Within the discipline of psychology two prominent domains of inquiry into reading are cognitive science and motivation theory. From the vast variety of investigations in cognitive science that include studies of the brain, language, speech, and thinking, we focus on one salient contribution made by Daniel Kahneman. He was awarded the Nobel Prize in 2002 for his work with Amos Tversky, emphasizing how our intuition and reasoning work together. Remarkably, two theories of reading comprehension, developed from cognitive perspectives, show striking parallels with the inner workings of intuition and reasoning portrayed in Kahneman’s research. Specifically, the landscape theory of van den Broek and the compensatory encoding theory of Walczyk both reveal intuitive qualities as well as reasoning processes in reading comprehension. Understanding the interplay of these processes can inform our viewpoints about the development of mature reading comprehension.

Central to our message in this chapter is the proposal that the motivations of readers align with the cognitive processes of intuition and reasoning to form an integrated system. In this alignment, intrinsic motivation is a major contributor to intuitive reading, while motivations related to self-discipline are the prominent forces driving reasoning in reading. We provide evidence for this alignment from both experimental and correlational investigations with students from grades four to college level. The significance of this alignment is that it reveals the interplay of cognition and motivation during reading and permits us to envision educational innovations that foster integrated development.

Intuition and Reasoning

The Kahneman and Tversky Perspective

On December 8, 2002, the Nobel Prize was awarded to Daniel Kahneman in Stockholm. Based on Kahneman’s lecture upon receiving the award, he wrote an article published in the American Psychologist (Kahneman, 2003). From that article and others, we extract his perspective on the two-tier system of the processes and contents in human cognition. In a lecture in 2008 at Harvard University Kahneman noted, “Most of the time we run at very low effort and people don’t check themselves as much as they should.” He was referring to the human tendency to judge things quickly, to go with the familiar and easy perceptions instead of giving a question or a problem sufficient attention, reflection, and thought. In the article and the lecture, Kahneman outlined two distinct systems of thinking which have an ancient history in psychology. The first cognitive system relies on perception, intuition, and emotion and is often performed unconsciously. The second system is a guided, controlled set of thinking operations. Both systems contribute to our intelligence and mental acuity.

A graphic display of intuition and reasoning is shown in Figure 18.1. On the intuition side, we are talking about our perceptions of the world such as seeing a tree, hearing a word, or feeling a flight of steps with our feet as we climb them. Our processes of seeing, hearing, or feeling in these situations share a cluster of attributes. As part of the intuitive system these processes are typically fast, automatic, effortless, associative, implicit (not available to introspection) and they may be emotionally salient. When we see a tree we do not make a decision about whether we are seeing the tree. Rather, it is fast, automatic, and effortless. As we hear a familiar word in an understandable sentence the meaning is brought to mind quickly, associated with other meanings automatically, and may bring laughter or tears. These processes all occur without our intentions or conscious attempts to make them happen. As we shall see, there are crucially important, similar processes in reading at several levels of sophistication.

On the reasoning side of our cognitive systems, the contents are conceptual and language based. We reason about concepts, problems, and decisions such as how to make an investment, whether to trust a neighbor, and how to program the digital recorder. As Figure 18.1 depicts, the processes of reasoning are slower, sequential, effortful, and governed by standards or criteria of satisfaction.

As Kahneman (2003) observed summarizing his own research and that of others, we may use the anthropomorphic phrase that reasoning
monitors the activities of intuition. Of course, the monitoring is loose and allows many intuitive judgments to be accepted, although some may be incorrect. The flow of intuitive information is so fast and rich that it all cannot be checked. Intuitive processing is often powerful and accurate. For example, studies show that nurses who intuitively detect subtle signs of illness may often be correct in important matters. Likewise, chess masters may play several chess games simultaneously making rapid, intuitive judgments about complex chess patterns and winning many games. A core quality of intuitive thoughts is that they come to mind spontaneously and effortlessly. In this sense, Kahneman refers to the contents of intuition as accessible. Some accessible perceptions are visible, like a brilliant red, whereas other accessible perceptions are emotional, like kind words from a significant other. The problem with many perceptions is that we may be inaccurate about them. We may simplify them, reduce them to categories, ignore important details, omit inconsistent information, or make rapid inferences that are incorrect. Occasionally, our inaccurate perceptions conflict with each other, collide with our conscious goals, or alert us to danger. When such incorrect perceptions imperil our well-being, we retrieve our forces of reasoning to monitor intuition and bail us out.

