Chapter 1

Introduction

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INTRODUCTION

The goal of the book is to provide readers with the expertise to teach all students to be fluent and engaged readers, which includes helping them gain a love for reading. This chapter provides an overview of the purpose of the book and a description of each of its chapters. It also describes a strategic science of teaching and its application to reading instruction. Finally, it incorporates a synthesis of findings in reading research from both educational psychology and the science of behavior.

KEY TERMS

Bidirectional naming	Reinforcement value
Class of responding	Stimulus
Conditioned seeing	Stimulus control
Cusp	Strategic science of teaching
Function	Textual responding
Learn units	Transparent and nontransparent words
Ontogeny	Verbal behavior
Operant	Verbal development cusps
Phylogeny	

When Text Speaks: Learning to Read and Reading to Learn

We recently overheard a teacher with decades of experience remark, "I teach but the students don't learn." This is sad, because there is a comprehensive science of teaching that integrates teaching and learning—the **strategic science of teaching**—which maintains that the process of teaching is not complete until the student has learned. In this approach to learning, development, and behavior analysis, teaching occurs not when a lesson has simply been presented, but only when the student has mastered the skill or objective of instruction.

According to the strategic science of teaching, the process of teaching is not complete until the student has learned.

All children with the relevant developmental foundations can be taught to read, but their many individual differences require different scientifically based instructional tactics. In this book we set forth a strategic approach to the teaching of reading, taking into account a synthesis of findings in reading research and the science of behavior over decades.[2, 3] Our focus is on the application of the strategic science of teaching to the teaching of reading, and our goal is to provide the reader with the expertise to teach all students to be fluent and ardent readers, including a passion for reading to learn. One of the prominent psychologists of the twentieth century argued that while it might be important to teach great books, it was vastly more important to teach a love of reading.[1]

Recent data from the United States Department of Education indicates that less than 40 percent of fourth graders are proficient readers![4] What is most depressing about this information is that it is clear that the existing knowledge about how to teach reading has not improved reading outcomes. This is not a very good recommendation for the utility of the evidence base. How is it that we think this book can improve the dilemma? Especially when we acknowledge that our research has not focused on the teaching of reading to the degree that many others have. What we set forth in this book is:

a. a reliable way to implement the consensus findings of prior research;
b. seven decades of research findings in the science of behavior (www.associationforbehavioranlysisInternational);
c. four decades of research to develop a strategic science of teaching (www.cabasschools.org;https://www.scienceofteaching.org/fasstboard);

d. a research program focused on how children's language communication develops.[5]

e. and how this results in knowing how to determine what the problem is when individual children are not learning to read, or reading to learn, and how to fix it.[6]

Part of what we must do is explain some of the special terms associated with our science. In many cases the terms may seem to be substitute jargon for the terms teachers have used for decades. However, if that were the case, we could simply use the existing terms. But, if the terms function to allow a different perspective, and that different perspective results in teaching children to read fluently when they would not have done otherwise, then the terms are necessary and earn their keep.

THE BEGINNING WORDS. *When should a child begin to learn to read?* This has been debated for at least a century. Our answer is based on research and successfully teaching very young children to read and to love to read. It is not children's chronological ages that determine the critical time when they are taught to read; rather, it is the presence of certain developmental milestones identified in research in the science of communicative or verbal behavior. The term **verbal behavior**, as we use it in related behavioral sciences, encompasses all the ways in which we communicate including, but not limited to, language in all of its forms. In the science of verbal behavior, key milestones are described as **verbal developmental cusps**. They are called cusps because (a) once children first demonstrate them, they are on the cusp of learning something that, when learned, opens an entire area of learning—what we call a **class of responding**.

One of the things that is learned is called an **operant**. Once the first operant is learned for a particular class of responding, other operants can be learned that belong in that class. That is, until the first operants—or foundational operants—are learned, the range of operants belonging to the class cannot be learned or are very difficult to learn. However, learning the foundational operants belonging to a class makes it possible to learn the range of operants belonging to the entire class.

For example, once a child has learned to say the transparent phoneme sounds for letters and can blend those into words, all subsequent reading curricula presume that the range of untaught words can be decoded (i.e., the child can see the print and say the untaught word or words they have never encountered before). What the sci-

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ence of behavior tells us is that we can expect this to happen *only if* a child has the necessary learning history that allows this formation of the class of responding. Thus, even if a teacher implements what the research consensus indicates as a best practice, a child who is missing the necessary learning history may not benefit from even the best teaching practices and curricula. If a particular child does not learn to blend phonemes, and the teacher and the other children progress to the next steps, the child's difficulties in reading continue to multiply. When we understand what the child is missing—that is, a particular **stimulus control** that is missing can be identified as a specific **cusp** or a function of missing a specific cusp—we then draw on research that has identified different teaching operations or tactics that, when used, result in the child mastering blending transparent phonemes. Learning the class of responses or operants is possible because the cusp for doing so has been established or induced.

