

# Theory-Based, Systematic Approach

## Introduction to Sequencing

Sequencing refers to students' abilities to put events in a chronological or causal order. These events may be familiar (making the bed, washing hands, eating breakfast) or unfamiliar (crossing a drawbridge, grilling hamburgers, snowboarding) depending on students' prior knowledge. Sequencing is necessary for:

- understanding and telling narratives;
- performing daily routines;
- problem solving;
- interacting appropriately with peers and adults;
- reading comprehension;
- academic success.

In order to sequence events correctly, a student has to understand cause and effect, make predictions, use and understand time and transition words (first, next, and last), and have knowledge of the critical elements in a story (setting, character, beginning, middle, and end, etc.). A student also needs to have adequate reasoning and planning skills.

Students with specific language impairments, learning disabilities, autism and other neurological deficits may have difficulty sequencing events and consequently retelling the events of a narrative (Candler & Hildreth, 1990; Jarvella & Lubinsky, 1975; Montgomery, 2002; Mesibov, 2004; Miles & Chapman, 2002; "Executive Function," 2009; Singer & Bashir, 1999; Tinaz, Schendan, Schan & Stern, 2005; Wright & Newhoff, 2001). Their difficulties can be attributed to a number of different causes. They may have executive functioning deficits, language impairments, auditory and visual processing deficits, or semantic and episodic memory deficits.

## Cognition and Sequencing Tasks

### Executive Functions

The ability to sequence events in a logical order is primarily reliant on our executive functions. The term *executive functions* refers to our abilities to solve problems and monitor, plan, and direct future behaviors (Tstatsanis, 2004). These mental processes help link past experiences and prior knowledge to our present actions ("Executive Function," 2009). Executive functions are activated when we begin a novel task or we are faced with a new challenge (Singer & Bashir, 1999). Meltzer (2004) identified the following executive function processes.

- planning
- prioritizing
- memorizing
- organizing
- shifting
- checking

(p. 80)

Sequencing tasks such as the ones in *HearBuilder® Sequencing* require students to use all of their executive function processes, especially when the task is unfamiliar. For example students may not have experience grilling hamburgers; however they may have seen their parents use a grill. Using *HearBuilder® Sequencing*, you can present students with five cards that illustrate grilling hamburgers. You may choose to have text on the cards that explains the process of grilling hamburgers and you can click on the cards to listen to the text. The computer displays the cards randomly and the students put them in the correct order.

In order to do this, students have to use their executive functioning systems. They need to *plan* and *prioritize* steps for placing the pictures in the correct order. They have to *organize* the steps so that they relate to each other logically, *shift* attention to the details in each picture, *remember* (memorize) the details of each picture, and *check* the pictures to make sure that they are in the correct order.

This task becomes more difficult when you remove one or more of the cuing elements (pictures, text, or audio) based upon students' strengths and weaknesses. Students with deficits in reading may have considerable difficulty when you remove the pictures and audio; whereas, students with visual processing problems may find it hard to sequence items with only pictures. Therefore in addition to executive functions, a number of other contributing factors may interfere with students' abilities to sequence events.

## Episodic Memory, Semantic Memory, and Sequencing

Episodic memory refers to recall of personal experiences. Episodes that are repeated consistently, like having lunch in the cafeteria, getting ready for school in the morning, or studying for a test, eventually become generalized and are stored as sequential routines in our semantic memory (Richgels, 1982). Like episodic memories, semantic memories of facts, concepts, and routines include a time component. This time component moves in only one direction. For example, we know to put on our socks before we put on our shoes, not after. Episodes that are generalized into semantic memories have been referred to as *schemas* (Schank & Abelson, 1977; Matlin, 1998). Schemas consist of prior knowledge and have strong effects on comprehension (Bransford & Johnson, 1973).

