as the "spying devices" meaning of the word "bug" in the sentence above that referred to various insects. My studies show that clients who are slower to suppress contextually-irrelevant interpretations have more difficulty on a general measure of discourse comprehension, even after accounting for their vocabulary knowledge, working memory capacity, and age. So far, the RH anatomical correlates of suppression deficit are elusive. Suppression deficit co-occurs with lesions that affect the inferior frontal gyrus and connected subcortical structures (Tompkins, Scharp, Gibbs Scott, & Meigh, in preparation), but not everyone with a suppression deficit has this lesion profile, and the evidence remains limited.

Again, a number of treatments have been proposed for a suppression deficit (see, e.g., Blake, 2007; Tompkins, & Baumgaertner, 1998; Tompkins et al., 2000). Instead of having clients work on generating alternative interpretations, treatment should focus on helping them select the appropriate interpretation from those they already have active. In most cases this involves highlighting and working with specific features of linguistic and extralinguistic context that point to the appropriate interpretation.

It is important to note that the coarse coding and suppression deficit accounts of RHD language comprehension have been presented as competing possibilities, even by my lab group. But as indicated previously, a coarse coding deficit may be evident only for particularly remote semantic relations. A suppression deficit has been detected with closer semantic relations, so the deficits are not necessarily mutually exclusive, and could occur in the same individual. This is also compatible with the theoretical view that coarse coding and suppression processes operate in different phases of comprehension.

Issues with Potential Future Relevance

Contextual Constraint in Comprehension

In several places above I have alluded to the ways in which contextual support can influence comprehension. A major debate in relation to two-phase comprehension frameworks is whether highly constrained contexts can preclude or override the initial, context-independent phase (e.g., the “spying devices” meaning of the word “bugs”). Some evidence suggests that this can occur (Coulson & Severens, 2007; Nieuwland & van Berkum, 2006; Otten & van Berkum, 2007), although the precise timing of contextual influence remains in question.

Contextual constraint refers to how strongly a context suggests a single interpretation. This is a difficult concept to define (e.g., Swinney, 1991), just as “context” is difficult to define. High constraint contexts are characterized by high agreement on judgments such as what caused a particular event (Virtue, Haberman, Clancy, Parrish, & Beeman, 2006) or what word completes a sentence fragment (e.g., “You sleep on a ____”). Constraint can also arise from broader contextual variables. The fragment, “She talked about ____,” can become very highly constrained in the presence of other contextual factors, such as the utterances that precede it, the familiarity of people conversing together, the surrounding physical environment, and/or the presence of co-verbal gestures. Little is known yet about the processing influences of contextual factors other than the linguistic context, so there is much to learn.

One challenge for any work on contextual bias is to determine what makes a context “sufficiently constraining.” Further investigation of contextual constraint may have great potential relevance for developing language treatment approaches for adults with RHD, by suggesting how and when to manipulate various aspects of context to influence performance.

Continuity of Literal and Nonliteral Language Processing

The notion that RHD affects nonliteral language comprehension is firmly entrenched. A variety of evidence, however, suggests that literal and nonliteral language are processed in similar ways (e.g., Pynte, Besson, Robichon, & Poli, 1996; Coulson & van Petten, 2002; also, our lab’s hypothesis about metaphor processing impairment as a special case of coarse coding deficit). As future research uncovers more of the specific processing difficulties that may occur in interpreting figurative language, it may be more useful clinically to focus on those processes rather than on the simple fact that a stimulus has a nonliteral interpretation. To exemplify, let us return to the metaphor “Her skin is silk.” Comprehension difficulty may have little to do with this statement’s metaphoricity, and rather may reflect a coarse coding deficit for a peripheral feature of the word ‘silk’ (its smoothness). If so, treatment could focus on coarse coding deficits (for peripheral semantic features) in either or both literally-and non-literally intended stimuli. In addition, treatment effects for either type of stimuli might be projected to generalize to the other. Such intriguing possibilities await future test.

Acknowledgments

Connie A. Tompkins is a professor in Communication Science and Disorders and the Center for the Neural Basis of Cognition at the University of Pittsburgh. An ASHA Fellow and recipient of the Honors of the Academy of Neurologic Communication Disorders and Sciences, Dr. Tompkins has over 100 publications, including her influential book, Right Hemisphere Communication Disorders: Theory and Management. Her research on right hemisphere communication and cognition has been supported by the National Institutes of Health since 1988.

References

Atchley RA, Burgess C, Keeney M. The effect of time course and context on the facilitation of semantic features in the cerebral hemispheres. Neuropsychology 1999;13:389–403. [PubMed: 10447300]

Beeman M. Semantic processing in the right hemisphere may contribute to drawing inferences from discourse. Brain and Language 1993;44:80–120. [PubMed: 8467379]

Beeman M, Bowden EM, Gernsbacher MA. Right and left hemisphere cooperation for drawing predictive and coherence inferences during normal story comprehension. Brain and Language 2000;71:310–336. [PubMed: 10716864]

Beeman M, Friedman RB, Grafman J, Perez E, Diamond S, Lindsay MB. Summation priming and coarse semantic coding in the right hemisphere. Journal of Cognitive Neuroscience 1994;6:26–45.