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Most classes of responding are not verbal development cusps. However, there is a group of classes of responding (or response classes) that constitutes verbal developmental cusps. These cusps often determine what children can be taught or learn incidentally (from observation, or exposure without being taught), and how the teacher should present instruction. Some of these cusps must be present for children to become fluent and ardent readers. Fortunately, there are now procedures to assess the presence or absence of cusps, and in many cases, there are tested procedures to establish missing cusps. Once the cusps become present, one or more obstacles to learning to read can be eliminated. The presence or absence of some cusps may also be the sources of types of reading "disorders" that, from a science of behavior, are not disorders but problems with stimulus control. That is, some students who are having difficulty learning to read may have learned the wrong stimulus control. The reading problems may have to do with learning to read or learning from reading.

THINGS WE COME TO SEE, HEAR, AND SAY AS STIMULUS CONTROL. The perspective of our science results in a different way of describing what we and our students see, hear, smell, feel, and think. Our **phylogeny** (our genetic material) as well as our **ontogeny** (our own history of experiences) results in each of us contacting the world a bit differently. When we learn

something such as a new word, we are often surprised when the word seems to appear everywhere. The word was probably always there but it had not become part of our environment. Thus, one's environment consists of "things" that we contact because we have learned them. "Things" that we have not learned are not part of our environment; these are "things" that we cannot contact. The expression "It's Greek to me" makes this point. When children cannot read a letter, word, or sentence, these stimuli are not things that attract their attention. They are not part of their environment, or world. **Stimuli** refer to things in the world, and **stimulus control** refers to the things in our environment that we contact, including an incident of learned stimulus control. Thus, when a child learns to say phoneme sounds, (i.e., a letter sound) for a particular grapheme (i.e., a printed letter), this textual stimulus results in the child saying the letter sound. When they cannot say the sound, the stimulus control is lacking. Seeing and saying a letter sound is an example of a learned operant. Other learned operants include blended words, sentences, or prosody (i.e., saying the sentence with expression).

Knowledgeable educators, designers of curriculum, and psychologists state the goals of instruction as behavioral objectives. Hence, when students learn objectives, they can do things they could not before, and these acts that they do or emit are observable and, hence, measurable. However, what is learned is not only the topography of the behavior but also the context, particular environment, or stimuli that result in the behavior; that is, they learn the stimulus control for the behavior. For example, the operant **function** of a word depends on what precedes it (the antecedent to the behavior) as well as the consequence of the behavior. When we decode (i.e., see print and say the word) the word *"sharp,"* the meaning/function of the word is based on what comes before and after the word is said. Both the antecedent and the consequence to saying the word are stimuli. Stimuli that precede the behavior of saying the word aloud, or to yourself, are discriminative stimuli, while the consequence of the word is the reinforcing stimulus or functional effect, including affect as one effect on the reader (i.e., the reader sees a *sharp* knife as a mental image). In another example of the reinforcer with the same word, *sharp,* if the sentence reads, "He is sharp as a tack," the reinforcement function might be seeing a mental image of a person who behaves very intelligently.

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The process of teaching reading requires bringing learners into contact with teaching operations that result in students developing stimulus control for all the components of reading. In education, the components of

reading are often categorized as the aspects of teaching children to (a) learn to read and (b) read to learn.

LEARNING TO READ. Printed text speaks a story or instructions about what, how, why, when, and where to do something. Learning to read refers to learning the fundamentals of seeing the printed text while simultaneously hearing it as speech. That is, learning to read involves acquiring the same stimulus control with print that we have when someone speaks to us by telling a story or providing instructions, directions, or descriptions. In other words, text must come to be an extension of listening. Moreover, learning to write should involve the same stimulus control for the writer as if the writer were speaking to a listener who is present. Students learning to read learn the fundamental stimulus control that results in text speaking to them. Students learning to write learn the stimulus control for affecting the behavior of a reader as if they were speaking to a reader.

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IDIOSYNCRATIC STIMULUS CONTROL. When instruction is inadequate or is not consistent with the best practices that work for most students, some students will learn incorrect stimulus control or need interventions that identify how to develop the correct stimulus control. Some of these have been identified in our labs, research, and demonstration schools; and the instructions in the chapters for teaching reading will: (1) describe instructional operations that minimize problematic stimulus control; (2) explain how to identify which stimulus control need to be fixed; and (3) teaching interventions that have a successful track record addressing the missing repertoires. To go about this, the teaching process involves not only implementing scientifically based operations that work for most students but a special expertise in problem solving learning problems. This is the expertise which constitutes a strategic science of teaching. That is, the strategic science of teaching requires the use of scientific tools and analysis in ways that are inextricably embedded in daily teaching practices. Chapter 2, for example, sets out the fundamental teaching operations that must be in place at the onset of and throughout instruction. If most teachers used these procedures, they could probably implement most of the findings prescribed in the existing evidence base for teaching reading.

