Trans-Symbolic Comprehension: A Higher Order of Thinking

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In the educational and psychological literature, the term comprehension has multiple meanings and connotations. When considered in light of popular and influential taxonomies of thinking (e.g., Anderson & Krathwohl, 2001; Bloom et al., 1956), comprehension is portrayed as simplistic and certain. For instance, in Taxonomy of Educational Objectives, Handbook I: Cognitive Domain (Bloom et al., 1956), commonly referred to as Bloom's Taxonomy, comprehension is categorized as a “lower-order” cognitive activity, second only to knowledge acquisition, or “mere rote learning or verbalization” (Bloom, Hastings, & Madaus, 1971 p. 149). This description connotes comprehension, or “understanding,” as minimally abstract, simple, and easy. Moreover, it suggests that comprehension is separate from, but a necessary precursor to, higher levels of cognitive activity represented in the taxonomy; namely application, analysis, synthesis, and evaluation.

However, the reading and understanding literatures paints a different picture. To those steeped in its examination, comprehension or understanding (most notably of text) is a far more complex and multifaceted enterprise than suggested by Bloom and colleagues (Duke & Carlisle, 2011; Keene, 2008). Theories and models of reading imply that understanding text is neither simple nor certain, requiring the orchestration of processes associated with higher orders of the Bloom taxonomy, including evaluating the author’s point of view, inferring relations not explicitly stated in the text, and elaborating (Pressley & Afflerbach, 1995). Likewise, decades of research on teaching and learning for understanding have demonstrated the complexity of these meaningful learning endeavors (Ritchhardt, Morrison, & Church, in press). In light of these bodies of literature, some have even suggested that comprehension is often an instantiation of
higher-order thinking, a position in direct contrast to the taxonomic perspective (Alexander et al., in press).

One of the paradoxes of Bloom’s conceptualization of comprehension is that, while it positioned in a more simplistic way than has been established in over a century of reading theory and research, it is nonetheless more expansive in its scope. Specifically, in Bloom’s taxonomy, comprehension is not constrained to the understanding of information presented in linguistic form (i.e., text or talk), as is typically the case within the educational literature. Rather, Bloom and colleagues discuss in detail the role of comprehension in the gaining meaning from a variety of non-linguistic compositions (e.g., mathematical statements, and paintings), an approach that is reflected in both historical and contemporary views of understanding. However, this trans-symbolic perspective of comprehension has not been mirrored in most of the contemporary literature on reading. Instead, established models of comprehension are explicitly or tacitly nested in the context of linguistic processing (e.g., Graesser, Mills, & Zwaan, 1997; Kintsch, 1998), generally excluding non-linguistic compositions or assuming that they are understood in the same manner as text.

This treatise examines the conflicting views of comprehension represented in taxonomies of thinking and the current literatures on the comprehension of text and understanding, suggesting that while Bloom’s view of comprehension is overly simplistic on the one hand, his trans-symbolic approach to its study is not. Rather, it is argued that the current literature on comprehension would benefit from a similar, expanded view of “understanding” that addresses meaning-making of both linguistic and non-linguistic compositions. Ultimately, the of Trans-Symbolic Comprehension framework (TSC; Loughlin & Alexander, in press) is forwarded as a
reconceptualization of comprehension that addresses the limitations of Bloom’s taxonomic approach while maintaining his trans-symbolic perspective.

**A Taxonomic View of Thinking**

While more than twenty different taxonomies of thinking are represented in educational literature and practice (for a review, see de Kock, Sleegers, & Voeten, 2004), the first, and by far the most influential, is that articulated by Bloom et al. (1956) in *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain*. Commonly referred to as Bloom's Taxonomy, this slim volume has had a lasting effect on many areas of education. Indeed, as described by Anderson and Sosnaik (1994), the taxonomy is, “arguably, the most influential educational monograph of the past half century (p. vii),” impacting not only educational assessment and evaluation, but also, and possibly most notably, beliefs about thinking and learning. But why, among the myriad publications on education, was Bloom’s taxonomy so powerful? One answer lies in its historical context.

At the time of the taxonomy’s original publication in 1956, behaviorism was the dominant paradigm in educational psychology (Alexander & Loughlin, in press; Bereiter & Scardamalia, 2005), resulting in the view learning a behavioral response to stimuli. Because of this emphasis on the stimulation of learning, not the process of learning itself, assessments and objectives of learning were imprecise, vaguely worded goals, making reliable assessments difficult and cumbersome (Snowman & Biehler, 2000). Moreover, the field of education was in the midst of an instructional objectives movement spawned by industrial and military psychology, wherein complex, *whole* tasks were broken down into specific, terminal behaviors that were observable and measurable and often ordered in hierarchical frames (Saettler, 1990).
In was in this context that Bloom’s taxonomy was presented. Originally designed to “provide for classification of the goals of our educational system…to help all teachers, administrators, professional specialists, and research workers who deal with curricular and evaluation problems” (p. 1), the taxonomy was an attempt to break down the complexities of learning into observable, doable pieces that could be easily identified, taught, and assessed. As such, in its more general form, the taxonomy outlines six levels of cognitive processes associated with learning:

1.0 Knowledge. Recognizing, remembering, or recalling previously learned information, such as facts, terms, procedures, or principals; information retrieval.

2.0 Comprehension. Understanding the meaning of information presented in some form of communication.

3.0 Application. Applying or demonstrating understood knowledge.

4.0 Analysis. Breaking down objects or ideas into simpler parts and seeing how parts relate and are organized; identifying elements, relationships, and organizational principles.

