From Schema-Based Information to Situation Models : How Can We Bridge Theories of Comprehension and Practice?

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How Can We Bridge Theories of Comprehension and Practice?

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Abstract:

Building on previous research regarding how the schema theory has been incorporated into L2 reading research in relation to how language proficiency plays a role in activating appropriate schemata, this paper compares and contrasts the schema-based approach to reading comprehension with that of alternative comprehension models that emphasize situation models as the central construct. The situation model theory of reading comprehension is applicable to an L2 literacy instruction. Text comprehension research shows that L2 readers' weaker lexical and syntactic representations in the target language affect understanding of text at varied comprehension levels. In terms of practical applications of the situation model theory, the authors discuss how teachers can engage L2 learners in pre-reading, during reading, and post-reading activities using different comprehension models. Accommodations such as this should allow the teachers to assist their students to compensate for their rather limited linguistic knowledge in their L2.

Key Words: *situation model, reading comprehension, linguistic threshold hypothesis, metacognitive processing*

Introduction

Throughout the past four decades, comprehension theories have evolved. In the 1970s and the 1980s, schema theory was a hot topic among cognitive psychologists (Alba & Hasher, 1983; Bransford & Johnson, 1972; Brewer & Nakamura, 1984; Dooling & Lachman, 1971; Minsky, 1975; Rumelhart & Ortony, 1977; Schank & Abelson, 1977) and reading researchers (Anderson & Pearson, 1984; Carrell, 1981, 1983, 1984, 1987; Pearson, 2005). According to Rumelhart (1980), schema theory is: "A theory about how knowledge is represented and about how that representation facilitates the use of the knowledge in particular ways. According to schema theories, all knowledge is packaged into units. These units are the schemata" (p. 34). Carroll (2008) describes a schema as a stored framework or expected arrangement of a body of knowledge about some topic. Many researchers found the activation of appropriate schemata to be a significant aspect of reading comprehension due to its relevance to the processing of new information using what is already known. Schemata theory has certainly provided insights into the knowledge structures used in learning, especially in reading comprehension (Nassaji, 2007).

By the late 1980s, the constructionist/constructivist (the two are essentially synonymous) view of

reading comprehension became more dominant, referring to the reader constructing text representations and emphasizing the ongoing interaction between readers and texts in the construction of coherent meaning while reading (Pearson & Hamm, 2005). To constructionists such as Clark, Graesser, Kintsch, McNamara, Radvansky, Singer, Trabasso, van Dijk, and Zwaan, the role of schema-based information seemed rather limited. According to Kintsch (2007), the concept of schemata "proved to be difficult because a fixed schematic structure had to be imposed on the contextually variable, fluid events that humans actually experience" (p. 37). In other words, due to the flexible and context-sensitive nature of discourse comprehension, it is hard to model the reading process with fixed structures such as schemata (Grabe, 2009). This is where a situation model (the highest level of representation after the surface level and propositional textbase representations), or "the cognitive representation of the events, actions, persons, and in general the situation, a text is about" (van Dijk & Kintsch, 1983, pp. 11-12), becomes an alternative theory of comprehension.

Graesser and Clark (1985) also pointed out that schemata lack domain-specific knowledge or general knowledge structures, including animate beings, inanimate concrete entities, abstract concepts, cause-oriented event structures, and goal-oriented activities. These researchers found relationships between such general knowledge structures and readers' inference generation, especially with regard to how goal and causal information was activated via *how* and *why* questions. The situation model theory was framed by Kintsch (1988) into the construction-integration (CI) model, a general model of discourse processing that consists of two phases: construction and integration. Building on Kintsch's work, Graesser, Singer, and Trabasso (1994) created the constructionist model, a framework focused on reader goal, coherence, and explanation. This model, in turn, was further developed by Zwaan, Langston, and Graesser (1995) and Zwaan and Radvansky (1998), as in their event-indexing model, which "assumes that situational coherence can be established along multiple dimensions of continuity" (McNamara & Magliano, 2009, p. 321).