Blake ML. Perspectives on treatment for communication deficits associated with right hemisphere brain damage. American Journal of Speech-Language Pathology 2007;16:331–342. [PubMed: 17971493]

Blake ML, Lesniewicz KS. Contextual bias and predictive inferencing in adults with and without right hemisphere brain damage. Aphasiology 2005;19(3–5):423–434.

Brownell, H. Right hemisphere contributions to understanding lexical connotation and metaphor. In: Grodzinsky, Y.; Shapiro, L.; Swinney, D., editors. Language and the brain: Representation and processing. San Diego: Academic Press; 2000. p. 185-201.

Brownell, HH.; Martino, G. Deficits in inference and social cognition: The effects of right hemisphere brain damage on discourse. In: Beeman, M.; Chiarello, C., editors. Right hemisphere language comprehension: Perspectives from cognitive neuroscience. Mahwah, NJ: Lawrence Erlbaum Associates; 1998. p. 309-328.

Brownell HH, Michel D, Powelson J, Gardner H. Surprise but not coherence: Sensitivity to verbal humor in right-hemisphere patients. Brain and Language 1983;18:20–27. [PubMed: 6839130]

Brownell HH, Potter HH, Bihrle AM, Gardner H. Inference deficits in right brain-damaged patients. Brain and Language 1986;27:310–321. [PubMed: 3955344]

Chiarello C, Liu S, Shears C, Quan N, Kacinik N. Priming of strong semantic relations in the left and right visual fields: A time course investigation. Neuropsychologia 2003;41:721–732. [PubMed: 12591029]

Coulson S, Severens E. Hemispheric asymmetry and pun comprehension: When cowboys have sore calves. Brain and Language 2007;100:172–187. [PubMed: 16199084]

Coulson S, van Petten C. Conceptual integration and metaphor: An event-related potential study. Memory & Cognition 2002;30(6):958–968.

Coulson S, Williams RF. Hemispheric differences and joke comprehension. Neuropsychologia 2005;43:128–141. [PubMed: 15488912]

Faust M, Lavidor M. Semantically convergent and semantically divergent priming in the cerebral hemispheres: Lexical decision and semantic judgment. Cognitive Brain Research 2003;17:585–597. [PubMed: 14561447]

Faust M, Barak O, Chiarello C. The effects of multiple script priming on word recognition by the two cerebral hemispheres: Implications for discourse processing. Brain and Language 2006;99(3):247–257. [PubMed: 16099024]

Ferstl, E. The functional neuroanatomy of text comprehension: What's the story so far?. In: Schmalhofer, F.; Perfetti, C., editors. Higher level language processes in the brain: Inference and comprehension processes. Mahwah, NJ: Lawrence Erlbaum Associates; 2007. p. 53-102.

Garrod SC, O'Brien EJ, Morris RK, Rayner K. Elaborative inferencing as an active or passive process. Journal of Experimental Psychology: Learning, Memory, and Cognition 1990;16:250–257.

Gernsbacher, M. The structure building framework: What it is, what it might also be, and why. In: Britton, BK.; Graesser, AC., editors. Models of text understanding. Hillsdale, NJ: Lawrence Erlbaum Associates; 1995. p. 289-311.

Gernsbacher, MA. Language comprehension as structure building. Hillsdale, NJ: Erlbaum; 1990.

Happé FGE, Brownell HH, Winner E. Acquired "theory of mind" impairments following stroke. Cognition 1999;70:211–240. [PubMed: 10384736]

Jung-Beeman M. Bilateral brain processes for comprehending natural language. Trends in Cognitive Sciences 2005;9(11):512–518. [PubMed: 16214387]

Just MA, Carpenter PA. A capacity theory of comprehension: Individual differences in working memory. Psychological Review 1992;99:122–149. [PubMed: 1546114]

Kintsch, W. Comprehension: A paradigm for cognition. Vol. xvi. New York: US: Cambridge University Press; 1998.

Klepousniotou E, Baum SR. Processing homonymy and polysemy: Effects of sentential context and time-course following unilateral brain damage. Brain and Language 2005;95:365–382. [PubMed: 16298667]

Lehman-Blake MT, Tompkins CA. Predictive inferencing in adults with right hemisphere brain damage. Journal of Speech, Language, and Hearing Research 2001;44:639–654.

Maki WS, McKinley LN, Thompson AG. Semantic distance norms computed from an electronic dictionary (WordNet). Behavior Research Methods, Instruments, & Computers 2004;36(3):421–431.