5.0 Synthesis. Generating new knowledge structures by rearranging component ideas into a new whole.

6.0 Evaluation. Making judgments about the value of knowledge based on internal evidence or external criteria.

The ordering of these six cognitive processes was based on three key assumptions. First, as described by Bloom et al. (1956), these six cognitive processes were ordered in terms of their perceived complexity, moving from “lower” to “higher” orders of the taxonomy. Thus knowledge was described as the least complex cognitive process and evaluation as the highest. Moreover, as articulated by Krathwohl, a coauthor of the Taxonomy (1956), the six processes
were viewed as a “cumulative hierarchy,” in which the mastery of more a complex category required prior mastery of all of the less complex categories below it (Anderson & Krathwohl, 2001). As such, comprehension relied upon prior mastery of knowledge or facts, application depended upon comprehension of relevant ideas and their association facts, and so on through the remaining levels. Finally, it was assumed that the six processes did not overlap (Furst, 1994); knowledge was discrete from comprehension, comprehension from application, and so on.

For its time, Bloom’s taxonomy was innovative, suggesting that learning was not a simple, unidimensional response to stimuli, but, rather, a more complex, multifaceted endeavor, a message that resonated with educators and curriculum writers (Marzano & Kendall, 2006). And, coming as it did during the instructional objectives movement, it gained immediate popularity in the field of education, particularly in the area of evaluation. In fact, as described by Marzano and Kendall (2006), within ten years, Bloom’s taxonomy was adopted as the primary tool for evaluating heavily funded national educational reform efforts and, as a result, became entrenched in curriculum and assessments documents across the county.

During the critical thinking movement of the 1980’s, exemplified and described by the “Delphi Report” (Facione, 1990), Bloom’s taxonomy was repurposed as a means of describing and classifying thinking. In particular, the taxonomy was widely used as a model for distinguishing between low level or basic thinking and so-called higher orders of thinking (Marzano & Kendall, 2006). Thus, although nowhere in the volume is the term “higher-order thinking” to be found, conceptions of higher-order and lower-order thinking associated with the taxonomy, as well as the distinction between them, have became codified in educational theory, practice, and assessment (Alexander et al., in press). Moreover, beliefs about the relative
complexity of the cognitive processes have spawned generations of educators and psychologists who associate particular cognitive processes with either higher- or lower-order thinking and who, endeavoring to promote student learning, eschew lower-order in favor of higher-order thinking (Ritchhardt, Morrison, & Church, in press).

In the intervening half-century, a number of updates and revisions to Bloom’s taxonomy have been forwarded (see de Kock, Sleegers, & Voeten, 2004), including a recent interpretation undertaken by a group including Krathwohl, a coauthor of the original publication. This revision, *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom’s Taxonomy of Educational Objectives*, forwarded by Anderson, Krathwohl, and colleagues, entails a number of modifications to the original taxonomy, both minor (e.g., changing the term *comprehension* to *understanding*) and significant (e.g., adding a second, knowledge-based dimension). However, the Anderson et al. (2001) taxonomy, like most other efforts to revise Bloom’s original version, retained the assumption that cognitive processes can and should be ordered by complexity; describing some processes as less-complex, simpler, more concrete, or lower-order than others.

Comprehension, or as recoined by Anderson et al. (2001), *understanding*, is one of the processes assumed to be lower order (Ritchhardt, Morrison, & Church, in press). It is to a closer examination of this assumption that we now turn.

**Perspectives on the Nature of Comprehension**

As noted previously, conceptions of comprehension differ in the literature. In this section, three perspectives on comprehension will be described and compared: comprehension as a taxonomic category, comprehension as reading and understanding text, and comprehension as understanding.

**Comprehension as a Taxonomic Category**
For Bloom and colleagues, comprehension, although positioned at the lower level of the taxonomy, represented the largest class of intellectual skills and abilities (Marzano & Kendall, 2006). As Bloom et al. argued,

…we are using the term “comprehension” to include those objectives, behaviors, or responses with represent an understanding of the literal message contained in a communication. In reaching such an understanding, the student may change the communication in his mind or in his overt responses to some parallel form more meaningful to him. There may also be responses which represent simple extensions beyond what is given in the communication itself. (1956, p. 89)

As evidenced by this description, the authors made an effort to constrain comprehension to a simplistic, “literal” understanding, emphasizing the limitations of this lower-level process. However, this simplistic view of comprehension is immediately called into question upon examination of three of its interrelated, but distinguishable subcategories: translation, interpretation, and extrapolation.

Translation, the lowest order of comprehension, is evidenced when the known concept is "put into different words or changed from one kind of symbology to another" (Bloom, Hastings, & Madaus, 1971, p. 149). Examples of translation include putting into words visual elements into words, such as graphic representations of trends in the cost of living or verbally analyzing a work of art. The second level of comprehension, interpretation, occurs when a learner goes beyond recognition of separate aspects of a communication to seeing interrelations among its constituent parts. This is evidenced when the learner draws connections to prior knowledge and separates important from unimportant aspects of the communication.
The last subcategory of comprehension is extrapolation. "In this category, the receiver of a communication is expected to go beyond the literal communication itself and make inferences about consequences or perceptibly extend the time dimensions, the sample, or the topic" (Bloom, et al., 1971, p. 149). Extrapolation is distinguishable from interpretation in its expansion beyond the boundaries of the present communication. Whereas interpretation is focused on relating parts of a communication in an effort to build a coherent mental representation, extrapolation reaches beyond the literal limits of the communication.

Several aspects of this taxonomic view of comprehension are notable. First, as might be expected from the previous discussion of the historical context, Bloom et al.’s (1956) conception of comprehension was very behavioral, in that comprehension was described in terms that are observable and measurable. Thus, while the authors articulated three subcategories of comprehension, and provided a number of illustrative examples, they did not explain in depth the processes inherent in translation, interpretation, or extrapolation, likely because these processes represent unobservable, latent activities. Another interesting facet involves the contradiction in the definition and operationalization of comprehension. The definition of comprehension forwarded Bloom et al. (1956) and quoted previously, limits it to “understanding the literal message contained in a communication.” However, the description of extrapolation in the Bloom et al. (1971) publication states that “the receiver of a communication is expected to go beyond the literal communication itself” (p. 149). Finally, it is notable that, because the purpose of Bloom’s taxonomy was to identify non-overlapping categories of cognitive activity (Faust, 1994), comprehension was assumed to be distinct from the other processes in it.