This article will explore how the situation model is applicable to L2 readers by comparing and contrasting multiple reading comprehension models. As L2 readers have weaker lexical and syntactic representations in the target language, it is possible that they may be limited to understanding text at the surface level or the propositional textbase level. Additionally, this study will demonstrate how engaging L2 learners in varied reading activities through different comprehension models helps them compensate for a lack of linguistic knowledge in their L2.

Schema-based Information and Language Proficiency

Brewer (1987) compared schemata and mental models in terms of memory representations. He defined schemata as "precompiled generic knowledge structures" and mental models as "specific knowledge structures that are constructed to represent a new situation through the generic knowledge of space, time, causality, and human intentionality" (p. 188). The former is stored in long-term memory, whereas the latter is constructed at the time of input (Brewer, 2003). Mental models also align with the mental representations proposed by van Dijik and Kintsch (1983) that are referred to as situation models. Situation model representations include "state of affairs that a text refer to" (Carroll, 2008, p. 172), spatial layouts, causal relationships, and bodies of knowledge (schemata).

Pearson and Hamm (2005) provided a much broader definition of schemata by making an analogy

between schemata and containers in which readers hold within themselves particular experiences and ideas (e.g., restaurant schema). Having a restaurant schema based on our experiential knowledge allows us to understand who seats customers, takes orders, delivers food, and receives the tip, as we read a passage about dining at a restaurant. Similarly, our background knowledge influences how we interpret what we read. Consider the following ambiguous passage:

> The procedure is actually quite simple. First, you arrange the items into different groups. Of course one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities that is the next step; otherwise, you are pretty well set. It is important not to overdo things. That is, it is better to do too few things at once than too many. In the short run this may not seem important but complications can easily arise. A mistake can be expensive as well. At first, the whole procedure will seem complicated. Soon, however, it will become just another fact of life. It is difficult to foresee any end to the necessity for this task in the immediate future, but then, one never can tell. After the procedure is completed one arranges the materials into different groups again. Then they can be put into their appropriate places. Eventually they will be used once more and the whole cycle will then have to be repeated. However, that is part of life. (Bransford & Johnson, 1972, as cited in Anderson & Pearson, 1984, p. 270).

Bransford and Johnson (1972) investigated how comprehenders recognized ambiguous terms such as "somewhere else" in the passage to be laundromat and found that those who were given the title, "Washing Clothes," were able to activate their laundry schema, as opposed to those who were not. The same goes with "cycle" to be interpreted as "washing cycle." Thus, the schema theory stresses knowledge-based or top-down processing, which refers to making use of the information at the highest levels to process language at the lowest levels, such as guessing the meaning of a word from the context in reading (Carroll, 2008). Bottom-up processing, on the other hand, makes use of information at the lowest level (e.g., phonemes, letters, words, syntax) to perform the highest level of processing. Although readers need to use both syntax and semantics to interpret the meaning of sentences, top-down processing aligns with the idea of relying on schemata to aid in comprehension (van Dijk & Kintsch, 1983).

In the case of L2 reading, research shows conflicting evidence of readers' overreliance on top-down processing to make sense of the meaning of the text that they are reading (Horiba, van den Broek, & Fletcher, 1993; Johnson, 1981; Steffensen, Joag-Dev, & Anderson, 1979) and on bottom-up processing due to their inability to utilize the knowledge structures effectively (Carrell, 1981, 1983; Nassaji, 2007). Carrell (1984) investigated underlying causes of such contradiction in L2 reading, finding that variation is likely due to schema availability, schema activation, and skill deficiencies. She found that L2 readers are more likely to stay at the textbase level due to (1) a lack of appropriate background knowledge, (2) an inability to activate background knowledge even if they have it because the text itself doesn't provide readers with cues to use background knowledge, and/or (3) a lack of linguistic knowledge. Thus, text-boundedness (i.e., readers' reliance on what is explicitly stated in a text) can occur for reasons related to both top-down processing (as in lack of background knowledge) and bottom-up processing (as in lack of linguistic knowledge).