When the intuitive system is inaccurate or threatening in some way, the reasoning system kicks in. We evaluate information that seems inconsistent or incomprehensible. In evaluating we compare, relate, reassess, organize, transform, and otherwise reconfigure our inputs from the intuitive perceptions.

In his writing, Kahneman (2003) provides a plethora of examples for intuition and reasoning. Consider this basic math problem:

A bat and a ball cost $1.10 in total.
The bat costs $1.00 more than the ball.
How much does the ball cost?

According to Kahneman, the neat and quick answer that so many come up with is $.10. But the correct answer is $.05. As Kahneman says, “[Intuition] determines an answer, and it’s immediate and it’s wrong.” Here, intuition is misleading because people see two things, a bat and a ball, with two monetary figures, $1.00 in one case and $.10 in the other case. So we assign $.10 to the ball. Only by reasoning mathematically do we determine $.05 for the ball (plus $.05 for the bat) yield a total of $1.10.

The reasoning system may be disrupted by many sources. The corrective operations of reasoning are impaired by time pressure, by being required to perform a competing task simultaneously, by performing the task in the evening for morning people or in the morning for evening people, and by distracting stimuli such as noise. As we all know, reasoning is delicate and decidedly not foolproof.

Cognitive Theories of Reading Comprehension

Landscape Theory

In an extensive program of experimental cognitive research, Paul van den Broek of the University of Minnesota promotes the landscape theory to illuminate and explain text comprehension. At the center of his formulation are twin processing systems; one called “memory based” and one termed “constructionist.” These processes are both crucial and operate in conjunction during reading comprehension (van den Broek, Rapp, & Kendeou, 2005).

In the memory-based view, the comprehender, say a fourth grader reading on grade level, encounters new information in reading a text. As each word appears, the meaning of that word is brought to mind; it appears rapidly and automatically and accurately (for a substantial majority of words). The meaning of these words is said to come forth “free.” We do not usually put effort to understand the meaning of a simple word. In addition, the word evokes associations with other words in the sentence and the surrounding text. These associations also come effortlessly. These memory-based processes related to word meanings are autonomous and passive. As van den Broek says, they are “dumb” in the sense that meaning activation for these words is not a conscious goal of the reader; it is merely happening.

On the other side of the coin are constructionist processes. These are initiated by explicit or implicit goals of the reader. The most general goal is a search/effort after meaning that readers bring to a text. Van den Broek and colleagues (2005) report that readers hold internal standards for coherent meanings during reading. They try to meet “standards of coherence” by integrating, organizing, connecting to background knowledge, and inferring sufficient to build a knowledge structure that makes sense to them. Constructionist-based processes prominently include activating knowledge that has been recently acquired from previous sections of text. Activations may also occur for background knowledge from long-term memory and for connections formed during recent reading. Many other constructionist processes may occur such as seeking key words, and most essentially, building causal inferences that enable the reader to formulate new knowledge structures that are integrated.