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Table 1.1
Components of Teaching Students to Read in Their Simplest Form

Term	*Explanation*
1. Reading readiness Seeks out and looks at books and seeks out and listen to stories. The child "loves" to look at books and being read to by readers. In a great deal of educational research, the relation between various ways of looking at the motivation to want to read has been found to be highly predictive of children learning to read fluently.	We describe teaching operations that establish the motivation to learn to read and the motivation to read for content. Strategic science of teaching research identifies ways to determine the degree of motivation to learn to read or read to learn. This is an empirical measure of reading readiness. Moreover, there are tested procedures to establish the motivation to read or read to learn. The first step in teaching children to learn to read is a measurably accurate indication of the presence of the motivation to read. The term in the science of behavior is **reinforcement value**, which means that they look at, choose, and prefer books; and they continue to read for longer and longer periods under certain conditions. Two chapters in the book are devoted to this type of stimulus control. One chapter is devoted to establishing the reinforcement value for learning to read and another chapter to establishing the reinforcement value for reading to learn.
2. Decode Textual Responding (see text and say phonemes or words).	When a reader sees print and says a word, in fact nothing is *decoded*. Just as students learning to read musical notation aren't said to decode .If the word were a code and referred to some secretly shared meaning or function, then the word code would apply. Instead, in a science of behavior, the terms *textual response* and *textual responding* include the antecedent or discriminative stimulus (i.e., the print) and the action or response. The overwhelming evidence prescribes teaching students to respond to phonemes rather than whole words. However, our research also shows that first they need to learn that phonemes are part of words as described in subsequent chapters. A phoneme is a component of the composite word. After the student has learned the component phonemes, they need to learn to blend. The procedures described in the following chapters illustrate best practices for doing this. In addi tion, we explain how to overcome the blending difficulties by using research-based procedures. The categories of textual responding should include **transparent** phonemic classes of responding and **nontransparent** phonemic classes. When a language is transparent, the sounds of text are the same for all words. In nontransparent languages the phonemes may change based on different types of letter groupings. English is only partly transparent, hence making it more difficult to learn "see and say" print.

Table 1.1 (cont.)
Components of Teaching Students to Read in Their Simplest Form

Term	*Explanation*
2. The sound or word that a student hears matches a picture, word, or letter. The word horse goes with a picture of a stimulus (i.e., picture of a horse) or a horse. All these responses and stimuli are related across different modes of sensing and responding. One might say they belong to a cross-modal frame.	Seeing the text and saying the word "horse" results in mentally seeing (i.e., **conditioned seeing**) the horse or the stimulus control for horse might also include imagery responses such as smell, feel of riding, sounds of horses, and pleasure or fear from hearing the print in reading. Readers who comprehend have one or more of these stimulus controls. There are several simple "match-to-sample" aspects of this phenomenon. If readers see the word, they must match the print to the horse or picture and vice versa; hear the word and then point to the print; see the word and say it, then match the printed word to the picture or the mental image of what the word "stands for." Of course, this also extends to much more sophisticated relations such as actions, functions, metaphors.
3. Read and do This is a basic and first step function of learning to read.	There are two major functions of reading. Technical reading is reading to engage in fundamental everyday functioning as well as reading in the fields of science, technology, engineering, and math where the reinforcement function allows the reader to learn from and build on the experiences of others. This function is often overlooked or minimally part of the curriculum in the typical approach to teaching reading. We seek to redress this oversight in the current text by teaching both the technical/scientific functional reinforcement value of reading writing. The other major reinforcement function of reading is aesthetic, entertainment, or existential in nature. Both functions need to be taught as the motivation that drives learning the structures of reading and writing. We outline a sequence of stimulus control to be taught, and how to teach the stimulus control for reading algorithms and doing what is written—ranging from learning to find hidden treasures to learning to do algebra solely from printed algorithms.

Table 1.1 (cont.)
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Term	*Explanation*
4. Read and draw Read and Draw demonstrates mental imagery or as we say, "conditioned seeing." The term conditioned seeing suggests the source for what some call mental imagery. Conditioned seeing suggest that certain stimuli, in this case words, result in sensing the stimuli as if they were present when, in fact, they are not..	Several chapters deal with aspects of conditioned seeing while one of the chapters deals extensively with how to test for conditioned seeing and then establish the stimulus control for it. Evidence of conditioned seeing is observed when learners draw accurate representations after reading.
5. Strategic Science of Teaching All these objectives need to be taught using a strategic science of teaching with correct presentations or learn units, and accurate and doable practical measurement of students' learning or not learning. In addition, the measurement must drive individualization such that all students master the objectives, albeit at different rates. Finally, the objectives mastered must be aligned with valid educational standards.	The procedures we describe in this book for teachers to use have been used day in and day out in our CABAS® Schools for almost 40 years and have been shown to be measurably effective ways to teach and measure at the same time. For more information, see www.cabasschools.org and https://www.scienceofteaching.org/fasst-board.
6. Verbal Developmental Cusps. Presence of the verbal developmental cusps that are the foundations for the joining of print with verbal behavior.	Reading is only possible if the necessary verbal developmental cusps are present. In some cases, difficulty with learning to read stems from missing specific or a combination of verbal development cusps. In this book, each of the chapters specifies the cusps that need be present for students to contact certain types of instruction or experiences. and how to establish those if they are missing.