Another set of noteworthy findings is that while earlier research demonstrated the effect of having

schematic knowledge on recall (Anderson, Reynolds, Schallert, & Goetz, 1977; Bransford & Johnson, 1972; Carrell, 1983), more recent research indicates that students must have intermediate language proficiency (in the language of the text) to be able to use appropriate knowledge of the topic to improve reading comprehension (Barry, 2000; Barry & Lazarte, 1995, 1998; McNeil, 2010). Barry and Lazarte (1995, 1998) analyzed how high-domain-knowledge and low-domain-knowledge readers performed on recall tasks. They found that having domain knowledge provided an advantage for high-knowledge readers. However, the complexity of sentence structures (i.e., more embedded clauses in a sentence) "seemed to cancel the advantage of previous exposure to the content domain" (Barry & Lazarte, 1995, p. 491). For domain knowledge to have a positive affect on readers' comprehension, they need to have intermediate proficiency in their L2, which enables them to process embedded clauses. If intermediate proficiency enables L2 readers to utilize appropriate schemata, then simply having students activate their prior knowledge is not sufficient to improve their reading comprehension, especially for those at the lower proficiency level.

In addition to the effect of language proficiency and background knowledge on reading comprehension, McNeil (2010) considered another variable—reading comprehension strategies (e.g., self-questioning). In this study involving university-level L2 learners who completed reading level three out of six of an intensive English program, McNeil found an overwhelmingly strong relationship between use of self-questioning and reading comprehension (this relationship accounted for 56.7% of the variance in reading comprehension scores), but not background knowledge. This study suggests that conscious actions of questioning and monitoring can outweigh the influence of existing domain knowledge (or the lack thereof) about what learners are reading.

Situation Model Theory and Metacognitive Strategies

The situation model theory assumes that comprehension requires the integration of textbase representations and activated prior knowledge, which is constantly updated by the ongoing situation. In order to achieve comprehension, readers need to take what the text literally says and connect it to their knowledge base, while constructing meanings through a situation model. How does the situation model theory apply to L2 reading? Regardless of linguistic differences between the L1 and the L2, native speakers and non-native speakers of the target language use the same semantics that are generated by their situation models.

Along with the situation model theory, various text comprehension researchers (Magliano & Millis, 2003; Magliano, Millis, Ozuru, & McNamara, 2007; McNamara, 2004; Trabasso & Magliano, 1996) have adapted metacognitive strategies to assess readers' cognitive processing during reading. Magliano and colleagues (1996, 2003, 2007) used think aloud/verbal protocols to assess how readers predicted what the text was about as well as their ability to make semantic associations with the texts. McNamara (2004) found the effectiveness of the self-explanation reading training or SERT (i.e., explaining aloud the meaning of information to themselves while reading) on reading comprehension over simply reading aloud, especially among students with low domain knowledge. Jiménez, Resko, Keyes, Puzio, Cole, and Rose (2011) also observed how bilingual self-talk facilitated student ownership of strategic interaction with the text. All of these findings indicate that the process of explaining textual meaning supports readers in filling knowledge gaps, resulting in increased comprehension. Thus, by having students attend to their cognitive processing (i.e., verbalizing what they understand about the text and drawing inferences) and metacognitve

processing (i.e., strategic use of cognition to monitor their own learning process), teachers can help them integrate the information stated in the text with the mental representation created in readers' mind (O'Malley, Chamot, Stewner-Mazanares, Russo, & Kupper, 1985).