## Language and Sequencing

### Executive Functions and Language

Executive functions rely on language abilities. Singer and Bashir (1999) reported that “within the early school years, and beyond the fourth grade in particular, the role of language becomes almost inextricably intertwined with executive function and self-regulatory processes.... Children learn to talk with each other, their teachers and themselves. They make plans, discuss, evaluate ideas, participate in groups, reflect on their work, change their minds, and rewrite their papers” (p. 267). Language, especially internal language, becomes the force that mediates students' executive functions—their abilities to plan, organize, prioritize, shift, memorize, and check (Meltzer, 2004).

## Comprehension of Stories

Story comprehension can be analyzed at macrostructure and microstructure levels. The macrostructure level refers to story grammar which assumes that all stories have a setting and an episode system (Stein & Glenn, 1979). Stories are predictable and governed by rules. These rules create schemas and help guide the speaker and the listener in telling and understanding stories (Merritt & Liles, 1987). The events in stories are related temporally and causally and schemas provide a framework for planning, inferencing, and predicting (Hayward, Gillam & Lien, 2007). Children as young as three can begin to identify the major events and details in a story (Skarakis-Doyle & Dempsey, 2008). By age five, children include much more information about the events of a story and are able to comprehend and use temporal concepts like *first*, *then*, *now*, and *last*. By age nine, they are able to introduce a story, and have a firm grasp on the beginning, middle, and end of a story (Lofranco, Peña & Bedore, 2006).

At the microstructure level, stories can be analyzed for vocabulary and grammar. A rich and large vocabulary is highly associated with increased knowledge about the world (Lovelace & Stewart, 2009). According to van Kleeck (2007), “vocabulary depth (richness and quality of semantic representations) has been shown to predict later reading comprehension” (p. 32). Sequences describing a task typically have specific vocabulary associated with them. For instance, the words *jack* and *spare* are associated with changing a tire. If a student is unfamiliar with these words, it would be difficult to comprehend the sequence of events for repairing a flat tire.

In addition to vocabulary, students have to comprehend the grammatical structures or cohesive devices that link the events in a story together. Berman and Slobin (1994) reported that students’ organization of narratives improved with increased understanding and use of cohesive devices. Cohesion ties the sentences together so that the message is communicated efficiently and effectively (Horton-Ikard, 2009). Halliday and Hasan (1976) identified five categories of cohesive devices that improve listener or reader comprehension. The five categories include:

- Reference – personal and demonstrative pronouns that refer to a person in the story;
- Conjunctive – connective devices that specify temporal and causal relationships;
- Lexical – repetitive or synonymous words that refer to a previous event;
- Substitution – using another word for a previously used word;
- Ellipsis – omission of words that have been stated previously.

The following six-step sequence from *HearBuilder® Sequencing* includes examples of all five categories.

### The Great Pumpkin Carver

Card 1: Shane brought home a pumpkin to carve. First he cut off the top.

Card 2: Shane then cleaned out the pumpkin.

Card 3: Once the guts and seeds were cleaned out, Shane drew a face on the pumpkin.

Card 4: He used the drawing as a guide to cut out the face.

Card 5: After the face was carved, Shane put a candle into the pumpkin and his mom lit it.

Card 6: Finally he put the top back on the pumpkin.

The pronouns *it* and *he* are used for reference in cards 4 and 5. The conjunctive devices *then*, *once*, *first*, *and*, *after*, and *finally* are used. The word *pumpkin* is repeated through the story. This is lexical cohesion. Substitution appears on card 4 when *drawing* takes the place of *drew a face*. Ellipsis is used in card 4 because *pumpkin* is omitted at the end of the sentence, *cut out the face*.

## Visual Processing and Sequencing

Visual processing refers to how the brain processes visual information. All of these processes may affect the ability to sequence events, especially pictures without text or audio cues. These are:

- Visual discrimination – the ability to compare and distinguish the differences between items;
- Visual figure-ground discrimination – discriminating an object from its background;
- Visual sequencing – identifying the correct order of words and images;
- Visual memory – the ability to remember things that are seen;
- Visual closure – the ability to identify an item when only shown parts of it;
- Spatial relationships – the ability to know where items are in space. This includes verbal and written descriptions (“Visual Processing,” 2009).