Most vitally, the memory-based and constructionist processes interact with each other. An example of the interaction is shown in research using an inconsistency paradigm. In this research approach, readers encounter information early in a paragraph (e.g., Bill was old and weak. [sentence 1]). That sentence is inconsistent with later information (Bill ran quickly and picked up the boy. [sentence 2]). Alternatively, a sentence may be given which is consistent with the prior such as (Bill was unable to reach the boy in time. [sentence 3]). Readers who encounter sentence 2 slow down and spend much longer reading the sentence than readers who encounter sentence 3. The increased reading time reflects the inconsistency. As the student perceives the inconsistent sentence, she needs to engage in some inferential processes and knowledge activation processes to establish the coherence of the two sentences. The rapid reading of sentence 3 was due to its predictability from sentence 1 and high level of similarity and meaning. Thus, the constructionist processes kick into gear to cope with memory-based processes that are inaccurate or incompatible with the quest for meaning. These constructionist processes are much slower, more conscious, and more deliberate, as well as being more goal driven, than the memory-based processes which are fast, automatic, and
Compensatory Encoding Theory

Proposed by Jeffrey Walczyk, compensatory encoding theory is a framework for understanding the interplay between automatic processes and strategic resources in reading (Walczyk et al., 2007). The theory describes how readers compensate for poorly automated skills and identifies a list of compensatory actions that serve to mend misinformation or misunderstandings generated by these skills.

For readers at the third-grade level and above, there are many automatic elements to the reading process. For example, letter identification is essentially automatic and rapid. Most 8-year-old students reading at Grade 3 grade equivalent and above do not stop at a single letter and ask, “Shall I recognize this letter?” Their letter recognition is free and automatic. Furthermore, as letters are embedded in words, words become the object of immediate perception and may be read accurate without seeing or requiring all of the letters. Even phrases may become objects of immediate perception based on our abilities to predict syntactically. Third graders will recognize a phrase “red, white, and b_____” as ending with “blue” based on knowledge of the flag and syntactic predictions. Few would read “red, white, and black,” much less “red, white, and but.” Students may also automatically process a genre, such as the beginning of a story, initiated by “Once upon a time...”

Thus, automatic processes include letter recognition, lexical access, speech recoding, semantic encoding, prepositional encoding, and sentence integrations. In on-grade reading for students who do not possess cognitive challenges, Walczyk et al. (2007) proposed that several compensatory strategies may be used when these automatic processes fail to function adequately. The reader brings these compensatory processes to the rescue when the normally automatic ones let them down. For example, sounding out words methodically is a compensation strategy used when students are insufficient or inaccurate. In contrast, the constructionist processes are akin to reasoning in the sense that they are slower, higher effort, logic driven, and may be used to monitor their counterparts. Thus, although memory-based processes do the vast bulk of the work in basic reading just as intuitive processes do the vast majority of cognitive enablement of our behavior, we have backup systems. When memory processes are insufficient or inaccurate we invoke complex, difficult, but more reliable constructionist systems to improve comprehension just as we invoke reasoning to give corrective action to misguided intuitions.

Although landscape theory explains comprehension for narrative and expository text, a powerful application of landscape theory has been made in explaining the positive benefits of refutational text in science. Previous investigators have shown that text which contains alerts to potentially confusing information or to information that conflicts with students’ background knowledge is more effective than text that does not include the alerts. Such alerts may include phrases such as notice that, or you may think...but actually... Although alerts are valuable, previous research had not attempted to explain the source of benefit for refutational text over traditional passages (van den Broek & Kendeou, 2008).

In a verbal protocol study, van den Broek and Kendeou (2008) asked students to read refutational text while thinking aloud, as well as read traditional text while thinking aloud. In the students’ verbal protocols the investigators observed that during the reading of refutational text students simultaneously activated text-based information that was incompatible with prior knowledge (subject to misconceptions), as well as text that was compatible with prior knowledge. Thus, the verbal protocols revealed co-activation of consistent and inconsistent knowledge during reading. After this co-activation, students performed inferences and reasoning processes that enabled them to resolve the conflict between the consistent and inconsistent information. Thus, the co-activation during refutational text reading brought up constructionist processes that enable students to build coherent knowledge. In contrast, verbal protocols for reading traditional text did not show the inferencing and integration efforts of students and did not result in highly coherent knowledge constructions after reading. The authors interpreted the benefits of refutational text which contained the alerts to be attributable to co-activation of memory-based information that is inconsistent with each other, which elicited constructionist-based processes of inferencing and reasoning that were sufficient to build an organized set of interrelated information that satisfied the readers’ standards of coherence.