McDonald CR, Bauer RM, Filoteo JV, Grande L, Roper SN, Buchanan RJ, et al. Semantic priming in patients with right frontal lesions. Journal of the International Neuropsychological Society 2005;11:132–143. [PubMed: 15962701]

McKoon G, Ratcliff R. Inference during reading. Psychological Review 1992;99:440–466. [PubMed: 1502273]

Nieuwland MS, van Berkum JJA. When peanuts fall in love: N400 evidence for the power of discourse. Journal of Cognitive Neuroscience 2006;18(7):1098–1111. [PubMed: 16839284]

O'Brien EJ, Shank DM, Myers JL, Rayner K. Elaborative inferences during reading: Do they occur on-line? Journal of Experimental Psychology: Learning, Memory, and Cognition 1988;14:410–420.

Otten M, van Berkum JJA. What makes a discourse constraining? Comparing the effects of discourse message and scenario fit on the discourse-dependent N400 effect. Brain Research 2007;153:166–177. [PubMed: 17466281]

Pynte J, Besson M, Robichon F, Poli J. The time-course of metaphor comprehension: An event-related potential study. Brain & Language 1996;55:293–316. [PubMed: 8954602]

Swinney DA. Lexical access during sentence comprehension: (Re)consideration of context effects. Journal of Verbal Learning and Verbal Behavior 1979;18:645–659.

Swinney, DA. The resolution of indeterminacy during language comprehension: Perspectives on modularity in lexical, structural, and pragmatic processes. In: Simpson, GB., editor. Understanding word and sentence. North-Holland: Elsevier Science Publishers; 1991. p. 367-385.

Tompkins, CA. Right hemisphere communication disorders: Theory and management. San Diego: Singular Publishing; 1995.

Tompkins CA, Baumgaertner A. Clinical value of online measures for adults with right hemisphere brain damage. American Journal of Speech-Language Pathology 1998;7:68–74.

Tompkins CA, Baumgaertner A, Lehman MT, Fassbinder W. Mechanisms of discourse comprehension impairment after right hemisphere brain damage: Suppression in lexical ambiguity resolution. Journal of Speech, Language, and Hearing Research 2000;43:62–78.

Tompkins CA, Bloise CGR, Timko ML, Baumgaertner A. Working memory and inference revision in brain-damaged and normally aging adults. Journal of Speech and Hearing Research 1994;37:896–912. [PubMed: 7967574]

Tompkins, CA.; Fassbinder, W.; Lehman-Blake, MT.; Baumgaertner, A. The nature and implications of right hemisphere language disorders: Issues in search of answers. In: Hillis, A., editor. Handbook of adult language disorders: Integrating cognitive neuropsychology, neurology, and rehabilitation. New York: Psychology Press; 2002. p. 429-448.

Tompkins CA, Fassbinder W, Lehman-Blake M, Baumgaertner A, Jayaram N. Inference generation during text comprehension by adults with right hemisphere brain damage: activation failure versus multiple activation. Journal of Speech, Language, and Hearing Research 2004;47(6):1380–1395.

Tompkins CA, Fassbinder W, Scharp VL, Meigh KM. Activation and maintenance of peripheral semantic features of unambiguous words after right hemisphere brain damage in adults. Aphasiology 2008;22 (2):119–138. [PubMed: 20011607]

Tompkins CA, Lehman MT. Interpreting intended meanings after right hemisphere brain damage: An analysis of evidence, potential accounts, and clinical implications. Topics in Stroke Rehabilitation 1998;5:29–47.

Tompkins CA, Lehman-Blake MT, Baumgaertner A, Fassbinder W. Mechanisms of discourse comprehension impairment after right hemisphere brain damage: Suppression in inferential ambiguity resolution. Journal of Speech, Language, and Hearing Research 2001;44:400–415.

Tompkins CA, Scharp VL, Fassbinder W, Meigh KM, Armstrong EM. A different story on “Theory of Mind” deficit in adults with right hemisphere brain damage. Aphasiology 2008;22(1):42–61.

Tompkins CA, Scharp VL, Gibbs Scott A, Meigh KM. Suppression in polarized ambiguity processing after right hemisphere brain damage. (in preparation).

Tompkins CA, Scharp VL, Meigh KM, Fassbinder W. Coarse coding and discourse comprehension in adults with right hemisphere brain damage. Aphasiology 2008;22(2):204–223.

van Dijk, TA.; Kintsch, W. Strategies of discourse comprehension. New York: Academic Press; 1983.

Virtue S, Haberman J, Clancy Z, Parrish T, Beeman MJ. Neural activity of inferences during story comprehension. Brain Research 2006;1084:104–114. [PubMed: 16574079]

Weylman S, Brownell HH, Roman M, Gardner H. Appreciation of indirect requests by left- and right-brain-damaged patients: The effects of verbal context and conventionality of wording. Brain and Language 1989;36:580–591. [PubMed: 2470462]

Winner E, Brownell HH, Happé F, Blum A, Pincus D. Distinguishing lies from jokes: Theory of mind deficits and discourse interpretation in right hemisphere brain-damaged patients. Brain and Language 1998;62:89–106. [PubMed: 9570881]

Zwaan RA, Radvansky GA. Situation models in language comprehension and memory. Psychological Bulletin 1998;123(2):162–185. [PubMed: 9522683]