Enhancing Communication for Individuals with Autism

A Guide to the Visual Immersion System™

by

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An Overview of the Visual Immersion System™

Communication disturbance is a hallmark of autism spectrum disorder (ASD). The nature and severity of an individual's communication disorder vary along the autism spectrum, and a variety of treatment approaches have been introduced to address communication impairments. The primary focus of this book is individuals with moderate-to-severe ASD who experience considerable difficulty comprehending and expressing spoken language. This chapter describes the communication impairments of these individuals; presents the rationale for a visually based approach to communication intervention; and gives an overview of the general principles that underlie a visually based, immersive communication system that we refer to as the Visual Immersion System™ (VIS™). Subsequent chapters provide recommended strategies and techniques for diagnosing and treating communication impairments based on a combination of evidence-based practices and clinical experiences within the Autism Language Program (ALP) at Boston Children's Hospital. Although these assessments and intervention techniques target individuals with moderate-to-severe ASD, they also have applicability to individuals with milder forms, generally referred to as high-level autism.

COMMUNICATION IMPAIRMENTS OF INDIVIDUALS WITH MODERATE-TO-SEVERE AUTISM SPECTRUM DISORDER

Individuals with moderate-to-severe ASD struggle to understand and express spoken words.

Spoken Language Difficulty: Comprehension

Many individuals with ASD experience considerable difficulty understanding spoken language. Specific impairments vary depending on the person's unique skill set, but common patterns include the following:

- Relatively strong comprehension of nouns with relative difficulty understanding more abstract language concepts, such as verbs, prepositions, adjectives, adverbs, and *wh-* questions
- Difficulty understanding semantic relations and complex syntactic structures

The severity of these comprehension difficulties may be masked because many individuals with moderate-to-severe ASD are highly skilled at using knowledge of daily routines and other context clues to help them decipher meaning. For instance, the individual may not linguistically understand the spoken directive, "Put on your coat and get in the car," but he or she might still correctly infer the intended meaning by watching the speaker put on her coat, pick up her car keys, and walk toward the door. Impairments in comprehending the speech signal alone are most easily detected when the utterance is novel or lacks familiar behavioral or contextual clues.

The practical consequence of living with significant comprehension impairments is that the person's conversations with caregivers, family members, and teachers tend to be incomplete, disjointed, or incoherent. Instead of providing a rich source of learning and comfort, spoken exchanges are curtailed or only partially understood. Maladaptive behaviors are frequently an outgrowth of these imprecise or unsuccessful communication exchanges. Thus, language's intended purpose of facilitating learning and human interaction goes unfulfilled—the harsh reality of imperfect language understanding.

Individuals with limited understanding of spoken language fortunately can learn from the stream of detailed sensory information that emanates naturally from the physical world. Sensory experiences of the physical world—such as auditory (e.g., wind rustling the trees, doorbell chimes), visual (e.g., physical appearance, movement, resemblance of a photograph to an object), olfactory (e.g., pleasant smell of a bakery), proprioceptive (e.g., feel of ice), and kinesthetic (e.g., awareness of sliding down a hill, falling, swinging) experiences—provide sufficient detail for learning about one's surroundings. The person with ASD may acquire a strong understanding of how the physical world is organized and operates through watching, listening, smelling, and touching and through active trial and error (Shane & Weiss-Kapp, 2007). Understanding gained through observation and direct experience alone, however, is largely limited to concrete subject matter. Symbolic communication and language is needed to move beyond the sensorimotor here and now and to engage in more complex or abstract thinking and imagination. Thus, a primary emphasis of this book is on facilitating language comprehension because when language comprehension is reduced or disrupted, a person's ability to understand, think, and reason about the world is significantly reduced. Language comprehension is also a prerequisite for language expression.

Spoken Language Difficulty: Expression

In the course of typical language development, comprehension precedes expression. Before young children use spoken words to communicate meaningfully with others, they already understand what many words mean. Given the comprehension impairments described previously, it is not surprising that those with moderate-to-severe ASD also tend to have difficulty using spoken language expressively.

Approximately 50% of individuals with ASD do not use speech functionally (Lord & Paul, 1997; Prizant & Wetherby, 2005; Rutter, 1978). Although some may use a limited number of spoken words, others do not speak at all. When spoken words are used, expression may be characterized by any of the following impairments:

- Vocabulary is limited, with nouns tending to be heavily overrepresented in the lexicon.
- Knowledge of syntax is both delayed and disordered. Utterances are grammatically incorrect or simpler than expected given an individual's chronological age.
- Scripted speech is used instead of generative speech. At times, scripts communicate a consistent meaning to others, but they are also used for self-regulation or simply to perseverate.
- Spoken language is primarily restricted to the function of requesting.

Expression for individuals with moderate-to-severe ASD tends to be physical in nature because their functional spoken language skills are inadequate. Physiological reactions (e.g., shivering) and behaviors (e.g., pulling a communication partner to the cabinet where cookies are kept) provide caregivers with clues about the individuals' wants, needs, and internal experiences. The message, however, tends to be less efficient and less clear in meaning than spoken language because the communication partner must interpret these behaviors. As a result, behaviors are misinterpreted, communication breaks down, and subsequent frustration may give rise to behavior difficulties and their associated social consequences (e.g., embarrassment, social isolation).

Nevertheless, many individuals with severe speech difficulties still exhibit at least minimal levels of comprehension and expression of spoken language. Their ability to understand a few spoken nouns or routine directives and to utter at least a few simple requests suggests that their language processing, although compromised, is not entirely defective. There is no research to date to support the view that individuals with moderate-to-severe ASD are fundamentally unable to learn language. Therefore, we contend that some level of communication and language competence is attainable for most individuals with moderate-to-severe ASD. The challenge for parents, clinicians, and teachers alike is to identify the appropriate instructional methods and materials for promoting communication and language competence. The approach to enhancing communication for learners with ASD detailed in this book specifically emphasizes the use of visual strategies and digital technologies, including visual graphic symbols and electronic screen media.

THE VISUAL IMMERSION SYSTEM'S RATIONALE FOR EMPHASIZING VISUALS IN COMMUNICATION AND LANGUAGE

One popular and intuitive approach to teaching individuals with speech comprehension and expression impairments is to focus *even more intensely* on teaching spoken language. Instruction is provided using speech, and learners are encouraged to talk. Such an approach is appealing because others easily understand speech without additional training, special equipment, or materials, and speech is considered the most socially appropriate means of communicating. Approaches focusing intensely on speech are also often selected because functional spoken language is the long-term intervention goal for many caregivers and therapists. Such spoken language–based interventions, unfortunately, have failed to yield the significant, broad gains in communication and language skills required to achieve functional levels of speech comprehension and expression.