## Auditory Processing and Sequencing

The term auditory processing refers to how the brain perceives and interprets sound information. Several skills determine auditory processing ability—or listening success. They are:

- Auditory Awareness – the ability to detect sound;
- Auditory Discrimination – the ability to hear differences between sounds;
- Auditory Identification – the ability to attach meaning to sounds and speech;
- Auditory Comprehension – the ability to understand longer auditory messages.

Typically these skills are developed in a general four-step hierarchy, but all work together and are essential for daily listening (Cochlear Americas, 2009; Johnson, Benson & Seaton, 1997; Nevins & Garber, 2006; Roeser & Downs, 2004; Stredler-Brown & Johnson, 2004). Difficulties with sequencing may occur at any of these levels, especially auditory comprehension.

## Disorders Affecting Sequencing

The following pages highlight a few of the disorders and delays that affect sequencing abilities.

### Auditory Processing Disorders

Students with auditory processing difficulties have breakdowns that occur beyond the physical ability to hear sound (Loraine, Jones, Strait & Johnson, 2009). These breakdowns may affect students' abilities to sequence events, especially when the event is presented using only the auditory channel. Some common characteristics of auditory processing disorders include:

- difficulty listening with background noise;
- difficulty retaining verbal information (such as directions);
- problems understanding and retaining multistep or multilevel verbal information such as directions;
- language difficulties—especially receptive language and vocabulary building;
- low academic performance;
- behavioral issues;
- difficulty attending to auditory information, especially in a noisy environment;
- needing extra time to process auditory information;
- difficulty with phonological awareness, reading, and spelling (Bellis, 2003; Kelly, 2004).

Comprehending oral narratives can be particularly difficult for students with auditory processing disorders because they require students to process information accurately, then to understand the information, retain it, and finally organize it (Anthony, Kleinow & Bobiak, 2009). This becomes more difficult in noisy environments, like a classroom. Anthony, Kleinow, and Bobiak (2009) found that students with auditory processing disorders and students that score at the lower end of normal on an auditory processing screener had more difficulty with comprehension of oral narratives in noisy environments.

### Autism Spectrum Disorders (ASD)

Familiar and unfamiliar sequencing tasks can be challenging for students with autism spectrum disorders (ASD) because of breakdowns in their executive functions systems. Sequencing of familiar events can be difficult because they require a dual focus. During a sequencing task, students have to attend to the steps of an activity and also attend to the desired outcome. Even though students with ASD may be able to perform the individual steps of a process, they do not understand how the steps relate to each other and how these steps ultimately affect the overall goal (Mesibov, 2004).

When presented with unfamiliar sequencing tasks, students with ASD typically do not have the ability to create a new problem solving strategy. In general they tend to perseverate and use a previously learned strategy that is not suitable for completing the new task. Generally these strategies are rule-based and do not allow for flexibility when trying to devise a new solution (Tstatsanis, 2004).

Kwon and Pae (2007) reported that students with Asperger's Syndrome had similar receptive language and were able to express the key elements in a narrative. However they had more difficulty using cohesive devices and complex syntax. These difficulties are at the microstructure level.

## Hearing Impairment

Although younger students with hearing impairments between the ages of six and seven have difficulty recalling sequences that are presented verbally with no visual cues, this improves by age nine. These deficits are attributed to auditory perceptual issues (Jutras & Gagné, 1999). In general students with hearing impairments have more difficulty with the microstructures of narratives. These students have difficulty understanding and synthesizing complex syntax and semantic relationships (Geffner, 1987). They are able to sequence pictures as well as their non-hearing impaired peers; however they have more difficulty understanding and using time and transition words (Jarvella & Lubinsky, 1975). Additionally when asked to retell more complex stories, their stories have fewer propositions or events and they make more errors using cohesive devices (Griffith, Ripich & Dastoli, 1990).