Table 1.1 (cont.)
Components of Teaching Students to Read in Their Simplest Form

Term	*Explanation*
7. Inference and Comprehension	These are referred to as derived relations. In reading these can include the kinds of stimulus control we described above for the word horse. Someone reading about the sound of horses could demonstrate comprehension by matching hoof beats to the word horse even though the text does not mention hoof beats. The source of comprehension lies in the prior history the reader has with stimulus relations and how they came to learn those relations from observation or direct instruction. Understanding this provides us with tools to improve the relevant stimulus control as they relate to interrelated frames.

However, the problem that teachers encounter is determining what to do when students are required to meet specific objectives. The teacher is left with the problem of "*How to do this*?" This is the point where the strategic science of teaching adds additional classroom-tested tools. The first steps involve explanations for how to individualize instruction such that the management of the classroom: (a) deals with different rates of learning; and (b) how to know when mastery occurs. A key scientific tool is measurement of the students' learning as teaching occurs; several chapters explain how to do that as an essential part of the process of teaching and not as something separate. Measurement tells you, for instance, when the objective is mastered so that the student can move forward even if other students cannot. Other tools prescribe tactics for how to do this in classrooms with very different students. Measurement also identifies when the student is not mastering the objective, which indicates that the student is not learning from the present instructional tactics and that instruction should stop. Finally, measurement helps us analyze a learning problem to determine: (a) why the student is not learning the correct stimulus control; or (b) if the wrong stimulus control is being learned.

Chapters in this book explain how to conduct measurement as part of the teaching process and how to use it to identify the potential source of a learning problem. Once the problem is identified, the teacher can intervene with relevant research-based interventions to establish stimulus control as described in the chapters. A great deal of research in reading describes teaching practices that work for most students who have common learning histories, but implementation of these also requires a set of practices. Using practices from the strategic science of teaching ensures fidelity of imple-

mentation of best practices and includes what to do when these procedures do not work for many stimulus control problems. We describe many of these problems and ways to solve them. Of course, like any science, there is a great deal that we don't know, but research will add tools to the science as the tactics and strategies in the science grow. We think that there is enough that we have learned thus far to disseminate to teachers with the expectation that using a strategic science of learning and verbal development can significantly advance the educational prognosis for many children.

After children master the prerequisites for learning to read their first transparent phonemes, a subset of students has difficulty with blending the phonemes together so they can say the word. The blending response requires the joining of the component phonemes of a word so that the child can say the composite word. For example, sometimes mastery of saying the individual sounds (i.e., s/n/a/k/e) does not result in saying the whole word (e.g., SNAKE). That is, the stimulus control does not shift from the controlling individual sounds to the composite word sound because the child does not hear the whole word or cannot produce the composite sounds. Some of the difficulties involving idiosyncratic stimulus control include not hearing the blend, not producing blending, component sounds to composite word problems, difficulty with learning particular classes of non-transparent textual responding, demonstrating comprehension only when reading aloud, simple inference in comprehension to name a few. Chapters in this book deal with analytical processes to identify the problems, teaching operations, and developmental interventions that prior research has found to fix the problems.

Once students have learned the components of reading, which we describe as *fluent accurate textual responding*, they are prepared to read to learn. However, fluent textual responding is only one component of reading. Moreover, simple comprehension does not necessarily lead to what is needed to read to learn. Much of the current educational research in reading points to real problems with students as they move from the grade levels where they are learning fundamental stimulus control for early reading to the stimulus control needed to *learn* from reading. How to fix this is the subject of Part Two of this book.

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Reading to Learn: What it is and How to Do It

Once children learn to accurately **textually respond** to novel words (e.g., minimum of 90 words per minute) and even more when they are fluent (e.g., 150 to 250 words per minute silently), they should acquire func-

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tions for using new words from reading the text. Research over the last decade suggests that learning new words from reading is tied to a verbal developmental cusp that is likely an extension of how one learns language functions as a listener; that is, from exposure to others who are using the words in ways that they are typically used. This particular cusp is **bidirectional naming**. A program of research shows that children who demonstrate bidirectional naming can learn the names of things simply by listening to another say the word in proximity to the children observing other sensory stimuli (i.e., hearing the word while viewing, smelling, touching, hearing another sound, or tasting another stimulus).[7] The cusp gains still other stimulus control as learners have additional experiences with numerous attributes of a stimulus, including its function and its relations to other stimuli. Neurotypical children who are in rich language environments demonstrate this as early as three years old, although it can be established by intervention as early as two years of age Unfortunately, some children such as children with disabilities like autism, some typically-developing children who are from economically disadvantaged communities, or some children who are English Language Learners (ELL), may acquire this stimulus control later, acquire it only as a listener, or may not ever successfully acquire this stimulus control without intervention.[7] This may mean that that they are missing the stimulus control for learning language incidentally. Of course, this also means that even if they learn to textually respond fluently, they do not learn new word functions because reading comprehension is a process of hearing another speak (e.g., the writer of a book) and sensing what they sense indirectly.