The similarities of Kahneman’s framing of intuition and reasoning with van den Broek’s landscape model of reading comprehension are substantial. Van den Broek’s memory-based processes are very much like the intuitive processes Kahneman proposes for many of our perceptions. In other words, like intuition, the memory-based processes are rapid, automatic, effortless, and may be effective. They may also be inaccurate. In contrast, the constructionist processes are akin to reasoning in the sense that they are slower, higher effort, logic driven, and may be used to monitor their counterparts. Thus, although memory-based processes do the vast bulk of the work in basic reading just as intuitive processes do the vast majority of cognitive enablement of our behavior, we have backup systems. When memory processes are insufficient or inaccurate we invoke complex, difficult, but more reliable constructionist systems to improve comprehension just as we invoke reasoning to give corrective action to misguided intuitions.

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In addition to traditional laboratory experiments, the landscape model has been investigated using computer simulations in artificial intelligence. The simulations contain predictions about word meanings, coherence of text, and ease of comprehension for particular paragraphs. From the model, authors can predict which sentences will be easily recalled by students. The computer simulation accurately predicts which sentences will be easily read aloud during a verbal protocol tasks or will be recalled accurately in free recall tasks following a text reading activity. Thus, the landscape model has been operationally defined precisely enough that it can be programmed into a computer and make accurate predictions about students’ level of reading comprehension.

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Motivations Align with Processes in the Cognitive System

People vary in their approaches to reading and studying in school. Some students are self-disciplined in their approach. They read history, science, or literature that is assigned and are committed to being thorough and complete in their work. Taking pride in the accomplishment that their consistency affords them, these students often have a schedule for school reading or homework and are conscientious in meeting standards of their teachers. These students are gratified by being high achievers and believe their success will benefit them in future schooling or later in life.

Students’ attributes of self-discipline have been studied recently by Angela Duckworth and her colleagues, including Martin Seligman, leader of the Positive Psychology Center at the University of Pennsylvania. One title from Duckworth’s research is a mini abstract of her findings which is the following: “Self-discipline outdoes IQ in predicting academic performance of adolescents.” In her study, Duckworth and Seligman (2005) studied 140 eighth-grade students in one investigation and 164 eighth graders in a follow up. Students took IQ tests and questionnaires about their study habits and their self-discipline based on work by Tangney, Baumeister, and Boone (2004). The questionnaire included 36 items with positive statements such as the following:

- I never allow myself to lose control.
- I keep everything neat.
- I am reliable.
- I eat healthy foods.

Negative indicators of self-discipline included the following:

- I have a hard time breaking bad habits.
- I change my mind fairly often.
- Sometimes I can't stop myself from doing something, even if I know it is wrong.
- Pleasure and fun sometimes keep me from getting work done.

This latter set was reverse coded to form a questionnaire where high scores reflected high self-discipline and low scores reflected low self-discipline. The main finding of Duckworth and Seligman’s study (2005) was that self-discipline predicted students’ GPA at .52 and .66 in studies 1 and 2, whereas IQ predicted final grades at .34 in study 2. Even when IQ was accounted for statistically, self-discipline significantly predicted GPA in both the first and second marking periods. One reason that self-discipline correlated with grades higher than IQ was that the very
highest achievers showed remarkably high self-discipline, although their IQ was only moderately high. In addition, the very lowest achievers showed strikingly low self-discipline, even though their IQ was only moderately low. A limitation of the study was that this was a magnet school with relatively high performing students who were relatively talented. For this group of individuals in a slightly narrow range of talented individuals, self-discipline makes the big difference in GPA. Impacts of self-discipline on reading and achievement are well documented in other studies (Duckworth, Peterson, Matthews, & Kelly, 2007).

