Executive Function Situational Awareness Observation Tool

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Abstract

John, an 8th grader, is dismissed from class and leisurely walks towards his locker while, at the same time, the peers around him are moving quickly towards their own lockers. He tries to catch the attention of his peers, but many just give a quick dismissive smile and hurry to gather their belongings before the bell rings. Once at his locker, John starts to talk eagerly to the boy next to him, but he does not initiate gathering his class materials. The boy is quickly exchanging one set of binders for another and gives John a few head nods that are clearly sending nonverbal signals that he does not want to talk right now because he is focused on arriving to class on time. Regardless, John keeps talking and then the bell rings. He seems almost startled by the bell and shoves one book in his locker before absentmindedly grabbing another book and spiral notebook. With an unhurried pace, he heads to his next class and is the last to arrive. All of the other students have out on their desks a textbook, pencil and composition notebook. John walks to the back of the class, flips through the newest science magazine on the teacher's desk, then sits down and drops his books to the floor. Upon being prompted by the teacher to take out his book, he suddenly realizes he does not have the right book with him.

Class ends at 9:50. At 9:45, students are told they need to get ready to leave class. Sam stays focused on his worksheet and does not notice his classmates getting up and moving about in the class. Peers start putting away laptops and books in the computer cabinet and class locker and begin packing up their personal belongings. Sam did not appear to notice these subtle changes in the pace and movement of the class, and instead, stays focused on his worksheet. The teacher then announces to the class, "2 minute warning to save, finish up and store your materials. Then, take out your grade sheets." Sam still does not respond. At this point, all the other students are packed up and ready to go and have blue cardstock grade sheets out for the teacher to write on. The teacher cues Sam, "Sam. Pack up please." Sam still does not respond. The teacher approaches his desk and says, "Sam you are running out of time." Sam replies, "UhHuh." However, he does not change his behavior but remains focused on the worksheet, although he is not actually writing on it. All of the students have left the classroom when Sam finally stops working, leaves his worksheet on the desk and walks out of the classroom.

John and Sam, while clearly struggling to meet situational expectations in the classroom, pose a challenge for the speech-language pathologist (SLP) to support as their scores on standardized measures of intelligence and language are high to above average and they both do not qualify for special education services. These high standardized scores demonstrated that when they were in a highly structured test setting with a very limited number of factors to attend to, they could hold information in their working memory, process information, and execute effectively. However, when the situational factors, such as peers, environmental cues, materials, and directions, to attend to increased *even slightly* so they had to integrate and organize these factors as a means to regulate their behavior, their executive control processes dramatically declined.

Parents, teachers, and SLPs alike are frustrated. Parents want services to support their struggling child, teachers feel these students are prompt-dependent and require a significant amount of the teacher's attention, and the SLP often expresses that he or she has tried compensatory strategies, but that they do not generalize to support the student in becoming more independent. This feedback, combined with our own multitude of student observations, led us to consider how we could more carefully distinguish a student's pattern of situational awareness strengths and limitations and, in turn, use this data to create effective and individualized treatment interventions as well as monitor progress toward the development of the core executive control skills.

Executive Function

There has been a steady and rapid rise in the number of students diagnosed with executive dysfunction (Barkley, 2012). While executive-function-based challenges are frequently concomitant symptoms of autism spectrum disorders, traumatic brain injury, attention deficit, and a variety of other neurologic diagnoses such as Tourette's, generalized anxiety disorder, and oppositional defiant disorder, there has been a rapid increase in the identification of executive-function-based challenges in the absence of other diagnoses. The diagnosis of executive function is laden with complexity, as it is not a single skill but rather the collection of multiple cognitive skills that function in a coordinated way to enable an individual to "engage in purposeful, organized, strategic, self-regulated, goal-directed behavior" (McCloskey, 2012, p. 15). Self-regulation is essential for task execution and involves three key components: (a) any action that allows students to stop and direct themselves, (b) how this action results in a change in their behavior, and (c) how this behavior changes the likelihood of future consequences or the attainment of a goal (Barkley, 2012). This ability to stop and direct oneself is deeply tied to a student having strong situational awareness (SA) skills.