Upon careful examination of the Taxonomy (1956), this last assumption proves very problematic. Despite being given its own, distinct category at the lower level of the taxonomy,
as noted by Marzano and Kendall (2006) and others (e.g., Geersten, 2003), aspects of comprehension are implicitly and explicitly found in the presumably higher-level categories. For instance, aspects of comprehension are found in the Analysis category. In the taxonomy, Analysis is described as identifying and classifying elements and the relation between elements. However, identifying and relating elements has significant overlap with the interpretation subcategory of comprehension, which requires the learner to identify interrelations between aspects of a communication. This overlap was acknowledged by Bloom and colleagues who stated in their description of analysis, “No entirely clear lines can be drawn between analysis and comprehension at one end or between analysis and evaluation at the other” (p. 144). They go on: “It is probably more defensible educationally to consider analysis as an aid to fuller comprehension” (p. 144).

A similar conflation occurs in the discussion of the Synthesis category, which is described as putting together elements and parts to form a meaningful pattern or structure. In the same fashion, comprehension, understanding the message of a communication, necessarily involves synthesis at multiple levels as evidenced again by the interpretation and extrapolation subcategories of comprehension. First, a comprehender must put together pieces of the message (e.g., words, visual elements) to form a coherent whole. Additionally, for even a surface understanding of the communication, the message must be integrated with prior knowledge. This process is even more critical if the comprehender is to extrapolate beyond the literal limits of the communication to, for instance, extend the timeline or infer unstated relations. As with analysis, this problem is noted by the authors of the Taxonomy. “Comprehension, application, and analysis also involve the putting together of elements and the construction of meaning” (p. 162).
Perhaps the clearest acknowledgment of the categorical conflation, however, can be found in the description of evaluation, the highest level of the taxonomy.

Although evaluation is placed last in the cognitive domain because it is regarded as requiring to some extent all other categories of behavior, it is not necessarily the last step in thinking or problem solving. It is quite possible that the evaluation process will in some cases be the prelude to acquisition of new knowledge, a new attempt at comprehension or application, or a new analysis and synthesis. (p. 185)

As suggested by this statement, as well as the implicit and explicit complications before it, a taxonomic view of comprehension is untenable. In fact, the entire complexity-based structure of Bloom’s taxonomy is problematic; the conflation of categories in the taxonomy has been documented statistically (e.g., Smith, 1970) and in practice (Fairbrother, 1975; Poole, 1972). Thus, it is clear that, even when constrained to understanding the “literal message” of a communication, assuming such a thing is possible, comprehension cannot be achieved without processes at the “higher order” of the taxonomy. Thus, comprehension is not distinct from the other categories, and the notion that it is a lower-order cognitive process is not supported, even by the taxonomy itself.

**Comprehension as Reading and Understanding Text**

Difficulty experienced by Bloom and colleagues in neatly categorizing and delineating comprehension from the other cognitive processes in the taxonomy would likely come as no surprise to those who are steeped in the study of reading. The literature examining how individuals understand textual information, termed reading or text comprehension, is vast and reflects the belief that comprehension is a complex, multifaceted process.
According to Duke and Carlisle (2011), comprehension refers to a listener’s or reader’s understanding of a message expressed by a speaker or writer. They further describe comprehension as an elaborate, constructive process, entailing an interaction between the text, the reader, and the context. Some factors that influence this interactive comprehension process include prior knowledge of the reader (Graesser, Singer, & Trabasso, 1994; Romance & Vitale, 2001), beliefs about the topic of the text (Schraw, 2000), epistemic beliefs about the nature of reading (Alexander et al., in press), comprehension goals (Geiger & Millis, 2004), topic interest (Hidi, 2001), motivation for the task (Guthrie et al., 2004; Guthrie et al., 2007), and emotional response to the text (Eva-Wood, 2004). Another critical aspect of text comprehension is the enactment of comprehension skills and strategies.

According to Pressley and colleagues (Pressley, 2000; Pressley & Afflerbach, 1995), successful comprehension also requires a number of comprehension processes reflecting varying degrees of complexity. For instance, successful comprehenders set goals and are aware of why they are reading a text, gain an overview of the text before reading, identify and use text structure to meaningfully navigate the text, make predictions about upcoming events in the text, and read selectively based on their overview. Comprehension also requires readers to associate ideas in text to what they already know, note whether their predictions and expectations about text content are being met, and revise their prior knowledge when compelling new ideas conflicting with prior knowledge are encountered. Comprehenders must also interpret the text, evaluate its quality based on externally- and internally-derived criteria, review important points at the conclusion of reading, and think about how ideas encountered in the text might be applied or used in the future.
A brief examination of this partial list of comprehension processes reveals examples at each level of Bloom’s taxonomy. For instance, application in text comprehension is evidenced when readers use text structures to meaningfully navigate a text or consider how the text might be applied or used. Analysis is required for identifying the parts of a text (e.g., the characters and setting) and synthesis is required to put these parts together with prior knowledge to create a meaningful whole. Evaluation is also evidenced in this list of comprehension processes, in selectively reading, identifying of important points in a text, and evaluating its quality. Thus, the perspective of comprehension reflected in the literature on reading supports conclusion from the previous section, namely that comprehension is not a discrete from other cognitive processes, nor does it represent a lower level of cognitive complexity.

**Comprehension as Understanding**

To those who examine *understanding*, a term used synonymously with comprehension in both the original (Bloom et al., 1956) and revised taxonomies (e.g., Anderson & Krathwohl, 2001), the taxonomic approach is fundamentally flawed; comprehension or understanding is not a precursor to application, analysis, evaluation, or creation, but a result of it (Wiske, 1997). Like Bloom and colleagues, those who study teaching and learning for understanding (e.g., Blythe et al., 1998; Keene, 2008; Wiggins & McTighe, 1998) suggest that education is primarily designed around the identification and retention of simplistic, memory-based activities (Saphier, Haley-Speca, & Gower, 2008). In reaction to this perceived educational orientation, they alternatively articulate understanding as the primary goal of teaching, with thinking as its necessary precursor (Ritchhardt, Morrison, & Church, in press).