In contrast, focusing on the visual modality to deliver communication intervention is promising for three reasons. First, the unique profile of strengths and weaknesses typically seen in children with ASD is well suited to the basic characteristics of visual input:

- Children with ASD tend to have strong visual processing skills (Althaus, de Sonneville, Minderaa, Hensen, & Til, 1996; Shah & Frith, 1993; Thaut, 1987), which may allow for their successful processing of visual information even if auditory information is not understood.
- Visuals offer a sustained referent, whereas spoken language is ephemeral; thus, the static nature of a visual symbol may allow the person additional time needed to successfully process information (Hodgdon, 1995; Shane & Weiss-Kapp, 2007).
- Individuals with ASD seem to understand visual graphics more than spoken language. For example, a child may recognize and understand a photograph of his hat more readily than the spoken word *hat*. To process spoken language, an individual must maintain the spoken word in memory while conjuring its image and meaning. A visual support eliminates the need for conjuring the image itself.

- Use of visual supports capitalizes on strengths in concrete thinking, rote memorization, and visual-spatial skills often seen in individuals with ASD. It compensates for areas of relative weakness associated with acquisition of oral language skills, such as abstract thinking, social cognition, communication, and attention (Quill, 1995, 1997).

Thus, the visual modality is a logical choice for delivering a communication intervention program targeting individuals with ASD.

The second reason for focusing on the visual modality is that our clinical case experiences and recent research have identified a natural *preference* for visual input among individuals with ASD. For instance, results of a survey conducted by Shane and Albert (2008) indicated that when children with ASD were given a choice, they tended to engage in electronic screen media activities to a greater extent than all other leisure activities combined. More than half of these children were reported to attentively watch movies, to imitate videos or television programs on occasion, and to demonstrate good overall procedural knowledge for electronic screen media devices (e.g., children knew how to rewind and fast forward videos and operate the remote control). Thus, it seems that children with ASD are intrinsically motivated not only to watch but also to interact with this medium. Furthermore, several research teams have found that electronic screen media–based instruction leads to faster skill acquisition, greater acquisition of targets, and better generalization than instruction by a live model (Charlop-Christy, Le, & Freeman, 2000; Sherer et al., 2001). Taken together, these findings imply that electronic screen media are not only engaging and easy for children with ASD to interact with but also efficacious as a teaching tool.

The third reason that we make strong use of the visual modality is that there is growing research evidence that interventions that utilize the visual modality can facilitate communication and learning. The Picture Exchange Communication System (PECS; Bondy & Frost, 1994) is a communication training system frequently used with children with ASD. In its beginning phase, individuals are taught to exchange a graphic drawing for a desired object as a means of requesting. Recent empirical evidence suggests that PECS is promising for facilitating communication in children ages 1–11 years, although it is not yet an established evidence-based intervention (Flippin, Reszka, & Watson, 2010). Organizational tools, such as timers, visual schedules, and first–then boards have all been shown to help children with ASD stay focused on the task at hand and cope with transitions (National Autism Center, 2009). Finally, video modeling is an effective method for teaching a wide variety of daily living, self-help, and vocational skills to individuals with ASD. Research indicates that both video modeling and video self-modeling are evidence-based practices that can effectively teach functional behavior skills and social-communication skills to children and adolescents with ASD (Bellini & Akullian, 2007; National Autism Center, 2009).

Due largely to the evidence-based research reported in these areas, the term *visuals* has become a buzz word in the special education community, and the use of visuals is widely supported by parents, educators, and others whose lives include a person with ASD. Until now, however, the logistics of creating the necessary visual supports, transporting them across environments, and obtaining them quickly and easily during spontaneous conversations has hindered their use in everyday communication and learning. The confluence of contemporary technology and growing interest of media and graphics fortunately has made the creation and implementation of a personalized visual support system both feasible and practical. Most Western households now own computers, and handheld media devices (i.e., smartphones, tablets, and other mobile devices) are ubiquitous. Individuals with ASD now have access to this technology because the cost of these devices has decreased drastically. Good screen resolution and features such as built-in cameras and microphones allow users to take photographs and videos and annotate

them, providing opportunities to quickly customize and personalize a user's communication program *on the fly*[1]. The technology has reached a point where such *just-in-time* communications can be a practical reality. That is, spontaneous two-way conversations can now be supported by mobile digital devices with user interfaces that can provide rapid access to all of the visual graphics and organization tools needed to create and deliver visual messages wherever and whenever they are needed—just-in-time. In addition, parents, classmates, and siblings of children with ASD are often proficient users of this technology, making it even more likely that such devices will be customized, maintained, and upgraded on a regular basis and will remain readily accessible across multiple environments. The stigma once associated with the use of a communication device is decreasing as more and more children, including those in elementary school, use handheld multimedia devices for both communication and entertainment. Therefore, this book also emphasizes the role that technology can play in making a visually immersive communication intervention program more affordable and accessible and more easily customized, personalized, and maintained.

DEFINING COMMUNICATION

Because the communication difficulties experienced by individuals with ASD are varied and complex, all potential forms of communication need to be explored as possible intervention options for promoting communication growth. Thus, we favor a broad definition of *communication*: the systematic exchange of information, not necessarily intentional, between a minimum of two people (Shane, 1979). This definition accounts for nonverbal, interpretive communication as well as for all of the spoken, gestural, and visual forms. We highlight some important characteristics of this definition next.

Communication Can Be Involuntary or Unintentional

Individuals can successfully communicate thoughts, desires, and emotional states through their physiological reactions or behaviors, even though they may not intend to do so. The behaviors and physiological reactions of an individual who does not speak or who has limited symbolic communication are often the only source of information to caregivers, teachers, and therapists about what the person is attending to, what captures his or her interest, and what he or she is experiencing internally. Recognizable external cues such as sweating or shivering can be interpreted by observers as indicators that a person is feeling hot or cold. The object of a person's interest and attention may be inferred similarly based on gaze direction, and current emotional state may be inferred from behaviors such as smiling or crying. Observers will also take advantage of situational context to help interpret communicative intent. For example, an observer might infer that a person's sweating is due to physical exertion if the person has just finished running. If, however, the person has recently appeared listless with an accompanying loss of appetite, the observer might infer that the person is sick.