There is a wealth of research on SA as it pertains to military operatives, emergency response providers, and medical professionals in high attention demand situations, such as the field of anesthesiology. Yet, there is little research related to SA, task execution, and academic performance. A pioneer in in the field of military situational intelligence, John Boyd, developed the OODA loop to identify the core features of situational awareness: Observe, Orient, Decide, Act. The OODA loop is a process that defines how we react to the stimuli we are bombarded with all day. In the first stage, we *Observe* or sense the key features in a situation to understand what is happening around us. These are not limited to visual stimuli, but also include kinesthetic (spatial/perceptual/temporal) and emotional information. In the *Orient* stage, an individual now focuses his or her attention to interpret what he or she has observed or sensed. The next step is to *Decide* and to determine a course of action based on what has been observed and focused upon. The last step is to *Act* upon that decision. The "loop" is considered to be what happens between the onset of the stimulus and one's reaction to that stimulus to regulate their behavior towards a future goal.

The work of Mica Endsely, "Measurement of Situation Awareness in Dynamic Systems", (Endsley,1995) has served to be the other seminal work to Boyd in defining SA. Endsley defines SA informally as "knowing what's going on" and, more formally, as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future" (Wickens, 2008, p. 2). Situational awareness involves both a spatial and temporal component. Time is a critical concept, as SA is dynamic and changes at a speed imposed by the characteristics of the task, the actions of individuals, and the features of the surrounding environment. As new information is processed, individuals with strong SA incorporate the ideas into their mental schema and make any necessary changes in their plans and actions to achieve the expected or desired goal of the current context in which they are exhibiting task execution skills. Situational awareness also involves spatial knowledge about the activities and events occurring in a specific location(s). (Endsley & Jones, 2001) Barkley emphasizes the importance of spatial capacity to self-regulation as individuals will purposefully

arrange themselves within their surroundings or organize their physical environment to attain goals (Barkley, 2012).

In more recent years, SA teamwork has emerged as a concept by which we assess the extent to which an individual knows and understands what other individuals on their team or who they are working with in their shared environment are thinking about and what goal they are working towards. To what extent do individuals in a situation share the same mental model to interpret each other's actions and or to make accurate projections regarding other's actions? This concept of possessing shared mental models to facilitate coordination of actions and communication in shared settings significantly aligns with the Social thinking™ concepts developed by Michelle Garcia Winner (Winner, 2007). In team SA research, there is a direct focus on the devices available for sharing situational information amongst individuals to inform about the situation. These can include direct communication (verbal and nonverbal), a shared environment, or shared displays (e.g., visual, audio, or tactile displays). Thus, in addition to the spatial, temporal, and objective components of SA, we now add a social component.

Given the general definition of SA is "the ability to perceive the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future" (Wickens, 2008, p. 2). Dominguez et al. (1994) extended this definition and identified that SA needed to include four specific elements:

1. **Extracting** information from the environment;
2. **Integrating** this information with relevant internal knowledge to create a mental picture of the current situation;
3. Using this picture to **direct further perceptual exploration** in a continual perceptual cycle; and
4. **Anticipating** future events.

Taking these four elements into account, SA is now defined as the "continuous extraction of environmental information, the integration of this information with previous knowledge to form a coherent mental picture, and the use of that picture in directing further perception and anticipating future events" (Dominguez, 1994, p. 19).

A review of the research revealed an absence of literature on SA as it pertains to students and their executive function and self-regulatory performance in the classroom. Therefore, we translated these formative definitions of SA into the four core elements of SA a student must exhibit for successful self-regulation and executive control.