Unlike Bloom’s approach to learning, however, educators and researchers concerned with the study of understanding eschew a simplistic, taxonomic approach to its examination. For
instance, Ritchhart et al. (in press) argue that learning “doesn’t happen in a lockstep, sequential manner, systematically progressing from one level to the next. It is much messier, complex, dynamic, and interconnected than that” (p. 5). Some influences on meaningful learning (i.e., understanding) include the appropriate use of deep and surface learning processes (Alexander, 1997; Craik & Lockhart, 1972; Marton & Saljo, 1976), transfer of learning from one context to another (Mayer & Wittrock, 1996; Salomon & Perkins, 1989), and the development of thoughtful habits of mind (Costa & Kallick, 2000; Tishman, 2000).

Drawing upon this understanding approach to learning, an alternate framework for considering the relation between thinking and learning has been forwarded by Ritchhardt and colleagues (e.g., Ritchhardt, Palmer, Church, & Tishman, 2006; Ritchhardt & Perkins, 2008; Ritchhardt et al., in press; Tishman & Palmer, 2002). Specifically, this framework suggests that there are particular kinds of thinking integral to understanding across all disciplines. These “high-leverage thinking moves” include observing and describing, reasoning with evidence, comparing and connecting, questioning and investigating, considering different viewpoints and perspectives, uncovering complexity and going beyond the surface of things, and building explanations and interpretations.

In contrast to the taxonomic approach adopted by Bloom and others, Ritchhardt and colleagues view the relation between these cognitive activities as an unordered framework—no type of thinking is more complex or important than another. In fact, Tishman and Palmer (2002) suggest that, instead of being graphically represented in a taxonomic or hierarchical frame, thinking might best be viewed as paints on an artist’s palette, with each type of thinking representing a different color. This visual analog suggests that learning tasks necessitate different thinking combinations and emphases. For instance, although all understanding requires
observation to a certain degree, learning from a physics demonstration requires more observation than does the comparison two characters in a novel. Likewise, reasoning is more essential to solving a proof in geometry than it is to learning to create a representational drawing, although reasoning is important in both contexts.

While Ritchhart and colleagues argue for the existence of types of thinking central to every understanding context, they take care to acknowledge that their list is not complete. “While these eight [types of thinking] represent high-leverage moves, it is important to once again stress that they are by no means exhaustive. We offer up this list as a useful starting place, and no more” (Ritchhart et al., in press, p. 12).

Discussion

The foregoing discussion of perspectives on the nature of comprehension suggested by the taxonomic, reading, and understanding literatures demonstrates that, while it is position at the lower levels of taxonomies (e.g., Bloom et al, 1956, 1971), comprehension is never the less a complex and difficult processes requiring a number of processes and types of thinking. This perspective, explicitly articulated by those in the fields of reading and understanding, is also tacitly acknowledged in the conflation of Bloom’s taxonomic categories. Therefore, the view of comprehension as lower-order, simplistic, or easy is not affirmed by the literature; comprehension reflects a “higher order” of thinking, learning, and understanding.

Perspectives on the Scope of Comprehension

As in the foregoing discussion of the nature of comprehension, the literature reflects differing perspectives on its scope; that is, in what contexts comprehension is instantiated. In this section, three such perspectives are examined, reflecting taxonomic, reading, and “new” literacies viewpoints. However, it is instructive to consider these viewpoints in light of their
historical contexts. As such, this section has the following organizational scheme: Foundational and Pre-Cognitivist Perspectives: James and Bloom; The Cognitivist Perspective: Comprehension of Text; and Post-Cognitivist Perspectives: “New” Literacies.

**Foundational and Pre-Cognitivist Perspectives: James and Bloom**

Interest in meaning-making or comprehension processes lies at the foundation of education and educational psychology, as evidenced in the writings of such foundational figures as Bartlett (1932), Dewey (1910), James (1890/1950), and Mead (1912). For instance, William James (1890/1950) in his seminal work, *Foundations of Psychology*, describes the mind as a “stream of consciousness” that is constantly seeking to understanding the environment though what he termed the “operations” or habits of the mind: attention, discrimination and comparison, association, and conception.

Attention is the necessary first step in the understanding or comprehension process, in which an individual focuses on a thought or percept, making it clearer and more vivid in the figurative or literal eye. A second complementary process is perception, specifically the ability to differentiation the whole from its constituent parts, or, what he later term, analysis. The third critical psychological process outlined by James is association, which is inclusive of both comparison and its the alter ego, discrimination. Association occurs when “objects at first appearing as wholes are analyzed into parts, and objects appearing separately are brought together and appear as new compound wholes to the mind” (p. 550).

The fourth mental process or habit of the mind is conception. For James, conception is a broad term that seemingly encompasses memory, understanding, and learning, resulting in the ability to “hold fast” to information “without confusion.” Moreover, conception seems to be the end result of the previously articulated processes, namely attention, perception, and association.
New conceptions come from new sensations, new movements, new emotions, new associations, new acts of attention, and new comparisons of old conceptions... At the outset we merely have the topic, then we operate upon it, and finally we have it again in a richer and truer way. (p. 467)

Although nowhere in the 1,000 pages of *Principles* (1890/1950) does James provide a clear and complete description of the interrelation of attention, perception, association, and conception, let alone forward a conceptual model describing how they bear on the comprehension of compositions, his writings inform its study. Specifically, James seems to suggest that attention, perception, and association are necessary precursors to comprehension, in that one must attend to and make sense of a composition before one can make meaning of it. Additionally, it is clear that James, like other foundational writers (Bartlett, 1932; Dewey, 1910; Mead, 1912), viewed the scope of comprehension broadly. In his description and discussion of these “operations” of the mind, James included a variety of compositions, from musical scores to scientific and mathematical theory, to paintings, text, and interpersonal exchanges, suggesting that James perceived understanding and comprehension as necessary for all forms of information.