## Learning Disabilities

Learning disabilities affect the brain's ability to "receive, process, store and respond to information" (NCLD, 2010). Students with learning disabilities may have difficulty with sequences depending on their strengths and weaknesses. Sequencing pictures may be difficult for a student with visual processing deficits, while auditory information may be difficult for a student with auditory deficits. Students with executive function deficits may not have the capacity to process events in a story and students with memory deficits may have difficulty recalling the correct order of events.

Snart (1988) found that students with learning disabilities were poorer in sequential processing and planning when compared to peers without learning disabilities. Students with learning disabilities may try to retell a story, but start in the middle, move to the beginning, then try to tell the ending, or they may not finish the story at all (Silver, 2001). Students with learning disabilities also tell shorter stories with fewer details, even though their expressive syntactic abilities did not differ from students without learning disabilities (Roth & Spekman, 1999). Bradlow, Kraus, and Hayes (2003) discovered that students with learning disabilities have greater difficulty perceiving sentences in noise which could impact classroom learning.

## Specific Language Impairment

### Sentence Comprehension

Specific language impairment (SLI) describes language deficits in the absence of any other diagnoses such as hearing impairments, behavioral or emotional disorders, neurological impairments, or mental retardation (Montgomery, 2002). In addition to expressive deficits, these students have significant difficulty with receptive language tasks. Montgomery (2002) suggested that these students may have poor comprehension skills due to deficits in verbal working memory and reduced knowledge of language. Students with these deficits have difficulty understanding unfamiliar and familiar language because they are unable to remember or process information quickly enough. Additionally, their poor knowledge of language makes it difficult to process an entire sentence because they are allocating their attention to unfamiliar grammatical forms and vocabulary (Montgomery, 2002). Montgomery (1995) also points out that sentence comprehension decreases for children with SLI as sentence length increases.

### Story Comprehension

The ability to retell a story becomes dependent on a student's ability to comprehend what is told, or read to them (Wright & Newhoff, 2001). Children with SLI produce narratives that do not have as many propositions or events, less sentences with main and subordinating clauses and do not follow typical story grammar patterns—setting, initial problem, reaction and attempt to solve the problem, resolution, and end (Merritt & Lyles, 1987; Stein & Glenn, 1979). Merritt and Lyles (1987) discovered that students with language impairments were able to understand factual questions about a story, but had considerable difficulty answering “why” questions about a story. These are the types of questions that typically indicate an understanding of causal relationships and are directly related to story grammar. For example, students with SLI may be able to name the princess in a story (Cinderella), but questions regarding *why she ran from the ballroom at midnight* may be more difficult. McCabe (1998) also reported that when students with SLI retell stories, they exhibit deficits in topic maintenance and event sequencing that make it very difficult for the listener to understand the speaker. These difficulties with narrative discourse comprehension and production have been shown to limit the acquisition of literacy skills (Dickinson & Smith, 1994).

## Teaching Sequencing

Sequencing activities benefit students by helping them to remember a process, to learn the names of the steps in a process, know the tools used to complete the process, and to understand and use the specific vocabulary associated with a process (Marr & Morgan, 2005). Sequencing activities that include the manipulation of pictures, words, and sentences help build important literacy skills like reading left to right, comprehending important details, predicting, and identifying the parts of a story. A majority of states have educational standards that address sequencing at basic levels (identifying what happened first, next) and at advanced levels (writing essays, performing experiments; Academic Benchmark, 2010). The federal government's *Common Core Standards* includes standards for describing the details of an event at nearly every grade level (2010). **HearBuilder® Sequencing** provides the clinician with a systematic way to target sequencing of pictures, text, and audio, beginning with simple two-step sequences and progressing to six-step sequences. The clinician or teacher has the option of manipulating all of the software settings to meet the individual needs and goals of each student.

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