The next section of this paper will explore ways in which teachers can engage L2 learners in a set of activities, namely pre-reading, during reading, and post-reading activities. The authors utilize both schema-based information and situation models within the context of the constructionist model/event-indexing model, due to its emphasis on comprehension strategies. Strategies do not play a prominent role in the previously mentioned CI model (Grasser, 2007).

Pre-Reading, During Reading, and Post-Reading Activities

Pre-reading Activities   Previewing, a widely practiced teaching method that allows students to "formulate hypotheses about the text," is directly related to the schema-based (top-down) theory of reading comprehension (Ajudeh, 2003, p. 8). Teachers may encourage their students to rely on top-down information such as titles, headings, and illustrations to predict the content of the text, while simultaneously activating their knowledge of the world. However, the theoretical construct of background knowledge relates to not just activating prior knowledge but organizing it (van Dijik & Kintsch, 1983). For example, semantic mapping or brainstorming is based on the idea of activating students' prior knowledge on the reading topic. After having students freely share their prior knowledge on a particular topic, the teacher typically categorizes each contribution into a concept, which can be stretched into additional subcategories. By engaging students in making semantic connections to use as retrieval cues, the teacher should help students build a knowledge structure about the topic that they are about to read. Brain research supports the idea that the more the "information is processed and stored in relational patterns" (i.e., relevant to the learners' lives and world), the more they can retrieve (Willis, 2006, p. 75). The student with additional assistance from the teacher should make the organizing efforts. Because the students' general knowledge is pre-existing and should be activated prior to reading, it makes sense to incorporate it into previewing as a pre-reading activity.

During Reading Activities   When reading a text, readers constantly update their comprehension according to each situation that they encounter. This is where the unfixed nature of situation models becomes beneficial. Because such mental representations are dynamic and ever-changing as the reader continues to read, the ongoing reading activity should occur simultaneously and allow readers to revise their situation models in order to construct a coherent understanding of the text. According to the previously mentioned event-indexing model proposed by Zwaan et al. (1995) and Zwaan and Radvansky (1998), readers keep track of different narrative dimensions such as time, space, cause/effect relationships, protagonist, and the protagonist's goal. Consider the following example:

> George got a peanut butter jar out of the cupboard and put it on the kitchen counter. He opened the jar and put the content on a butter knife. He carefully put a small amount of the peanut butter on a tip of a mousetrap.

Until readers come to the final sentence, they are likely to have created the situation model of George

(protagonist) making a peanut butter sandwich (goal) in the kitchen (space). Upon reading the final sentence, they immediately need to revise their understanding of George's goal to that of setting a mousetrap. As the above example illustrates, mapping new information onto existing information during reading requires that knowledge structures be coherent. When they become incoherent, readers need to build new situation models (e.g., setting a mousetrap). Because situation models are constructed at the time readers encounter events in the text, it makes sense to incorporate them into during reading activities.

Teaching methods that are directly related to the situation model theory of reading comprehension include questioning (Ajudeh, 2003; Carrell, 1998; McNeil, 2010) and self-explaining (McNamara, 2004). By having students create their own questions using cue cards containing *who*, *what*, *when*, *where*, *how*, and *why*, the teacher can support students' ability to attend to the key information needed to increase their comprehension. The teacher might also ask students to write or draw examples of who the protagonist is, what his/her goal is, when and where the action took place, how the goal was achieved, and why the action caused an outcome. However, teachers need to keep in mind that not all questions during reading lead to deeper levels of comprehension. Graesser (2007) and Magliano, Trabasso, and Graesser (1999) point out that *how* questions and *what happens next* questions seem to disrupt readers' processing and memory. However, to constructionists, explanations and why-questions are fundamental to the construction of meaning (Graesser, 2007).

Post-reading Activities   Post-reading activities such as multiple-choice questions and short answer questions have been conventionally used to assess reading comprehension in our school systems. However, Magliano et al. (2007) argued that students might already know the answers to such questions without relying on the information they obtain as a result of reading. Therefore, conventional tests using multiple-choice questions and short answer questions do not necessarily measure the depth of comprehension ability, which requires not only the information readers already know but also text input and cognitive processes (e.g., making connections between old and new information, drawing inferences).