[1]At times in this text, we refer to this "on the fly" utilization of visual supports as *just-in-time opportunities.* The term and concept was first proposed by Shane (2007) in the Rehabilitation Engineering Research Center (RERC) on Communication Enhancement and presented in a seminar entitled *Everyday Uses of AAC and Technology (Visual Supports, Low-Tech Aids, and High-Tech Devices)* presented at the Milestones Autism/Asperger's Conference in Cleveland, Ohio, in June 2010. With the just-in-time thinking in mind, we created an app known as SymbolTalk (see Autismate for availability). An important feature of SymbolTalk from the just-in-time perspective is the capacity to select and review a message and send it wirelessly from one iPad to another. This feature allows a mentor to access, create, and wirelessly transmit a message—in the form of an isolated element, scene, or element cue—to a learner's iPad. The immediacy of delivery using this closed loop network is one of a multitude of ways to deliver a just-in-time opportunity. For further discussion on just-in-time opportunities, see Chapter 5.

Communication Can Be Equivalent Across Modalities

The same thought, idea, feeling, or belief can be communicated in more than one way (e.g., through vocalizations, speech, text, facial expression, body posture, physiological responses, gestures, manual signs, photographs, line drawings, video). Communication partners for individuals with significant communication impairments need to seek out whatever information is available, regardless of the channel.

Communication Modalities Can Be Symbolic or Nonsymbolic

Some communication modalities rely on the use of symbols to convey information (e.g., speech, manual signs, graphics, video), whereas others do not. Some nonsymbolic ways to communicate involve using actual objects (e.g., holding up a bathing suit to signal the desire to swim), behaviors (e.g., pulling a parent to the package of cookies to signal "hungry"), or physiological responses (e.g., shivering when cold, feverish, or in shock).

Nonsymbolic communication contains the same inherent limitations as involuntary and unintentional communication—the communication partner must interpret the behaviors in context in order to infer their communicative intent. Shared human experience is generally sufficient to allow for the accurate interpretation of behaviors indicating physical states (e.g., pain, hunger, thirst, hot, cold, nausea, fatigue) or affective states (e.g., overjoyed, happy, sad, interested). As the observed behaviors move beyond these areas, however, the potential for misinterpretation, and thus miscommunication, increases.

We believe that all communication intervention programs should aim for progress from unintentional and nonsymbolic communication to more symbolic, intentional communication. Because nonsymbolic modes of expression do convey some communicative intent, they offer a good starting point and can serve as the foundation for the acquisition of more symbolic expressions. Thus, the trajectory of communication growth should be as follows:

- From unintentional behaviors and reactions to intentional communicative bids
- From nonsymbolic forms to symbolic forms
- From concrete, iconic symbols to more abstract forms
- From stand-alone symbols to combinations of symbols that resemble the structure of language

FRAMEWORK FOR VISUAL LANGUAGE INTERVENTION

The use of visual graphics to support learning and communication for individuals with ASD is expanding. Shane and Weiss-Kapp (2008) proposed a framework that includes three modes of visual support:

1. *Visual expressive mode*: visual cues used for the purpose of expressive communication
2. *Visual instructional mode*: visual cues used for the purpose of comprehension, which are imposed as an alternative to, or in conjunction with, speech
3. *Visual organizational mode*: visual cues used to represent the organization of an activity, routine, script, or schedule

This logical framework accounts for the many ways that visuals can strengthen communication and learning for individuals with moderate-to-severe ASD. Despite their extensive use, however, current visual supports do not compose a cohesive, rule-bound visual language system. Rather, they are independent visual cues. Since the 1970s, graphic symbols have become more common as a means for individuals with ASD to

communicate, mark transitions, and improve their learning. The graphic symbols can range from hand-drawn pictograms to photographs and highly stylized animations. The availability of these graphic representations has expanded the options for intervention in general and, more specifically, has enabled communication options that extend beyond speech-based therapies alone. Yet, despite the widespread appeal of graphic symbols, no actual visual language has evolved from this effort. Instead, there are large libraries of graphic symbol sets (e.g., Mayer-Johnson Picture Communication Symbols, Symbolstix, DynaSyms, Widgit Literacy Symbols) depicting a wide range of grammatical categories, including nouns, verbs, prepositions, and *wh-* questions. Formal research investigating the effectiveness of graphics for communication, however, has been directed mainly toward nouns (Schlosser & Sigafoos, 2002).

A major limitation of using graphic symbol sets to support communication is that they do not offer a natural or intuitive way for individuals to learn how to combine individual symbols to form meaningful phrases or sentences. Practitioners have tended to disregard the significant challenge of teaching the rules of language (i.e., how to combine graphic elements to form semantically meaningful and syntactically correct phrases and sentences)[2]. We believe this to be an alarming shortcoming given extensive clinical observations that those with moderate-to-severe ASD experience considerable difficulty learning the meaning of symbolic combinations, whether spoken or visually based. For the most part, their language is dominated by knowledge of common nouns with limited understanding of verbs, prepositions, and adjectives or how to combine these grammatical forms with nouns to form meaningful phrases and sentences. The ability to arrange graphics in a horizontal line does not necessarily indicate that the individual knows or is learning the linguistic relationship between the elements. For example, it is not unusual for a person with ASD to understand that a graphic depiction of a car in isolation stands for a car and a graphic splotch of blue represents the color blue. Simply lining up these two graphics next to each other, however, is inadequate for helping the person realize that BLUE and CAR should be interpreted as the single entity "blue car." The all-important generative aspect of language is missing from such approaches. Such approaches make it easy to string graphic symbols together but do not explain or teach the linguistic rules for combining individual elements. This, in part, may explain the inherent lack of progress in evolving graphic symbol sets toward becoming visual languages. In contrast, the VIS provides a framework for teaching the linguistic skill of combining language constructs. Acquiring this ability gives the learner the capacity to generate semantic relationships using a set of established combinatorial rules, which is further explained in the next section.