In many ways, Bloom et al.’s (1956), description of comprehension and its subprocesses (i.e., translation, interpretation, extrapolation) resonates with the work of James (1890/1950), particularly when taking into account the previously argued conflation of comprehension with other categories of Bloom’s taxonomy. For instance, Bloom’s comprehension subprocess, translation, is closely tied to James’s attention and perception; in order to translate a communication from one form to another, one must first attend to and perceive it. Likewise, Bloom’s interpretation subprocess is akin to James’s association, in that understanding a
message necessitates both analysis and synthesis. Similarly, Bloom’s extrapolation subprocess is like James’s conception, as both rely on meaningful understanding that allows for its use in expanded or new contexts.

Also, like James, Bloom and colleagues, suggested that comprehension is instantiated in a variety of contexts. To demonstrate the viability of their taxonomy for education, Bloom et al. (1956; 1971) set out to show its broad applicability, drawing on content experts in a variety of disciplines, (e.g., art, mathematics, social studies, language arts, and science) to provide examples of tasks and behaviors that operationalized each aspect of the taxonomy. Thus, Bloom and colleagues demonstrated how comprehension, and its three subprocesses was instantiated across symbol-systems, in linguistic (e.g., language arts or literature) and non-linguistic (e.g., mathematics or art) compositions.

The works of James (1890/1950) and Bloom (1956; 1971) suggest that they perceived the scope of comprehension broadly, including both tacit and explicit references to its instantiation in a variety of symbol-systems. However, this trans-symbolic view of comprehension predated the cognitivist revolution and the concomitant rise of the cognitivist paradigm that greatly impacted beliefs about the nature and scope of comprehension.

**The Cognitivist Perspective: Comprehension of Text**

The cognitivist revolution began, by many accounts, in 1957, just one year after Bloom’s original publication of the *Taxonomy* (Gardner, 1985; Miller 2003). This revolution of ideas was a reaction against the behaviorist paradigm, which, as noted previously, viewed learning as a response to environmental stimuli (Bereiter & Scardamalia, 2005). In contrast, those espousing the cognitivist paradigm viewed learning in relation to the burgeoning research on artificial intelligence and computer science, emphasizing the inner mental activities and processes that
guide learning, such as thinking, memory, knowing, and problem solving (Gardner, 1985). Thus, changes in behavior were viewed principally as an indication of associated internal mechanisms of thought and processes of knowing (Loughin & Alexander, in press). In investigating and articulating the computer-like mechanisms of meaning-making, theorists, particularly those espousing an Information Processing approach, relied primarily upon language-based inputs, specifically text (Reynolds & Sinatra, 2005).

The cognitivist emphasis on language resulted in the nesting of comprehension within text. For instance, while the literature on comprehension includes many theories and models (for an overview see Tracey & Morrow, 2006), and myriad comprehension processes have been identified (Pressley & Afflerbach, 1992), these comprehension models and processes emphasize comprehension of language, particularly classroom talk and written. Moreover, unlike the view of comprehension espoused by Bloom et al. (1956, 1971), most of these examinations do not consider text as one of many opportunities for comprehension.

Rather, for the most part, theories and models of comprehension either exclude non-linguistic compositions (e.g., Graesser, 2007) or assume that they are understood in the same manner as text (e.g., Kintsch, 1998). This has resulted in the frequent conflation of comprehension with reading comprehension. Indeed, a cursory search for the term comprehension in the Index of prominent texts educational psychology handbooks and textbooks yields the following directive: “see Reading Comprehension” (e.g., Alexander & Winne, 2006).

Post-Cognitivist Perspectives: “New” Literacies

The past decade or so has seen a rise in reactions against the mind-as-computer and information-processing perspectives of cognitivism (Wallace et al., 2007). These so-called “post-cognitivist” perspectives include situated cognition (Greeno, 1998), ecological psychology
(Bronfenbrenner, 1979), evolutionary psychology (Buss, 2004), and socioculturalism (Wertsch, 1991). These paradigmatic orientations represent wide-ranging emphases and lines of inquiry (for an overview see L’Abate, in press), but are united in their increased consideration of the role of environment, broadly construed, on the investigation of the mind and behavior.

The rise of post-positivist perspectives has coincided with a reexamination of the scope of comprehension, both outside and within the field of reading. For instance, the New London Group (1996), a group of educators, psychologists, and semioticians, published an influential statement on the importance of expanding the definition of literacy (i.e., the ability to read and write) beyond text to incorporate human communication in a wide variety of contexts.

Within the field of reading, there is a similar movement to broaden the definition and conception of text, and thus comprehension, to incorporate other forms of communication (Flood & Lapp, 1995). For instance, comprehension has been associated with creative compositions like television and film (Kendeou, et al., 2009; Watts, 2007), pictures (Paris & Paris, 2003), paintings (Clyde, 2003; Williams, 2007), and dance (Au & Raphael, 2000). Likewise, many examinations have been undertaken in an effort to describe comprehension of mathematics (Fletcher, Lucas, & Barron, 1999), and technology-based (e.g., Coiro & Dobler, 2007, Salmerón, Kintsch, & Cañas, 2006), and multi-symbolic compositions (e.g., Butcher, 2006, Mayer, 2001, 2003).

Many of these inquiries have been grouped together under the umbrella term new literacies (Leu et al. 2009). However, as noted by Leu et al. (2009), this descriptor is non-specific and means different things to different people, with little consensus on, or unification within, the field. For instance, while some researchers ground their work in sociocultural frame (e.g., Gee, 2007; Street, 1995, 2003), other reflect a cognitivist view (e.g., Alexander & Jetton,
Moreover, there is disagreement on the even the descriptor for these lines of inquiry. For instance, Alexander et al. (in press) argue that there is nothing “new” about comprehension processes, regardless of their perceptual or symbolic compositions; only that the surface features have changed. They therefore argue against the validity of the *new literacies* descriptor. Despite these differences in theoretical grounding and terminology, according to Coiro et al. (2008), what is common to these disparate lines of inquiry is the shared belief that meaning-making is required for much more than traditional text or language, and that the field must work to identify the skills, strategies, and dispositions associated with comprehending a variety of compositions.