LEARNING TO LEARN FROM EXPERIENCE ALONE. Deficits in stimulus control for **Incidental Bi-directional Naming (Inc-BiN)** can interfere with learning new word functions from reading. One of the reasons that typically developing children do not learn the stimulus control of BiN from their environment is because they may not have frequent contact with caretakers using verbal behavior with them and they may not have rich verbal environments that reflect the written language used in school (i.e., language and non-language communicative interactions). This can be the result of living in an impoverished environment where the demands of the families' economic survival require working multiple jobs and the multi-generational effects of this situation. Of course, any environmental condi-

tions that result in a child making little contact with verbal interactions can lead to the same outcome. The lack of contact with the verbal behavior of caretakers, and fewer verbal interactions with caretakers, has at least two unfortunate outcomes: (a) little contact with verbal behavior by caretakers results in a limited verbal repertoire. As previously stated, we use the term **verbal behavior** in place of what others may call *vocabulary*, but we are referring to using words and nonwords in listener and speaker functions; and (b) a lack of ability to contact verbal stimuli results in delays in developing the stimulus control for learning words incidentally (Inc-BiN). Thus, children in a verbally impoverished environment may enter school with deficits in verbal behavior as both a listener and speaker and lack some or all stimulus control for BiN. Subsequently, when they learn to textually respond, and are ready to learn from the text speaking to them, they do not know what the text means (i.e., the functions of the text) and they can't learn new word meanings (i.e., listener and speaker functions). This experiential or instructional history results an ever-increasing gap between children who have extensive BiN stimulus control and those who do not.

We now have tools to deal with deficits in stimulus control for Inc-BiN. That is, there are procedures from verbal behavior developmental research that *can lead to children developing stimulus control for* Inc-BiN. Fixing or improving Inc-BiN stimulus control is one of the interventions that can make *reading for learning* possible. This is one example of the identification of the lack of stimulus control that is the root of one type of reading problem. There are several of these related to different components of reading. Subsequent chapters describe how to identify whether the lack of cusps is the problem, and if so, what intervention or interventions may effectively result in children learning either what they could not learn before, or learning much faster, and in some cases learning in ways they could not before, as when they develop Inc-BiN stimulus control.

Establishing Incidental Bidirectional stimulus control is one of the interventions that can make reading for learning possible for students who struggle with reading.

Prior to identifying the stimulus control for incidental bidirectional naming and how that stimulus control is learned, either incidentally or with special interventions, some scholars argued that language was a result of a phylogenetically inherent "language acquisition device" and was independent of learning. While this position is rarely held to be the case now, there are neurological and other physical anatomical, chemical, and physiological attributes of human evolution that contribute to the evolvement of communicative behavior including language.[8] However, it is the interaction of those attributes with environmental experiences—including the verbal environment. Nevertheless, as described above, the

commonly shared environment of a community is part of an individual's community only at the point that the individual demonstrates the relevant stimulus control. One of the puzzles in language development has been how is it possible for children to demonstrate the remarkable attainment of thousands of words without being taught directly (i.e., verbal functions as a listener and speaker). We now understand that the onset of Inc-BiN is an important part of the puzzle regarding how the environment comes to teach so effectively, and that it is a necessary, if not sufficient, explanation for the acquisition of complex language. There are a series of controlling stimuli that, when present, result in the automatic teaching of an ever-expanding verbal stimulus control and an ever-expanding network of relations between words resulting in complex language and cognition. These findings expand our tools for teaching reading such that students can *learn to learn* from reading when they could not before.

Students learn the usage of new words to the degree that they have acquired levels of stimulus control for Inc-BiN. When they read, the meaning or function of words that are novel to them is learned because of the stimulus control made possible by Inc-BiN. They should see what they read as if what they read were a movie and they should find themselves completely involved. Moreover, students who are passionate and love to read use every opportunity to read. The content or story of the description of new and interesting phenomena grab the reader's attention. The resulting effect is an ever-expanding stimulus control leading to an expanded environment for the reader. The text speaks and the reader listens; as the reader listens, more is learned.

However, the achievement of fluent textual responding and even the achievement of grade level performance does not automatically result in interest in reading (i.e., enhanced **reinforcement value** for reading). Students can read on grade level, and yet lack a passion for reading for (a) information, (b) entertainment, or (c) other aesthetic functions. In the case of students like these, the reinforcement may be grades, finishing assignments, keeping up with classmates, or other unidentified reinforcers. We have identified procedures that develop the reinforcement stimulus control for reading fiction; the reinforcement stimulus for reading fiction is embedded in the content of reading and the procedures we describe establish the content as the direct reinforcer for reading. Earlier, we described the importance of establishing reinforcement value for continuously observing, preferring, and choosing books before learning to textually respond as the first and critical step in teaching children to read. The next step is to ensure that the

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content of reading reinforces reading such that students become passionate readers.