Rationale for Creating a Visual Language within the Visual Immersion System

The VIS recognizes that comprehending or producing a series of graphic symbols that correspond to spoken or written language is a fundamental skill that needs to be developed before individuals can advance to using more highly developed means of augmented communication. The marvel of developing a visual language is that a series of isolated and inherently unrelated graphic symbols, each having its own designated or restricted meaning, can, when properly combined, represent an identifiable communicative operation such as a request, directive, comment, or question. The process of

[2]An extensive literature review revealed virtually no research that identifies formal intervention approaches for teaching individuals with ASD to combine graphic elements to communicate at the level of language. Although the VIS does not offer a completely rule-based visual language, it does incorporate basic language features: 1) it uses visual element "words" in a structured and conventional way; 2) words in the form of isolated elements (albeit visual) represent different linguistic categories; 3) words are combined in left-to-right order; 4) the rules for combining words to form basic declarative and interrogative sentences follow those of spoken English; and 5) the system follows the reasoning of Brown's (1973) semantic relations model but uses isolated visual elements instead of spoken words.

combining symbols together is only possible once an individual understands that there can be inherent semantic relationships between individual linguistic elements.

Linguistic construction ability can often be taken for granted because typically developing children easily demonstrate this skill during spoken language exchanges. In fact, humans are assumed to have the innate capacity to construct meaningful utterances and to exchange such utterances with others. Humans have the physiological capacity (speech mechanism) and the cognitive-linguistic means (human language) to engage in intentional communication using syntactically correct and semantically meaningful phrases and sentences. Armed with a solid foundation of spoken language, children around 5 years of age learn to read and write by mapping text to spoken words.

This sequence of first learning to communicate via speech and then using this knowledge to acquire a written form appears in both human evolution and child development. Scientists believe that early humans developed speech first. Later, they created a picture-based form of written language (e.g., pictographs, ideographs, cuneiform, hieroglyphics.). Early humans probably found spoken language to be sufficient for person-to-person communication but needed a more permanent format for documenting ideas, concepts, possessions, and so forth. In a similar fashion, infants are initially exposed to spoken language—the primary form of language used by caregivers to communicate with them on a daily basis. Through their exposure to spoken language, infants learn not only the meaning of individual words but also the rules for how to combine individual words to generate novel, meaningful phrases and sentences. Later, children learn to read and write by mapping text labels onto each spoken word. In both of these cases, the first language is speech, and mastering spoken language provides the core foundation for subsequently acquiring written language.

But what happens to children who have been immersed in speech but still fail to develop a basic competence with spoken language? If they have not first mastered the semantic relationships and syntax of spoken language, they cannot be expected to acquire written language by mapping text onto speech. They need an alternative language mode that can provide the same communicative abilities and language understanding as speech. We propose that a visual language is well suited to this task. The first challenge for individuals with limited or no understanding of spoken language is to learn the meaning of the individual visual symbols that represent specific linguistic elements of vocabulary acquisition (i.e., nouns, verbs, prepositions, and so on). Next, they must learn how to combine individual visual symbols into linguistic element strings that form syntactically correct and semantically meaningful visual phrases and sentences. We refer to this process as *visual semantic relationships* (VSRs). After they have mastered the skill of communicating using VSRs, they can begin to learn to read and write text. In contrast to the typical acquisition of reading and writing that maps text to spoken words, individuals without spoken language will need to learn how to map text to pictures.

Visual Semantic Relationships

Graphic symbols are the building blocks of our proposed visual language. Each graphic symbol represents a linguistic element in this visual language (e.g., noun, verb, object). *VSR* refers to the set of rules that need to be understood and applied in order to combine these disparate visual elements into meaningful phrases and sentences. VSRs are similar to the concept of semantic relationships first introduced by Brown (1973). He recorded the utterances of young children over time (from 17 to 48 months old) and used all of the contextual information available to infer what the children *meant* to say. He identified five stages of semantic development. For the earliest stage (two-word utterances), he identified eight basic linguistic relationships that children used systematically to convey meaningful communications.

Table 1.1. Example of emerging speech showing corresponding semantic relationship

Two-word utterance	Semantic relation expressed
1. Mommy come; daddy sit	agent + action
2. Drive car; eat grape	action + object
3. Mommy sock; baby book	agent + object
4. Go park; sit chair	action + location
5. Cup table; toy floor	entity + location
6. My teddy; mommy dress	possessor + possession
7. Box shiny; crayon big	entity + attribute
8. Dat money; dis telephone	demonstrative + entity

Source: Brown (1973).

The main difference between Brown's semantic relations and the VIS's VSRs is that the basic building block of the VSR is the graphic symbol and not the spoken word. These concepts are nevertheless similar in that combinations of individual language elements bond together to form a meaningful communication. The individual elements that make up a VSR consist of various linguistic categories including nouns, verbs, prepositions, and adjectives; this is reflected in the extensive range of semantic relationships in Stage 1. The meaning that results from creating a VSR is equivalent to the meaning conveyed by rules underlying Brown's (1973) semantic relations (see Table 1.1).

A VSR is more than the sum of the meanings of the individual visual symbols. For example, combining actor + action + descriptor + object (e.g., "Boy push red truck") evokes a mental image of a boy grasping the truck and pushing it along. The specific interrelationship of the individual symbols conveys this rich meaning. The same four elements could be combined into a different VSR (e.g., "Truck push red boy"), and the resulting meaning would be dramatically different. Combining elements to form meaningful sentences is a generative, rule-based process and is not the result of simply memorizing specific element sequences after repeated exposures (e.g., scripts). The application of these VSR principles in terms of the VIS's two tiers of communication is described next, with additional detail provided in Chapter 5.

In summary, we propose that acquiring a visual language in which isolated graphic symbols can be combined to convey basic communicative operations is an essential skill for individuals with complex communication needs (including ASD) who have good visual processing skills but have little or no functional speech and cannot use written language as a viable, alternative communication form. The importance of this "combining" capability cannot be overstated. We contend that individuals who evidence restricted spoken language comprehension and production will be severely restricted in their ability to communicate until they can effectively combine words and phrases into more meaningful communication units. This restricted language is generally limited expressively to simple requesting and receptively to following simple commands. Furthermore, we contend that the small number of intentionally directed communicative acts observed in individuals with moderate-to-severe ASD will remain so until the skill in combining visual symbols in a generative, meaningful way is achieved[3].

[3]We do not consider a string of symbols learned by rote such as *agent + verb + object + please* (to signal a request) or *I hear/see/smell + object* (to signal a comment), when overlearned in a discrete trial format, to be a strong foundation for a generative language. These symbols are unlikely to lead to advanced language or diverse speech act utilization.

Even though the procedure of combining language constructs is a popular and presumably essential skill for successful augmented communication, it is largely ignored in the literature and by clinical and research communities. Communication displays that present visual symbols arranged in a grid pattern assume that users not only understand the meaning of distinct visual symbols but also understand the rules for combining individual symbols into meaningful phrases and sentences. There are unfortunately few clinical guidelines—and little developmental perspective and research—for how to properly or efficiently teach or learn this process of combining.