1. **Extracts**: the student *observes* the key information about space, time, objects, and people in the environment to *orient* themselves and "gets a sense" of what is happening in the specific moment in time in order to extract the most relevant information while ignoring nonrelevant information. They use this salient information to successfully *integrate* information with their internal knowledge base to create a mental picture of the current situation.
2. **Determines Purpose**: the student uses this mental picture to decide or determine his or her role (status) or purpose within that given volume of time and space of the situation. Considering the increase in research in teamwork, SA, and the importance of social thinking and communication to the field of speech and language pathology, the student also determines or recognizes the role and communication of others within the situation.

3. **Predicts**: The student comprehends the meaning of the above to anticipate his or her expected behaviors in the near future and to predict the most efficient way to navigate space, sequence actions for goal attainment, gather necessary materials, and coordinate his or her actions with and in consideration of others.

4. **Shifts flexibly**: In the OODA loop, once the individual has observed and oriented to the environment, he or she decides a course of action and then acts. In the classroom "act" presents as the ability to stay on-task and to inhibit those behaviors which impede task completion. In other words to "not act" or exhibit impulse control. Given the ever changing demands of the classroom environment, the student must remain flexible to shift and change their actions to match the dynamic nature of the situation. As such, this tool effectively captures the dynamic nature of executive function skills in everyday settings.

The Situational Awareness Observation Tool

Our SA Observation Rubric was designed to be aligned with Endsley's Level I model of SA (Wickens, 2008) to easily assess in a specific context a student's ability to perceive the relevant and multiple situational elements in the environment which lead to awareness (objects, events, people, systems, environmental factors) and their current states (locations, conditions, actions). To simplify, we utilized the acronym STOP to capture a student's ability to observe, orient, decide, and act upon the features of *Space, Time, Objects* and *People* in their environment.

Rationale

The importance of:

> developing nonstandardized, functional, and context-sensitive assessment is supported by extensive research demonstrating the shortcomings of standardized, office-bound language and neuropsychological testing for individuals with prefrontal dysfunction. (Coelho, Ylvisaker, & Turkstra, 2005, p. 4)

In the area of executive function, considerable conceptual and empirical research has been conducted to interpret standardized measures that impact the executive system as a whole. These are static measures, and yet the ability to execute tasks occurs at a dynamic level in an ever-changing environment (Burgess, 1998). Identified limitations and criticisms of using standardized measures to predict executive functions include (1) standardized scores are frequently not related to the activities and behaviors required in the classroom environment and (2) standard measures typically only reflect a specific skill or behavior that has been assessed at a single point in time and may have been influenced by noncognitive factors such as fatigue or emotions. (Fuchs, 1986; Haywood, 1992; Tzuriel & Samuels, 2000). In a review of the research on the correlation between standardized measures and situational observation of the executive function skills of students in the classroom and home environment, researchers concluded, "the magnitude of these relationships was typically weak" (Coelho et al., 2005, p. 4). The downfalls of test conditions that limited a test's ecological and predictive validity have been well documented. (Coelho et al., 2005; Ylvisaker, 1992; See Appendix A). Coelho et al. concluded from this extensive review of the literature the weak correlation between standardized measures of prefrontal executive control skills and everyday performance that it is

> critical that educational and vocational assessments include procedures designed to identify carefully and systematically strengths and weaknesses of the individual's performance in relation to a variety of contextual variables, including settings, people, times of day, activities, materials, instructions, and supports. (Coelho et al., 2005, p. 11)

Within the domain of a *dynamic executive function assessment tool*, however, the research being conducted towards instrument development is still emerging. A number of rating scales have been developed to offer a window into the everyday behavior associated with the specific domains of the executive functions and they serve as a screening tool for executive dysfunction. Widely used, the Behavior Rating Inventory of Executive Function® (BRIEF®), a questionnaire completed by parents and teachers of school-aged children, is designed to provide a better understanding of a child's behavioral regulation and meta-cognitive skills by measuring eight aspects of executive functioning: (a) to select appropriate goals for a particular task, (b) to plan and organize an approach to problem solving, (c) to initiate a plan, (d) to inhibit distractions, (e) to hold a goal and plan in mind, (f) to flexibly try a new approach when necessary, and (g) to check to see that the goal is achieved. Other multi-rater scales that offer a standardized score include the Brown ADD Rating Scales for Children, Adolescents and Adults, the Comprehensive Executive Function Inventory™ (CEFI®) and the Barkley Deficits in Executive Functioning Scale - Children and Adolescents (BDEFS-CA).