Alignment of Motivation Processes with Cognitive Systems

We propose that there is an alignment between the two sides of the cognitive system described previously—intuition and reasoning—and the two sides of the motivation system presented in the previous paragraphs—self-discipline and intrinsic motivation. That is, certain types of motivation occur primarily with intuitive reading processes. An example may be the reading processes of a skilled reader who is enjoying a favorite type of fiction. This individual is reading easily, meanings are appearing in the mind effortlessly, and it is rare that the individual corrects mistakes and checks his thinking during this form of reading. The motivation prevailing during intuitive reading is likely to be intrinsic motivation. For the individual enjoying fiction, it is the gratification of the moment that sustains the reading activity. This reading act is not performed for the purpose of attaining an external goal or acquiring information to be used at a later time.

In contrast to intuitive reading performed under conditions of intrinsic motivation, reasoning in reading is likely to be accompanied by motivational processes of self-discipline. For example, a student who is reading a science text in school is likely to have an explicit goal of comprehending the text for an explicit purpose such as writing answers to questions about the topic. The individual will bring standards of coherence to the activity, will use strategies such as identifying key points, organizing information, and linking to prior knowledge in order to build a knowledge structure and enter the material into long-term memory. In this reading of a science text, reasoning, or constructionist processes in van den Broek’s theory, is often required because the words are difficult, the sentences and information structures are complicated, and the burden on recently learned knowledge is heavy. Thus, self-discipline comes into play. The successful reader of this science text is likely to be self-disciplined in the sense that he subdivides broad aims into subgoals, frequently makes inferences deliberately to connect information within the text being read, and may take notes or organize ideas, placing concepts and relationships in his own words. Sustaining high effort and working to completion of tasks is key to success in this reading event and the persevering individual is most likely to attain the goals of building coherent understandings. Students who give up midcourse or neglect key points or fail to be resilient in the face of challenge will be less likely to achieve personal and classroom expectations for comprehending text. This may be called strategic reading and the use of strategies requires slow, deliberate, and methodical effort.

The two forms of reading may be contrasted both cognitively and motivationally. Intuitive reading is dominated by fluent flow of basic processes. It occurs quickly, effortlessly with positive affect, which suggests intrinsic motivation as a propelling force of this reading. On the other side, strategic reading is performed with cognitive awareness, deliberate use of strategies to build meanings according to standards of coherence, and constant attempts to integrate knowledge with background information. Motivations for this reading are characterized by persistent effort in attaining long-term goals. An individual performs the difficult operations to gain valued knowledge, to maintain the self-image as a high caliber student, to sustain a high GPA, and to be known as a successful student in the classroom and school.

We do not wish to make an inherent connection between genre and alignment. Although intrinsic motivation often occurs with fiction, intrinsic motivation may appear for information text that is familiar to a reader interested in the topic. However, intuitive reading is most likely to occur when the reader’s disposition is to read for the absorption in text. In contrast, reasoning is most probable when the reader is seeking to gain knowledge that may be connected to prior knowledge about a topic. Frequently, but not necessarily, these varying reading dispositions are connected to different genres. Intuitive, intrinsic reading may occur for science text if the reader is expert in the topic and facile with the text’s register. Likewise, reasoned, self-disciplined reading may occur with literature that challenges the reader to think methodically. These cases are slight exceptions to the general trend for ‘light’ fiction to be reading intuitively for intrinsic motivation and ‘heavier’ exposition to be read with self-disciplined reasoning.