GENERAL PRINCIPLES OF THE VISUAL IMMERSION SYSTEM

The overall goal of the VIS is to teach children with moderate-to-severe ASD how to become more effective communicators. The intervention program provides a visual communication system to complement the spoken language that many individuals with ASD find so difficult to understand and speak. It teaches them that visual symbols can be used effectively to share information with their communication partners both receptively and expressively. The VIS is defined by the following four principles:

1. Communication is used for multiple pragmatic functions.
2. There are two tiers of communication: scenes and element strings.
3. Communicative competence flourishes in a visually immersive environment.
4. Spontaneous communication and language arts are important.

Principle 1: Communication Is Used for Multiple Pragmatic Functions

Typically developing individuals use language for a variety of pragmatic functions, such as requesting, directing, commenting, asking, and answering questions. This is true across the entire life span. Children fulfill various communicative functions through gestures (e.g., pointing to an object to call someone's attention to it), vocalizations (e.g., crying or screaming to protest removal of a desired item), and physical communication (e.g., reaching for desired items, touching a caregiver to gain attention, giving objects to caregivers as an act of showing) even before they develop spoken language. Spoken words that do emerge often serve as replacements for gestures and other nonlinguistic forms of communication, and they are used to request, comment, ask questions, and gain attention (Owens, 2008). In order to promote the communication skills of all individuals with ASD, regardless of developmental or chronological age, interventionists should consider the multiple pragmatic functions of language from the outset of intervention. The VIS contends that an effective, practical communication system should support seven basic communicative functions that are critical for satisfying the functional needs expressed in everyday communicative exchanges:

1. Protesting
2. Organization and transitions
3. Requesting
4. Directives
5. Commenting
6. Questions
7. Social pragmatics

The first two communicative functions focus on language that supports the individual's need for behavioral organization and control. The remaining five functions enable the child to communicate and understand when he or she is participating in everyday activities. Although this list is not meant to denote a developmental progression, children tend to acquire functions at the top of the list prior to those at the bottom. Nevertheless, these functions are not serial in nature, and one function should not be taught to the exclusion of others. The visual graphic approach advocated here is not intended to teach advanced communicative functions such as abstract language (e.g., "with liberty and justice for all"), passive voice (e.g., "The book was read by the boy"), complex syntactic structures (e.g., "If he had not checked the weather in the morning, then he would have forgotten to bring his umbrella"), figurative language (e.g., "She flew to the bookstore"), or humor (e.g., "Why did the chicken cross the road?").

Chapters 6–12 offer a discussion of each of the seven communicative functions, including considerable focus on ways to assess and intervene.

Principle 2: There Are Two Tiers of Communication: Scenes and Element Strings

The VIS strives to teach children how to use visual symbols to comprehend and express each of the seven communicative functions. To accomplish this, the VIS relies on a two-tiered visual communication system. Tier 1 involves dynamic and static visual scenes, and Tier 2 involves visual element strings. Functioning at the Tier 2 level requires an increase in the child's level of symbolic competence and an understanding of the structure of language.

Tier 1: Visual Scenes Visual scenes are symbols that represent an entire event or activity. They contain the relevant background context, agents, objects, actions, and interactions of the agents and objects. Visual scenes are either 1) *dynamic scenes,* full-motion video clips that illustrate how the activity or event unfolds over time, or 2) *static scenes,* digital photographs that capture a single prototypical moment in an activity or event. An example of a static visual scene representing the sentence, "The woman is climbing a mountain," is presented in Figure 1.1.

The value of using visual scenes in support of spoken language is illustrated in Figures 1.2–1.4. Figure 1.2 shows the course of spoken language as it is processed and comprehended by a typical listener. According to the schematic, spoken language is first taken into short-term memory. It is then handled by the language processor. The intended information is eventually comprehended.

For individuals with moderate-to-severe ASD, however, interpretation of spoken language can take a different path, as shown in Figure 1.3. This schematic shows an

Figure 1.1. Static visual scene representing the sentence, "The woman is climbing a mountain."

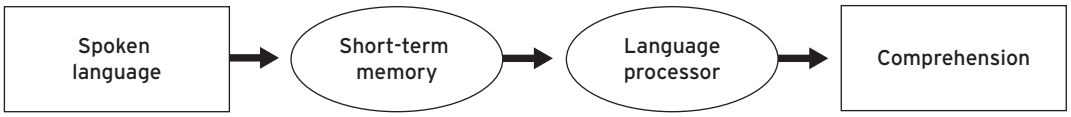

Figure 1.2. Schematic model of language comprehension—typical development.

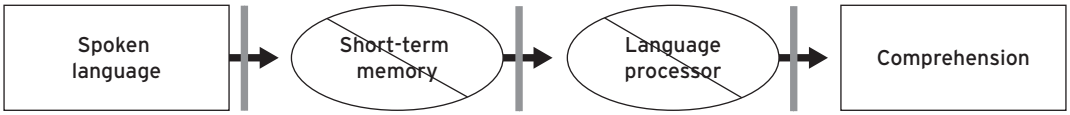

Figure 1.3. Model of language comprehension for an individual with moderate-to-severe autism spectrum disorder.

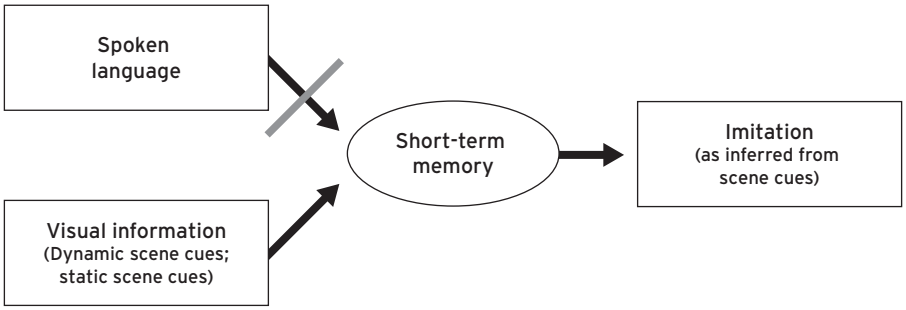

Figure 1.4. Use of a dynamic or static scene cue to bypass spoken language.

interruption at the short-term and language processing stages, disrupting the pathway to comprehension. Clinical insight suggests that the difficulty with comprehension is due to one or more factors:

- Not attending to auditory stimuli
- Not understanding the symbolic nature of language
- Inability of short-term memory to account for the fleeting nature of spoken language
- "Broken" language processor

According to Figure 1.3, the primary culprit for the comprehension disturbance is that spoken language input does not proceed down the pathway to comprehension.