At present, however, there is no consensus on an appropriate framework for this examination. In his discussion of future directions for new literacies research, Unsworth (2008) articulated the need or a "trans-disciplinary" framework to provide unified resource for research on comprehension of "meaning-making" systems, such as language, visual display, sound, and movement. He urged literacy educators, linguists, information and media researchers, and psychologists to find common, compatible or complementary theoretical frameworks that, together, inform the ways in which individuals process and understand information. Additionally, he argued that this framework should allow researchers to pursue a focused study within a single meaning-making system, while building bridges between symbol systems.

**Discussion**

As evidenced by this discussion, the scope of comprehension has been differentially perceived in the 120 odd years since the publication of James’s *Principles* (1890/1950), and heavily influenced by the historical backdrop of educational theory. An expansive view of comprehension is grounded in both foundational writings (e.g., James, 1890/1950), taxonomic
perspectives (e.g., Bloom et al., 1956, 1971) and some of the current literature on reading (e.g., Leu et al., 2006). In fact, in light of this discussion, it is arguable that the emphasis on the comprehension of text has been predicated on the popularity of the cognitivist paradigm in educational theory and research, and is thus, in the scheme of educational history, an anamoly. Rather, historical speaking, it has been more common to view comprehension as understanding endeavors in the many symbolic and compositional forms through which human communicate, as did Bloom and colleagues. Thus, examinations of comprehension should consider both the understanding of linguistic and non-linguistic compositions.

As also evidenced by this discussion, however, while decades of research has illuminated the processes inherent in gaining meaning from text, the understanding of how individuals comprehend other, non-linguistic compositions remains rudimentary. For instance, what comprehension processes are commonly used for understanding non-verbal compositions, such as visual displays, both realistic and abstract, or mathematics? Moreover, what is the relation between these processes and what research has shown to be important in text comprehension?

These open questions suggest that there is a need for a theoretical reconceptualization of comprehension that, like the work of Bloom and colleagues (1956,1971) addresses the processes inherent in understanding information within and across symbol systems. Trans-Symbolic Comprehension (TSC; Loughlin & Alexander, in press) is forwarded as such a framework.

**Trans-Symbolic Comprehension**

Drawing on the preceding perspectives of the nature and scope of comprehension, Trans-Symbolic Comprehension (TSC: Loughlin & Alexander, in press) is offered as a framework for investigating meaning-making processes across and within symbol systems. Specifically, the TSC suggests that both trans-symbolic and symbol-specific processes are present in any act of
comprehension. When reading a text, for instance, it is argued that individuals comprehend the message through trans-symbolic processes that are essential to understanding any form of communication, as well as use processes that are particular to understanding text. Likewise, comprehending a painting entails both painting-specific and general, trans-symbolic, processing.

The TSC framework is germane the discussions of Bloom’s taxonomy, thinking, and comprehension that have been the focus of this treatise for two reasons. First, as has been argued previously, while not on the higher end of Bloom’s or other popular taxonomies, comprehension is never the less “higher order” in the sense that it is abstract, complex, difficult to achieve, and a significant facet of meaningful learning. Moreover, comprehension results from a number of processes and types of thinking. The TSC reflects this view of comprehension.

The second, and possibly more significant, rationale for the inclusion of the TSC here relates to the scope of comprehension. As discussed, one of the paradoxes of Bloom’s conceptualization of comprehension is that, while it over-simplified comprehension, it was nonetheless more expansive in its scope, discussing in detail the role of comprehension in the gaining meaning from a variety of non-linguistic compositions (e.g., mathematical statements, and paintings). This valuable, trans-symbolic approach is not mirrored in much of the contemporary literature on comprehension. Thus, the TSC is forwarded here in an effort to address the limitations of Bloom’s taxonomic approach to comprehension while maintaining his trans-symbolic perspective of it.

At the outset, however, it is necessary to emphasize that, although the TSC is forwarded as an alternative framework of comprehension, it does not seek to undermine or negate the decades of research on text comprehension processes. Rather, this work intends to expand the frame of comprehension to reflect other forms of human communication. In fact, it is fully
expected that many of the processes currently associated with text comprehension will be evidenced in meaning-making endeavors in non-linguistic compositions, for reasons that will be addressed.

In this section, the TSC framework is described, and its component processes—trans-symbolic and symbol-specific processes—are briefly framed in the extant literature. In particular, the TSC is considered in light of those perspectives heretofore discussed (i.e., the writings of Bloom and James and the literatures on understanding, text comprehension, and “new” literacies), with special emphasis is given to the work of Bloom. First, however, it is necessary to raise key definitions.

**Definition of Terms**

**Composition.** For our purposes, compositions are *intentional, meaningful, human communications that have been encoded symbolically and reified*. Intentional communication is thus distinguished from unintentional communication by the deliberative intent of the communicator. For instance, the definition of composition is inclusive of a pen and ink drawing of a dog, but exclusive of an accidental scribble that also resembles a dog. Moreover, compositions are necessarily communicative. That is, they intend to convey some idea, belief, or emotion. Further, this meaningful communication must be encoded in a symbol system (i.e., linguistics, mathematics). Finally, a composition is reified, in that the deliberate, meaningful, encoded communication has been given concrete or material form (e.g., poem, mathematical argument, sculpture). Thus, this definition of composition is exclusive of communications that have not, is some from, been recorded.

**Symbol system.** At this juncture, it is important to address the choice to focus on symbol systems as the descriptor of compositions. *Symbol systems are structures that give meaning to...*
perceptual patterns (e.g., cat, +, or ♫ are understood in the structures of language, mathematics, and music, respectively). In literature that distinguishes between text and other forms of communication, many descriptors are used, including signs or codes (Halliday & Hansan, 1985; Kress and van Leeuwen, 1996), modes (Unsworth, 2008), channels (Sadoski & Paivio, 2001), media (Mayer, 2001), representations (Ainsworth, 2008), literacies (Leu et al. 2009), languages (Goodman, 1976), and structures (Gernsbacher, 1990).