One may ask if establishing high reinforcement value for reading content is necessary for all readers or if it is only necessary for learners with reading challenges. We would argue that it is necessary for all readers. Our work has reliably shown that establishing strong reinforcement value for reading content has resulted in an increase in grade level comprehension and vocabulary from one to 3.9 grade levels in as little as 312 minutes of intervention.[6] Given that reading-to-learn is the overwhelming obstacle for students in the middle and upper-middle grades as well as secondary school, the development of procedures to establish reading as a reinforcer that increases reading-to-learn adds a powerful tool to teachers who can reliably implement the procedures.[6] This also suggests that reinforcement for content needs to be a major component of the curriculum.

In addition to reading for content, there are other stimulus controls that may be missing or incorrect. *Corrective Reading* [9] is a curriculum that has an excellent research record and is effective for students who are significantly behind grade level in third through sixth grade. It is most effective when used with procedures from the strategic science of teaching. In fact, any curriculum can be best implemented using procedures from the strategic science of teaching (SST). A system wide application of SST is the Comprehensive Application of Behavior Analysis to Schooling (www.cabasschools.org) or CABAS® and the model of CABAS® designed for general education is the Accelerated Independent Learner model (AIL). The AIL procedures are effective in implementing any intact curriculum (e.g., *Reading Street*) but they also add functional objectives when curricular objectives are structural, as is often the case. An example of this is how we have described our objectives using the term "learning verbal behavior," not just language, and "learning verbal functions," not just vocabulary.

LEARNING THE FUNCTION OF WORDS AS DISTINGUISHED FROM LEARNING VOCABULARY. Most dictionaries define words by using other words. Dictionaries consist of definitions of words at certain points in the history of a given language community. In the science of verbal behavior, a *word* or group of words has particular functions in a given verbal community and those functions constitute *meaning*. The meaning cannot be described fully by using other words necessarily. When children learn languages, in fact, they really learn verbal functions. Words are used

Most dictionaries define words by using other words. Dictionaries consist of definitions of words at certain points in the history of a given language community. In the science of verbal behavior, a word or group of words has particular functions in a given verbal community and those functions constitute meaning.

to ask others to do things, state the word for various stimuli and many other attempts to affect the behavior, including the use of words by others and thinking. It is beyond the scope of this book to describe the multiple functions of verbal behavior except how the function of language is critical to expert reading, and by extension, expert writing. One dictionary—the *Oxford Dictionary of English*—does provide examples of words in functional context. In that dictionary, the first and subsequent examples of words are shown as they are used to affect the behavior or emotions of readers. The 26 volumes display usages of words in historical context. The also define words by using other words as other dictionaries do. While dictionaries are indispensable for learning how to use the function of words, they do not necessarily teach the functional usage. Making this distinction is critical when deciding what and how to reach reading comprehension and for setting the stage for students to read to learn.

When children learn word functions as a listener and as a speaker, they learn them under conditions that establish the function of the words in a given context. The context consists of the motivating conditions, such as the need to know to affect the behavior of others or be affected by the behaviors to the mutual benefit of the writer and reader. For example, in the Middle Ages in England, a mother might say to a child, "Fetch the water." The child who is under the stimulus control of those spoken words will bring water to the mother. However, if another child who demonstrates the stimulus control for BiN observes this scenario, then they will learn to respond as a listener and as a speaker as a result of observing another child respond to the words. The degree to which this child picks up functional word usage is related to the degree of Inc-BiN stimulus control exerts on the child. What is important for the objectives of this book is that when we read-to-learn, we learn by observing the speaker and listener functions of print. The degree to which readers benefit from learning the functions of words by reading builds on their verbal cusps because print is simply an extension of the speaker and listener repertoire. Thus, even if students are fluent textual responders, they may still need interventions to establish stimulus control if they do not demonstrate that they can learn word functions from reading.

Some interventions involve providing intensive instruction for saying the names of things, actions, functions of words that are novel for early reading learners—particularly those who are ELL, from verbally poor environments, or who have native word function disabilities. There are numerous language interventions in the verbal developmental literature. How to identify those students who need particular interventions and how to fix the learning problem is the focus of chapters in this book. Just as

reading is the joining of print to listening, writing is the joining of print to speaking. We regard writing as an extension of reading, and our laboratory and schools have built a program of research that has proven useful. Moreover, just as the functions of reading are scientific/technical and aesthetic, this also the case with writing. Reading and writing require the structure of grammar and the tools of textually responding, but the learning of function is the most important and often-ignored tool because procedures to teach the functions of reading have largely been clarified by research in verbal behavior.