Figure 1.4 shows language processing with the addition of visual scene input. Although the pathway of spoken language continues to be disrupted, input from the visual channel enters into short-term memory. Comprehension is achieved and demonstrated through imitation. (*Note:* The language processor was bypassed because the addition of the scene cues made it unnecessary.)

Comprehension Difficulties Children who are exposed to visual scenes as communicative acts can demonstrate their comprehension by imitating the activity or event depicted by the visual symbols. The task of comprehending or imitating a dynamic scene cue is relatively easy because all of the critical information, especially movement, is perceptually present in the symbol. Children have a harder time comprehending the meaning of a static scene because the movement information has been removed—motion must be *inferred* from the still frame image. Intervention for children just beginning to understand symbols starts with dynamic scenes because these scenes are such faithful renditions of real-world people, objects, actions, and events. Once mastered, dynamic scenes

are faded in favor of static scenes cues. This transition to static scenes marks the VIS's initial step in advancing the individual's communication growth toward more abstract symbol formats that will be needed for Tier 2 communications.

Thus, from a clinical perspective, the early deployment of dynamic or static scene cues has two specific functions during the VIS intervention. First, visual scene cues can significantly improve understanding when paired with spoken language directives (i.e., a scene cue is shown at the same time the command, "Put the dish in the sink") (Schlosser et al., 2013). Second, scene cues that are recognized and understood can help teach language elements.

Advantage of Visual Scenes The major advantage of visual scenes is that they bypass any need for language processing and knowledge of language structure. Meaning is fully contained in the perceptual and behavioral information depicted in the symbol. No additional rules for syntax and grammar are needed to successfully decipher the message; what you see is what you get. In addition, the entire event or activity is captured by a single symbol. There is no need to string together multiple symbols in order to convey the meaning of the event or activity. Because dynamic and static scene cues rely on perceptual information to convey their meaning, they are an excellent choice for supporting five of the seven communicative functions: organization and transitions, requesting, directives, commenting, and questions.

Communicating effectively with visual scenes is a noteworthy accomplishment. Children who can communicate their wants and needs, who understand the organization of the day and what is going to happen next, who learn self-help skills, and who can give and follow directives have the competence to handle most of the routine communication needs that arise during the course of a daily routine. These children are less likely to exhibit behavior problems due to frustration and aggression and can take more personal control over their daily lives.

Disadvantages of Visual Scenes In order to "talk" via visual scenes, both communication partners must have a large inventory of videos or digital photographs at their disposal. Thus, visual scenes are limited because of the following:

- It is difficult to anticipate all of the messages the user will want to convey. There is a high probability that some communication opportunities will be lost because the user does not have certain previously created visual scenes.
- When materials are made in advance, they may become outdated if the original scene itself has changed over time.
- Visual scenes cannot effectively represent nonvisual sensory experiences (e.g., tastes, smells, tactile sensations, and sounds, except for sound incorporated into videos).
- Visual scenes are not effective at representing abstract concepts (e.g., knowledge, justice, progress, luck).
- Scenes can be difficult to create if they require the coordination of multiple actors, someone to film the event, and a setting free from distractions (e.g., other people, objects, noises). They may also need to be edited.
- As the user's inventory of visual scenes expands, he or she may have difficulty finding a specific symbol when the opportunity arises. Keeping the inventory readily available when making the transition from home to school and to the community may be inconvenient. (*Note:* Newer technology may help to reduce both of these obstacles. Digital cameras and camcorders, often embedded in laptops and small mobile electronic devices [e.g., smartphones, tablets], make it easier to create, store,

search for, and share visual symbols whenever and wherever they are needed to support communication exchanges.)

- Perhaps the biggest disadvantage of visual scenes is that they do not support the communicator's ability to generate novel messages. Individuals can only communicate using scenes that already exist. Whoever creates the scene cue library has control over what the individual will be able to express. This is a major reason to try to progress to Tier 2 communication.

Due to these limitations, visual scenes are not a good choice for supporting some of the communicative functions: protesting (feelings), commenting (subjective opinions), questions (concepts of who, what, where, or when), and social pragmatics. If embedded graphics are added into the pure scene, additional functions can be introduced (e.g., graphics representing "no" or "take a break" to enable protest and refusal; graphics to promote awareness and concern for others' feelings and views).

Tier 2: Visual Element Strings Visual elements are symbols that can be used to represent an individual component that is not depicted as part of a larger scene. The background context is removed, and all surrounding agents or objects are eliminated. Element symbols represent basic linguistic categories that convey different types of meaning during information exchanges:

- *Agent*: represents actors; conventionally referred to as *nouns*
- *Action*: represents behaviors; conventionally referred to as *verbs*
- *Object*: represents things that can be seen, touched, or heard; conventionally referred to as *nouns*
- *Spatial*: represents the position of one object with respect to another; conventionally referred to as *prepositions*
- *Attribute*: describes a key quality or characteristic of an agent, action, or object; conventionally referred to as an *adjective* or *adverb*
- *Questions*: includes *who, what, where, when,* and *yes-no* questions
- *Temporal concepts*: includes concepts such as *first, next, then, now, soon,* and *later*
- *Interjections*: includes *hurray, ouch, yuck, yippee, oops,* and *thanks*

Figure 1.5 shows examples of element symbols that represent an agent, object, verb, and descriptor. The first box is labeled *the girl* and contains a photograph of a girl. The second box is labeled *red* and contains a red circle. The third box is labeled *run* and contains a stylized graphic representing a man running. The last box is labeled *car* and contains a photograph of a wooden car. These visual element symbols can be combined into *strings* to create visually based messages. The individual elements are arranged in a left-to-right sequence and ordered according to the syntactic structure of spoken language. The element chain does not necessarily create a complete or morphologically and syntactically rich sentence, but it does represent all of the core information units required to convey the intended meaning. Figure 1.6 presents an example of an element string for, "The woman is climbing a mountain." The first box, labeled *woman,* has a picture of a woman. The next box, labeled *climb,* shows the graphic portrayal of climbing. The last box, labeled *mountain,* has a picture of a mountain.