Evidence for Alignment

Our case for the alignment of the basic cognitive systems in reading and fundamental motivations in reading begins with simple cogency. It seems eminently sensible that intuitive reading, which is easy and propelled by automatic processes, should be performed when the individual is seeking enjoyment in the process. When the individual is seeking immediate gratification from reading she will find text that requires medium to low effort while it is rewarding her with events, characters, and experiences. On the other hand, when we face challenging texts that we read for the purposes of education or employment, we are unlikely to rely on intrinsic motivation as a propelling force. Rather, we tap our capacity for self-discipline by thinking of long-term goals, planning our approach to the reading challenge, and deploying our strategic resources as adefectly as possible.

Experimental Studies

Compelling evidence favoring this alignment consists of experimental studies of these variables. Narvaez, van den Broek, and Ruiz (1999) attempted to determine whether students who were reading for intrinsic motivation performed reading processes differently than individuals who were reading for a typical school studying task which required self-discipline. They gave undergraduate students a narrative text consisting of a fictional story about a bellboy who hears strange sounds from a hotel room and breaks into the room to save a woman. They also gave them an expository text on the scientific theory and evidence concerning the causes of the eradication of dinosaurs. One group was instructed that they should read for pleasure as though they were reading for fun or recreation. They were to imagine they had...
music and a sunny day for their reading activity. The second group was instructed that they should attempt to gain as much information from the text as possible and that they should prepare for an examination over the content of the text. They should think of themselves as studying in a library or their room. Students read aloud and verbal protocol data were collected and coded into categories consisting of evaluations, repetitions, and coherence breaks which represented reflections about the integration of information in the text. Verbal protocols were also coded into associations, explanations, and predictions.

Students who read for the purpose of studying, which required self-discipline and reasoning, revealed in their verbal protocols that they were undergoing more evaluations, repetitions, and detection of coherence breaks in the text. However, the impacts of the two motivations on cognitive processing appeared for expository text significantly, but did not appear for narrative text (i.e., bellboy story). In other words, when reading the expository text (e.g., eradication of dinosaurs), students who were reading under the self-discipline that required them to gain knowledge, performed a large number of reasoning processes that were not performed by individuals who were reading for entertainment or intrinsic motivation. On the other hand, the motivational conditions did not significantly influence the evaluations, repetitions, or coherence breaks that appeared in the verbal protocols for those reading narrative texts.

This evidence supports the alignment of motivational processes and cognitive systems. When students face the task of building knowledge from text they employ their self-disciplinary competencies of reasoning during reading. These reasoning processes occur more dramatically in the presence of expository than narrative text. On the other hand, when students read for pleasure or reading to satisfy curiosity in a topic (e.g., bellboy story), they do not perform these reasoning processes as fully. They are less likely to report repetitions or breaks in the coherence of text as problems to be solved in the reading activity.

Because this evidence is based on true experiments, with individual students assigned to motivation treatment conditions, our conclusion from the data must be that the nature of the motivation impacted the nature of the reading process. Whether students were reading intuitively or strategically depended upon whether they were reading for intrinsic motivation, which led to intuitive reading, or knowledge building, which required self-discipline in the case of studying. Furthermore, this occurred irrespectively of students’ working memory capacity. It should be noted that this striking alignment appeared for expository text and was not examined in this study for its possible occurrence with narrative text.

Conclusion

An educational implication of this alignment suggests that both intuitive and reasoning processes of reading should be fostered in schools. However, in school after about Grade 4, knowledge goals increase in importance. Texts that convey this knowledge are often complex, challenging, and may conflict with student naïve experience-based understandings. Information texts, although they are not popular with students, are pre-eminently valuable for students’ knowledge acquisition, which is the main agenda of middle and secondary schooling.

Teaching students the motivational processes of self-discipline and the cognitive systems of reasoning about text ascends in importance with advancements in schooling. At the same time, the powerhouses that drive both intuitive and reasoned reading, consisting of intrinsic motivation and self-discipline, should receive explicit attention from educators in order to assure that students receive full support in becoming deep comprehenders and broadly engaged readers.

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