Writing is an Extension of Reading just as Speaking is an Extension of Listening

In the chapter that focuses on writing, our strategy is to teach the function of writing such that the function is the *learned* reinforcement.[10] Just as learning the function of speaking requires learning under the conditions in which the learner is reinforced by speaking in certain ways using certain words, we need to build that reinforcing function into the writing curriculum and the teaching tactics. This does not mean that we ignore structure, but rather describe how to teach the structure of writing by using functional objectives simultaneously. For example, *constructed spelling* is corrected in a context in which learning accurate spelling still results in reinforcing effects. This means that the student learns the correct spelling and the function. The theory that allowing *constructed spelling* will not get in the way of what is mistakenly called *creative usage* is scientifically flawed. Creative usage involves using the correct spelling in such a way that a history of learning how to "affect a reader" over multiple experiences leads to novel effects. We describe a curriculum and strategic operations to teach function and reinforcement value for writing.

> *In writing, creative usage involves using the correct spelling in such a way that a history of learning how to "affect a reader" over multiple experiences leads to novel effects.*

Teaching Reading to Upper Elementary and Secondary Students

Students who pass through elementary school without learning to read, or reading to learn, present a significant problem. What is to be done about the students who are not among the 34 percent who read proficiently in fourth grade? One answer is to use the procedures we describe for beginning and intermediate readers. However, implementing those procedures requires identifying tactics that work for more mature students who have

likely received years of instruction that has not worked. Repeated failures are likely to result in establishing print stimuli and any stimuli associated with reading as punishers. That is, any stimuli associated with reading can result in a range of responses including: embarrassment, escape and avoidance, truancy, and any non-constructive behavior resulting in teacher disapproval and simultaneous peer attention. Each time the student is unsuccessful they are learning a set of alternative stimulus control that usually is detrimental short term to the classroom learning environment and long-term failure for the student. We present some possible solutions to improving the prognosis for these students.

Research on reading interventions and challenges for adolescents shows at least three important outcomes that inform our program of reading intervention for older students. First, research indicates that when older readers struggle with reading, they struggle in five areas: (a) reading motivation; (b) decoding multi-syllabic words; c) reading fluency; d) vocabulary encountered during reading; and e) reading comprehension[11]. Second, research also indicates that there have been fewer published reading interventions for older students when compared to younger students. For instance, Wanzek et al. (2010) reported only nine published studies with interventions for upper elementary students. Finally, research indicates that effective reading interventions can result in sustained effects for secondary students. [11] We focus our research program on identifying reading interventions for older students based on the science of behavior. The work reported in this book is from our research and the research of others in the fields of the science of behavior, special and general education, and/or reading instruction. This book has two chapters dedicated to teaching struggling readers in upper elementary, middle, and secondary school. The interventions described in these chapters have unique features that form a framework. We describe these features next.

CHALLENGES TO READING INSTRUCTION IN SECONDARY SCHOOLS. There are several unique challenges that teachers of older students may face. One challenge is that middle and high schools are not typically designed to teach early reading skills, so neither the schedules nor teaching expertise at these levels promotes for reading instruction. Thus, the structure of reading instruction for secondary students, and even upper elementary students, who are struggling with reading is important and could use one of two approaches: whole class instruction, or targeted intervention instruction. Whole class instruction requires that a group of students receives reading instruction, and it typically uses existing intervention curricula such as *Corrective Reading* to teach a group of students. We find that this approach is

very effective and works well if a school can dedicate a full period for an entire school year to reading instruction. In that sense, this approach works well for upper elementary and middle school students who are behind in reading. However, when students are in high school, there are fewer opportunities and resources for them to participate in whole class reading instruction. Further, students in high school have a level of autonomy related to their educational experiences (e.g., they can choose to attend or not attend an intervention classroom) and opinions about the social acceptability of an intervention (this is true in middle school as well). Students may have developed a set of responses to reading instruction that allows them to not be embarrassed when reading in class (e.g., escape or avoidance behaviors during reading periods). As a result, we think that a very specific intervention approach is important for these students and, if possible, should be used during an after-school period or a dedicated class period. It also must be carefully developed to ensure that it is reinforcing for students and does not promote escape or avoidance responses.

A very specific intervention approach is important for secondary struggling readers. If possible, it should be used during an after-school period or a dedicated class period. It also must be carefully developed to ensure that it is reinforcing for students and does not promote escape or avoidance responses.

WE DO NOT GENERALLY VIEW READING COMPREHENSION AS "THINKING." Reading comprehension is often thought of as a higher level of reading that reflects a student's ability to analyze or infer meaning from a text. In fact, standardized tests of reading in third grade, and higher, measure reading comprehension. Test questions usually focus on what a student understands about an author's purpose, identifying the main idea, and similar concepts that are intended to measure their level of reading comprehension. Thus, when a secondary student is not reading well based on a test, educators may frame the issue as a reading comprehension issue because that is what the test was intended to measure. When a reading challenge is defined as "comprehension," interventions to address it may try to improve "comprehension" by accessing "thinking" through metacognitive strategies, monitoring comprehension, and generating questions about a text.