Although these terms reflect slightly different discriminatory emphases, these descriptors either highlight the perceptual system though which a communication occurs (e.g., the visual channel) or the totality of the whole communicative system (e.g., mode of dress). However, to emphasize the belief that compositions are encoded in a symbolic system and, therefore, must be decoded and comprehended, the TSC describes compositions in terms of their symbol systems.

**Comprehension.** Comprehension is defined here as an interactive process through which an individual comes to understand a composition. Comprehension is thus distinguishable from perception. Whereas, perception is related to making sense of perceptual information, such as sounds or images (Gibson, 1994), comprehension is related to meaning making, or understanding the message. Missing from this definition of comprehension is a statement regarding the nature of the type of information to be comprehended. This omission is deliberate, and intended to be broadly applicable. In fact, comprehension might be better defined as an interactive process in which an individual come to understand or make meaning from information, regardless of the symbol system in which it is communicated. Thus, comprehension is applicable to both linguistic and non-linguistic compositions.

**Component Processes**
As mentioned previously, the TSC reconceptualizes the nature of comprehension, more particularly the processes that give rise to the understanding of symbolic representations, as relation between two component processes: trans-symbolic and symbol-specific.

**Trans-symbolic comprehension processes.** Trans-symbolic processes are processes that are instantiated in comprehension of any composition. The existence of trans-symbolic comprehension processes is predicated on two key assumptions; a) that unearthing the meaning of both linguistic and non-linguistic compositions requires understanding or comprehension processes, and b) that, at some level, these processes are the same or similar across symbol systems. Evidence to support both of these assumptions and, therefore the existence of trans-symbolic comprehension processes, can be found in many of the literatures described in the preceding discussions of the nature and scope of comprehension.

**Linguistic and non-linguistic compositions require comprehension.** There is ample support in the literature for the assertion that comprehension is required for both text (i.e., linguistic) and other, non-text compositions. The comprehension of text has been well-established by research and theory in the field of reading; indeed, as noted, the terms comprehension and reading comprehension are often used synonymously (Alexander & Winne, 2006).

What is less-established is the necessity of comprehension in other contexts. However, the literature reviewed herein provides a number of substantiations for this claim. For instance, writings of James (1890/1950) and Bloom and colleagues (1956, 1971) offer a number of examples of comprehension across disciplines and symbol-systems, the understanding literature (e.g., Keene, 2008; Ritchhardt et al., in press) suggest that understanding is critical to learning across all disciplines, and the “new” literacies movement is hinged on the goal of expanding
notions of text and comprehension to include a wide variety of compositional forms. From these sources and others (Elgin, 1993; Goodman, 1976; Kress & van Leeuwen, 1996), it seems clear that this first assumption underpinning the existence of trans-symbolic processes has been met.

Comprehension processes are the same or similar across symbol systems. This second assumption, while not so explicitly addressed, can be inferred from these same bodies of literature and some likely trans-symbolic processes can be discerned. For instance, James (1890/1950) suggests that all understanding requires attention, perception, discrimination, association, and conception; attention and perception as necessary precursors to comprehension and discrimination and conception as actively involved in it. The work of Bloom and colleagues (1956; 1971) is also instructive, suggesting that trans-symbolic comprehension might entail interpretation and extrapolation (translation, as will be discussed, is more likely a symbol-specific process). In order to interrelate separate parts of a communication for example, a key feature of interpretation, comprehenders must connect the parts and message of the composition to relevant prior knowledge.

Likewise, the literature on understanding, particularly the work of Ritchhart and colleagues (e.g., Ritchhardt et al., in press), provide examples of processes or types of thinking that might undergird comprehension of all compositions: observing and describing, reasoning with evidence, comparing and connecting, questioning and investigating, considering different viewpoints and perspectives, uncovering complexity and going beyond the surface of things, and building explanations and interpretations.

Beyond these broad descriptors, however, the particulars of trans-symbolic processes are not suggested. For instance, what is involved in discriminating (James, 1890/1950), extrapolating (Bloom et al. 1971), or questioning and investigating (Ritchhardt et al., in press)?
The answers might be found in an examination of the rich corpus of literature on text comprehension. Because, the TSC assumes that every act of comprehension includes both trans-symbolic and symbol-specific processes, the myriad associated processes associated with text comprehension can likely be organized into trans-symbolic and text-specific processes. Thus, the lengthy list of text comprehension processes presented earlier (e.g., setting goals, using text structure, making predictions, associating new information with prior knowledge, and evaluating; Pressley & Afflerbach, 1995) may reveal specific trans-symbolic processes. However, in order to discern those, it is first necessary to discriminate them from symbol-specific processes.

**Symbol-specific comprehension processes.** While the evidence to this point has suggested the existence of trans-symbol comprehension processes that are instantiated when an individual attempts to understand a composition, regardless of the symbology in which it is encoded, another body of literature suggests otherwise. Specifically, some work in human intelligence and cognitive psychology view meaning-making processes as necessarily nested, and thus differentially enacted, within symbol systems. In other words, there is support for the existence of symbol-specific processes. Moreover, there is some suggestion as to the nature of these processes.

**Support in the literature.** A full review of this literature is beyond the scope of this treatise, however several examples are instructive. For instance, Sadoski and Paivio (1991) argue, based on Dual Coding theory, that at some level, words and pictures evoke different conceptual processes involving separate cognitive mechanisms. Likewise, Barsalou et al. (1999) argue for what they term perceptual symbol systems. According to this view, small fragments of perceptual features are retained in the information coding process, such that an individual's
conception of a chair is inclusive, to an extent, of its color, shape, and texture. Accordingly, higher cognitive functions such as knowledge, memory, language, and thought, are sensitive to modality.