As an alternative approach to assessing reading comprehension, Magliano and Millis (2003) have developed the Reading Strategy and Assessment Tool (R-SAT), which comprises verbal protocols along with think aloud protocols to "measure comprehension strategies associated with different standards of coherence" (Magliano et al., 2007, p. 121). Use of this assessment tool revealed that skilled readers were able to maintain global coherence by making connections with prior discourse, whereas less skilled readers talked about sentences in isolation. This finding provided evidence that underlying knowledge representations used by skilled readers were missing from less skilled readers' textbase representations.

To enhance students' coherent reading comprehension, a teacher should have students identify inconsistent/irrelevant lines in a short passage (Oakhill & Cain, 2007). Oakhill and Cain used inconsistency detection tasks, such as the one below, to assess children's ability to monitor their comprehension.

> Moles are small brown animals and they live underground using networks of tunnels. Moles cannot see very well, but their hearing and sense of smell are good. They sleep in underground nests lined with grass, leaves, and twigs. Moles use their front feet for digging and their short fur allows them to move along their tunnels either forwards or backwards. They mainly eat worms but they also eat insects and snails. Moles are easily able to find food for their young because their eyesight is so good.
>   ____ This passage makes sense, it does not need to be changed.

_____ This passage does not make sense, it needs to be changed. (p. 58)

When students underline the sentences that do not make sense, they can monitor how consistent each line is with the previous line(s). For example, the last sentence in this example is not consistent with the second sentence in terms of moles' eyesight. In fact, the two sentences provide contradictory information, which readers should be able to identify if they have the correct situation model. In addition to asking whether or not the passage makes sense, the teacher helps elicit students' critical thinking (i.e., Why, and in what ways, should the passage be changed?).

Teachers also should engage students in cognitive tasks such as completing graphic organizers with text information. Monitoring comprehension includes recognizing text structures (Grabe, 2009), and research indicates that the more the text information is represented in an organized manner along with linguistic cues to signal particular discourse patterns (e.g., cause-effect, comparison-contrast, problem-solution), the better readers will comprehend (Jiang & Grabe, 2007; Trabasso & Bouchard, 2002). Grabe and Jiang (2010) proposed use of partially completed graphic organizers to raise awareness of such discourse structures among L2 readers. In addition, the teacher should encourage students to use discourse features (e.g., "so," as in "so it can grow and multiply without limit"), which function as cues for specific types of discourse (i.e., cause-effect). Linguistic cues such as this are beneficial to all readers regardless of their native language, but they are especially beneficial to L2 readers who may spend much of their time and effort on textbase representations rather than on underlying representations.

Conclusion

Text comprehension involves making connections between the new information represented in text and given information (i.e., both schema-based knowledge from the readers' long-term memory and situation models that are constructed in their mind). Fixed, schema-based knowledge alone is not enough for readers to go beyond the textbase level of representation because comprehension is an ongoing process. To enhance use of appropriate situation models among students so that they can comprehend the underlying content of a text, teachers need to engage students in a variety of activities. Through pre-reading, during reading, and post-reading activities, students not only activate and organize schemata from their long-term memory but also construct and reconstruct their situation models, while also monitoring their comprehension.

By previewing, students should rely on top-down processing to hypothesize what the text is about. Teachers should also support students' reading comprehension by incorporating cognitive and metacognitive strategies such as thinking aloud/verbal protocols, questioning, self-explaining, inconsistency detection, and recognition of text structures as discourse cues. These types of strategies help L2 learners monitor their situation models to fill in linguistic knowledge gaps. Given the benefits of schema-based knowledge and situation models in reading comprehension, it is crucial for teachers to train their students to become strategic readers by making use of both resources to construct meaning from text.

Notes

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