In this text, we take a parsimonious view of comprehension, and this view is embedded in our approach to teaching older students who are struggling with reading. First, we view responses to questions such as author's purpose and main idea as responses under the stimulus control of specific antecedents. For instance, a common comprehension question is "What is the author's purpose for writing this text?" That question should evoke a

particular type of response from a reader. However, rather than viewing this response as "thinking," we see it as an issue of stimulus control that we can establish through instruction. Generally, comprehension questions can be categorized into three groups: literal, inferential, and evaluative questions. Literal questions are questions where the answer is explicitly in the text. Inferential questions are questions where the answer is in the text but is not explicit; thus, the answer might need to be inferred. Evaluative questions are questions where the student must join their experiences or knowledge of the world to the text. Within these three categories are specific types of questions such as main idea, author's purpose, and so on. We suggest that correct responses to these questions do not necessarily reflect "thinking" but, instead, reflect responses under the appropriate stimulus control of a question. For example, a student who can answer a comprehension question about the author's purpose has learned to emit a response under a particular type of stimulus control for antecedents associated with this type of question. When we operationalize comprehension in this way, we can teach it instead of targeting "thinking," which we cannot observe.

Rather than viewing reading comprehension as "thinking," we see it as a type of stimulus control that we can establish through instruction.

Second, we view the complex comprehension responses that sometimes characterize successful reading as forms of derived or generative responses to questions or text. For example, a student may be asked to draw on similarities and differences between characters in two novel passages as part of a comprehension exercise. Although this may be described as advanced comprehension, we characterize this type of comprehension as a complex repertoire that emerges more readily after students master component reading repertoires. An example from math might be helpful when describing this view of reading comprehension. Imagine that a high school student does not perform well in calculus. An initial assessment shows a pattern in their incorrect responses to calculus problems and a teacher might provide additional examples or interventions to address the specific types of calculus problems that they are missing. However, imagine that the student continues to make mistakes in calculus, even after receiving additional instruction. In this case, the teacher might ensure that the student has mastered specific prerequisite repertoires that calculus requires such as algebra, geometry, and trigonometry. If the teacher focuses on teaching missing component repertoires and instead of focusing on correcting individual responses, the student may master calculus more rapidly. In the same way, establishing mastery of prerequisite reading repertoires when they are missing may also

facilitate the emergence of derived, generative, and advanced or complex reading comprehension responses.

IDENTIFY COMPONENT REPERTOIRES FOR READING INSTRUCTION. As previously described, research conducted by Edwards et al. (2008) indicates that when older readers struggle with reading, they struggle in five areas: (a) reading motivation; (b) decoding multi-syllabic words; (c) reading fluency; (d) vocabulary encountered during reading; and (e) reading comprehension (Boardman et al., 2007; Roberts et al., 2008). We operationally define these repertoires using research from the science of verbal behavior and then assess them as major repertoires that adolescent students need to be effective readers. Further, we extend this framework to include two additional repertoires from the science of behavior: (1) learning, defined as repertoires such as naming and observational learning that can accelerate the acquisition of complex responses; and (2) academic self-management, defined as behaviors that lead to independence in school settings (e.g., goal setting, self-monitoring, self-reinforcement, self-advocacy). We think this repertoire is important because what may appear to be a learning challenge can actually be an issue of limited self-management. Taken together, these seven repertoires comprise a framework that we use to describe reading interventions for older students in this text. Table 1.2 illustrates this framework.

CONCLUSION

Table 1.2
Framework for Older Students who are Struggling Readers

Term	*Description*	*Example*
Motivation	Readers choose books as preferred activities or reinforcers. They can engage with text for extended time periods.	A student reads for 10 minutes and chooses books over other academic activities such as coloring.
Word Study	Textually responding to parts of multi-syllabic words instead of individual letters and sounds.	When a student sees the word *rented*, he breaks the word into two parts ("rent" and "ed") and then blends them together to read the word.
Fluency	Number of textual stimuli read correctly per minute. This can include letter, word, and passage fluency	A student reads 120 words correctly during a one-minute timing.
Vocabulary	Defining terms based on knowledge of the word and/or from a reading passage	A student reads the word "appealing" in a passage and both define it and uses it.
Comprehension	Speaker-as-own-listener behavior. When reading, a reader can act as a listener for their own self-talk	A student reads a passage aloud and can answer questions about the passage after reading it
Learning	How a student acquires concepts or skills through incidental learning or direct instruction	A student can learn from two demonstration learn units, observing a peer, or through instruction as a listener
Academic Self-Management	Measuring and making changes to one's own behavior	A student sets their own goals, advocates for their needs with teachers, and follows their self-determined daily schedule

This chapter described a strategic science of teaching and defined important terms and concepts related to early reading and writing instruction. In the subsequent chapters, you will encounter practical applications of behavioral science to reading instruction and intervention for learners from pre-K through high school. Supplemental activities and examples are provided as well. Our hope is that this book will help more students learn to read successfully.

GLOSSARY

Where are the glossary items?

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