Tier 2 of the communication system is more complex than visual scenes. Children must first learn the meaning of the visual symbols that represent each type of linguistic element. Then, they must learn the rules for combining the elements into syntactically and semantically correct sentences (e.g., subject + verb + adjective + object). The intended

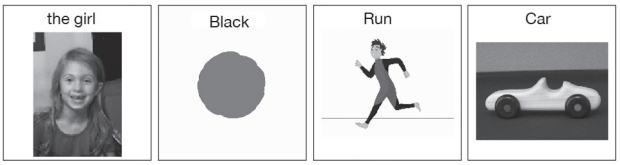

Figure 1.5. Examples of element symbols that represent an agent, descriptor, verb, and object.

Figure 1.6. Example of an element string representing the sentence, "The woman is climbing a mountain."

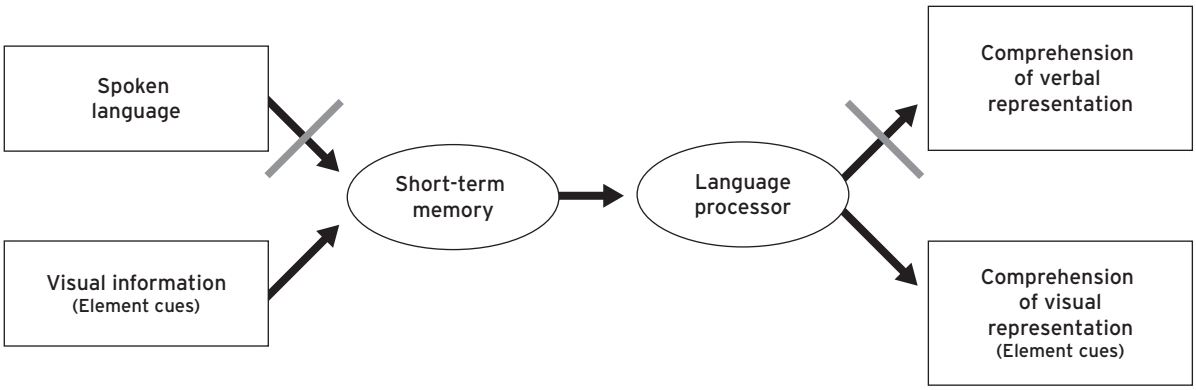

Figure 1.7. Model of visual and spoken language comprehension for an individual with moderate-to-severe autism spectrum disorder.

activity, event, or thought is no longer represented by a single symbol but by the combined left-to-right sequence of individual visual symbols. The whole is greater than the sum of its parts. The VIS's Tier 2 goal is *generative sentence creation,* whereby an individual understands the meaning of isolated symbols and the syntactic rules governing their combinations.

Figure 1.7 provides a schematic of language understanding when element cues are provided. The path from spoken language to short-term memory is blocked, but the path from visual information to short-term memory is open. Short-term memory leads to the language processor, but the path to comprehension of verbal information is still blocked. The path to comprehension of visual representation is open. It is interesting to note that, unlike in Figure 1.4, short-term memory and the language processor remain involved during a comprehension task because visual (not verbal) content is received, processed, and then understood. Understanding is facilitated, in this case, by the comprehension of *visual* representations.

The transition from reliance on visual scene cues to understanding and using element cues is a significant accomplishment. The acquisition of this competence is viewed as the gateway to generative language use. It requires movement beyond concrete and relatively easy-to-understand scene cues in order to begin to combine language elements using established rules of syntax.

In our experience, teaching children about Tier 1 visual scenes is easy, but migrating to Tier 2 visual element strings is substantially more complicated. The effort, though, is

well worth it because mastery enables generative language. Given a limited set of visual symbols representing the basic language elements, communication partners can combine them in (almost) infinite ways to produce novel, meaningful sentences.

Advantages of Element Strings The major advantage of the element strings communication level is that it utilizes the structure of language to facilitate novel sentence generation. Anticipating what an individual will want to say is difficult. Users who are given a finite set of visual symbols can create the novel sentences they want to communicate without interventionists needing to prepare a specific symbol in advance. Equally important, achieving symbolic competence with visual element strings enables users to take full advantage of all seven of the practical communicative functions.

Disadvantages of Element Strings Learning the visual symbols representing each type of language element is difficult. Although the visual symbols for agent and object elements tend to be relatively easy to learn, the symbolic representations for verbs, prepositions, adjectives, and *wh-* questions tend to be more demanding. There are two formidable challenges: 1) commercially available visual symbol libraries seem to represent nouns effectively but experience more difficulty depicting verbs, especially prepositions and adjectives; and 2) there is no well-proven intervention strategy for teaching the structure of language that is primarily based on visual graphic content. Typically developing children learn the rules of language first through their exposure to spoken language. They do not learn to associate visual symbols to the various spoken language elements until much later. Individuals with mild-to-severe ASD unfortunately cannot follow this same path. We know of no evidence-based intervention approach that effectively teaches the structure and rules of language based predominantly on exposure to visual symbols.

There is reason to be optimistic about Tier 2 interventions, however. As digital-age technology becomes more pervasive in homes, schools, shirt pockets, and handbags, promising multimedia, interactive instructional approaches are in development and are being field-tested.

1. These approaches use electronic screen media to teach the meaning of the visual symbols for verbs, prepositions, and adjectives by using animated symbols instead of static images. This provides the essential movement and spatial relation information critical for improving the understanding of these concepts.
2. These approaches use electronic screen media to teach the meaning of the visual symbols for *wh-* questions through interactive applications in which visual scenes are dissected into their separate who, what, and where components, or these separate components are combined to create complete visual scenes.
3. These approaches use electronic screen media to teach language syntax by using guided discovery in an interactive video-based tool. In this case, color-coded visual symbols that stand for language elements are arranged in a left-to-right orientation, and when combined, generate meaningful sentences that describe corresponding dynamic scenes or video segments. These visual illustrations of difficult and abstract language concepts and their syntax seem to be effective in increasing the ability to comprehend "visual sentences" and use them for expression as well as comprehension.

Why Choose Visual Graphics Instead of Text as the Symbol Set for a Visual Graphic Language? Visual symbols can be represented either as graphics or text. A question worth considering is whether text alone would be better suited to introducing

language to individuals with complex communication needs. We believe that adopting text as the symbol set of choice would be impractical for several reasons:

1. Text lacks any visual resemblance to its referent, or *iconicity*, making the association of symbol to referent difficult and in many cases impossible.
2. Effective communication will be thwarted when such a bewildering level of symbolic representation impedes comprehension or expression.
3. Deriving meaning of individual words from combinations of individual letters can be challenging.
4. The communication process and the reading process would be comingled—learning to communicate would be stalled by complications posed by learning to read.