Schnotz (2005), another cognitive psychologist, distinguishes between depictions and descriptions. Descriptions consist of symbols, defined as signs that have no similarity to their referent. Text and mathematical expressions are common kinds of descriptions. For instance, the word "ant" has no similarity to a real ant and the symbol 2 has no relation to two single units of an actual something. Descriptive representations are more powerful than depictions in expressing some forms of abstract knowledge. Schnotz (2005) notes that the sentence, "The Marsh Harrier feeds on mammals or reptiles," is easy constructed; however communicating this same information through depictive representations requires a series of pictures.

Depictions, on the other hand, consist of icons, which share a structural commonality with their referent. Pictures, paintings, and drawings are depictive representations, as are maps and bar graphs. Descriptive representations are more informationally complete and are thus more useful for communicating a large amount of concrete information efficiently. For instance, in the Marsh Harrier example, a picture of the bird stalking a mouse on the edge of a marsh communicates several things: the Marsh Harrier preys on mice, the size of the bird relative to the mouse and their orientation in space, the marsh environment common to the bird, and so on. Depictions illustrate the saying, "A picture is worth a thousand words" and are more useful than descriptive representations for drawing inferences (Butcher, 2006; Kosslyn, 1994).

**The nature of symbol-specific processes.** Unlike the previous examination of trans-symbolic processes, it is challenging to discern from the literature particular symbol-specific processes. Aside from the contention that depictive representations likely elicit more inferences
than descriptions (Butcher, 2006; Kosslyn, 1994; Schnottz, 2005), the work in cognitive psychology cited here is silent on the subject. However, the work of Bloom and colleagues (1956, 1971) may again prove valuable, providing a useful starting place for exploring symbol-specific processes.

The first of Bloom’s comprehension subprocesses, translation, "put into different words or [change] from one kind of symbology to another" (Bloom, Hastings, & Madaus, 1971, p. 149), seems necessarily tied to symbology. Translation from one symbology to another is related to perception, as a learner is unable to translate from the base symbology without first perceiving and, if necessary, decoding it. For instance, the parts of a painting cannot be put into words before the viewer sees those parts. Likewise, a reader cannot translate the words on the page into spoken language without first seeing and decoding the symbols and spaces before him. Therefore, because it is first nested in one mode, be it verbal or non-verbal in nature, the processes inherent in translation may be more specific to each mode.

Interpretation, the second subcategory of comprehension, may include symbol-specific processes, in addition to those trans-symbolic processes already identified. As described by the authors, a key feature of interpretation is discerning which parts of the communication are important for understanding the message, and which parts are not needed. The knowledge relevant for making this distinction might be symbol-specific. When tasked with interpreting a newspaper article, for example, a skilled reader knows that a news article is structured with the most relevant information appearing in the first several sentences followed by increasingly less important information. In contrast, the most important aspects of a painting are typically positioned in the center of the canvas, with supporting visual material at the edges (Kress & van Leeuwen, 1996). Without knowledge of organizational structures particular to the symbol-
system, and likely within differing compositional types within it, distinguishing important from unimportant information would be very challenging.

**Research on the TSC Framework**

As noted by Loughlin and Alexander (in press), the TSC is a newly articulated framework and, as such, is an ongoing project. As is appropriate when forwarded new framework, the authors are interrogating its robustness by iteratively exploring and modeling particular relations arising from it. Currently, the TSC is being used to as a guiding framework supporting an examination of the relation between comprehension of text and paintings using think-aloud protocols. While pilot studies have been completed, the full inquiry is currently in the data analytic phase. Preliminary findings have, however, provided three key indicators supporting the TSC:

1. Understanding paintings, non-linguistic compositions, illicit comprehension processes;
2. Painting comprehension elicits some of the same processes as text comprehension (i.e., trans-symbolic processes); and
3. Painting comprehension elicits some process that are not found in text comprehension (i.e., symbol-specific processes).

Assuming these preliminary findings are borne out in the full inquiry, additional research will be needed to address the relation between the comprehension processes of other symbol-system, in an effort to further articulate the robustness and scope TSC.

**Conclusion**

In the educational and psychological literature, comprehension has been differentially perceived, in relation to both its nature and scope. When considered from the perspective of taxonomies of thinking (e.g., Bloom et al., 1956, 1971), comprehension is positioned in the
lower-orders and portrayed as simplistic, easy, and certain. However, in light of the literatures on reading and understanding (e.g., Pressley & Afflerbach, 1995; Ritchhardt et al., in press), and as tacitly acknowledged in Bloom’s taxonomy itself, comprehension is complex, multifaceted, and challenging, requiring a number of comprehension processes and types of thinking. Thus, while it is not high on Bloom’s taxonomic structure, it is nonetheless a “higher order” cognitive activity.

While the flaws in Bloom’s taxonomic perspective of comprehension have been portrayed here, his broad, trans-symbolic view of comprehension has likewise been praised. For decades, the literature on comprehension has been nested in the comprehension of linguistic compositions, particularly talk and text, resulting in the conflation of comprehension with comprehension of text (Alexander & Winne, 2006). However, recent movements from outside and within the field of reading have sought to expand this frame to, once again, reflect Bloom’s trans-symbolic view of comprehension (e.g., Leu et al., 2009; New London Group, 1996).

The Trans-Symbolic Comprehension (TSC; Loughlin & Alexander, in press) seeks to reconceptualize the nature of comprehension, more particularly the processes that give rise to the understanding of symbolic representations, serving as a possible framework for research reflecting an expanded view of comprehension, on that is not nested in the comprehension of linguistic compositions. The TSC reflects Bloom and colleagues (1956, 1971) complex relation to comprehension, addressing the limitations of their taxonomic approach to its examination by repositing comprehension as “higher order” and emphasizing the complexity of thinking required for it, while maintaining their trans-symbolic perspective of its scope. Thus, the Tran-Symbolic Comprehension framework is articulated as a higher order of thinking.
References


TRANS-SYMBOLIC COMPREHENSION