From a practical clinical perspective, the most promising strategy for representing the elements of language is to isolate them and utilize the most understandable graphics. Decoding and interpreting the meaning of many graphic symbols is inherently easier than understanding the meaning of text because the iconicity of the graphic representations enhances recognition. For example, when a visual graphic is employed in either static or animated form, it may well visually resemble the person, object, or concept it is intended to represent. This resemblance of symbol to referent will improve recognition and, we hope, comprehension. Language elements represented by sight words alone do not share this "look-alike" feature.

Text may indeed be an appropriate symbolic format for individuals with ASD who have a diagnosis of hyperlexia (i.e., have a special affinity for words and letters and are self-taught readers but may not be able to translate or understand the meaning of what is read), show a predilection for print, can decode or interpret text, or who exhibit strong sight-word recognition. It is important, however, to first determine the extent to which that person is truly able to derive *meaning* from the text he or she reads. Even in cases where the person can extract some meaning from text, graphic symbols might still serve as a valuable teaching aid to support meaning. After all, the true benefit of combining graphic symbols together is not to generate sentences but to create meaningful content. The phrases and sentences that result from symbol combinations only support communication if the meaning behind the entire symbol string is recognized. Thus, text may be suitable as a symbol option for individuals who are nonspeakers as long as they possess strong language-comprehension skills. It is less suitable as an initial symbol system for those experiencing more significant language challenges.

Principle 3: Communicative Competence Flourishes in a Visually Immersive Environment

One important reason why typically developing infants learn language easily is because they are immersed in it. They hear speech prenatally, and their caregivers immediately begin to engage them in ongoing conversations about what is happening in their immediate world using *motherese,* simplified speech that helps infants learn the rules of language. Children hear the same language spoken by others as their world expands beyond home to school and the community. Spoken language becomes the common, shared symbol system for communicating in and about the world. That same type of immersion is required for children with moderate-to-severe ASD.

Based on extensive clinical experience, including a multiyear field study, we concluded that establishing a successful visual language intervention program requires a departure from the manner in which visuals are used in traditional communication programs:

- Once the type of graphic symbol set has been selected, the symbols should simultaneously accompany speech throughout the day, serving as a central part of the

program—not included as an afterthought supporting only expressive speech. Such valuable opportunities for aided language stimulation are meant to enhance comprehension of spoken language.

- All caregivers and significant others who routinely interact with infants and children throughout the day (e.g., family, teachers, therapists, peers) should rely on an identical set of visual symbol supports.
- Visual symbols should be readily available and seamlessly applied across environments (i.e., home, school, and community).
- Visual symbols should be used to support receptive as well as expressive communication. Because language comprehension typically precedes expression, we emphasize the importance of providing a solid receptive base before expecting expressive communication. As learners become more proficient at understanding the meaning intended by the visual symbols that occur in conjunction with spoken language, they should apply this knowledge to generate novel expressive statements on their own. (*Note:* The reader should not assume that this discussion on comprehension [and its role in the emergence of expression] suggests that expressive language should not be a focus of intervention and merely awaits the emergence of comprehension.)
- Spontaneous communication as well as specific language instruction needs to be embedded within the ongoing events of everyday life.
- Successfully maintaining such an immersive environment requires universal buy-in—investment of time and effort by all engaged in interactions with the child.

Principle 4: Spontaneous Communication and Language Arts Are Important

Spontaneous communication and language instruction (often referred to as language arts) are distinct VIS goals that should be seamlessly embedded within the ongoing events of everyday life.

Spontaneous Communication Frequent opportunities to use and rehearse communication at the individual's current levels of ability should be encouraged during social exchanges throughout the day. As natural opportunities to communicate arise, caregivers should ensure that they are learner directed, utilizing the communication tier, communicative functions, and vocabulary that have already been mastered. The goal is for communication to become easy, nonthreatening, useful, rewarding, and fun.

Language Arts Formal language instruction—unlike spontaneous communication—should be conducted separately from the ongoing stream of spontaneous communications. Instruction is instructor controlled and focused explicitly on targeted skills. Competence with the targeted skills leads to their expected inclusion in spontaneous communication. Although frequent success with spontaneous communication is important, it should not occur at the expense of continued language growth. Therefore, we advocate specific instruction of language skills. The focus during these instructional periods usually includes expansion of visual-graphic utterances, acquisition of new vocabulary, learning of unfamiliar syntactic structures and semantic relations, and increased exposure to yet untried communicative operations. Two overarching goals are generally targeted during off-line instruction within the VIS:

- Progression beyond Tier 1 communication cues (focused on scenes) toward Tier 2 concentration on language-based element strings
- Acquisition and use of additional communicative operations

The augmentative and alternative communication (AAC) literature offers insufficient information and insight as to how to establish an intensive and effective immersive visual approach to communication. As a consequence, we have turned to studies in developmental psychology as they apply to the neurotypical development of symbolic content and language acquisition. The next chapter provides an overview of that research, offering a detailed extrapolation from neurotypical development of visual symbolic competence (including gestural and manual sign systems, visual-graphics, and video content) as well as findings related to language acquisition of individuals with ASD.

CONCLUSION

Just over a decade ago, Stephen Hawking, the preeminent theoretical physicist, cosmologist, and author toured The Center for Communication Enhancement at Boston Children's Hospital. He was an early adopter of the Multivoice speech synthesizer developed at our center. It was a revolutionary computer voice based on Dennis Klatt's (1987) groundbreaking research. During the visit, he was shown a saying framed on the wall of the clinic: "You don't need dexterity to manipulate concepts." A 14-year-old boy with cerebral palsy authored this sentence. It was especially surreal to share this insight with a man as improbably accomplished as Stephen Hawking, despite extraordinary physical restrictions. He was apparently so moved by what he read that he later displayed it on his web site.

This encounter has stirred another quotation based on our clinical observations and research. After observing and studying the effects of scene cues (both static and dynamic) as well as the augmenting effect of other visual supports, we would submit, "You don't need language to recognize some concepts or follow an assortment of directives." We recognize this notion does raise a host of psycholinguistic questions, both theoretical and philosophical. Nevertheless, in the simplest terms, we would submit that the presence of the right video, a proper photograph, and so forth is sufficient to warn a listener about a demand or evoke a memory without needing to recall or use language.