Many of these rating scales do predict impairments in daily life activities and can be a valid description of the capacities involved in self-regulation, organization and problem-solving, and time management. There are some acknowledged drawbacks. One challenge is that the scales represent the rater reflecting collectively about many observations of the student against the child's ability to execute in a space/situation in a specific moment in time. Some researchers have found that "BRIEF index scores showed no significant correlation with performance-based EF" (Mahone, 2002, p. 1). As outlined by Wortham, rating scales have been identified as being highly subjective and are prone to rater error and bias. Different interpretations of ambiguous terms (e.g., what does "sometimes" always mean?) may lead to raters being less reliable when considering their collective experiences with the student. Furthermore, raters may not be objective, but may rate the child on the basis of previous interactions or on an emotional basis (Wortham, 2008).

Development of the STOP Observation Tool

Thus, we identified the need for an observational tool that measures student performance in a specific situation, which would lead to a better understanding of, and capture the degree to which, the elements of the physical/spatial, temporal, objects, and social environmental factors act as barriers or facilitators to successful task execution for a student. The tool identifies the core skills of SA that are directly observable. It can be used to record information from one observation from a specific situation. To gain a pattern of strengths and weaknesses, the clinician can also make multiple copies of the checklist and record behaviors from a number of contexts in order to collect specific data and to answer questions about the student's executive function skills across the day and in a variety of situations. The qualitative nature of the tool can also be used to identify areas of need for treatment and to assess student progress.

There are many advantages of the STOP observation tool (Appendix B). It is flexible, as it can be used with a variety of assessment strategies and can be used to observe students at many grade and ability levels. It requires minimal formal training by an SLP, teacher, and/or educational support staff to communicate findings with parents and students. The student's progress in developing the underlying SA skills for successful task execution can be tracked. Scoring errors are minimized as behaviors are clearly described and there are no ambiguous terms to interpret. Behaviors can be recorded frequently and in a variety of familiar and novel contexts to gain a clear and broad picture of the student ability and the internal and external factors that influence SA. The items are comprehensive, but the number of items to rate were limited to prevent the rater from feeling overwhelmed with assessment and record keeping. To use, the clinician identifies the context of the situation, observes the student, and then rates presence or absence of the core features of SA. As the situation itself can influence a student's SA skills, we therefore created a subjective rating questionnaire from the Situational Awareness Rating

Technique (SART; Taylor 1990) specific to the classroom setting. This questionnaire takes into consideration the complexity, variability, novelty, and relative stability of the situation.

Clinical Illustration

The following example of a student we observed demonstrates a profile of executive function challenges that commonly leads to a referral for an observation assessment. The executive functioning skills of this student would be best described using the SA tool. The features of SA appear in brackets.

Matt

Class started at 8:10, but at 8:15, Matt arrives **[Time]**. He drops his backpack by his desk and hands his teacher a late pass. Instead of walking towards the floor where all the other students are seated for morning meeting **[Space]**, he walks towards the art table in the class room [**Space**]. Once redirected, he walks to the rug where the morning meeting is occurring, but can't figure out where to sit **[Predict Space]**. Some students move to make him room, but he does not seem to notice **[People]**. Instead, he walks across the rug in front of the teacher and weaves his way in out and out his classmates, occasionally stepping on someone's finger or coat [**Space**]. Many students say, "Matt!" in disgust, but he does not respond [**People**]. He then stands near the back of the room and looks inside boxes that are holding spiral notebooks. He remains standing and watches the group **[Time - sequence of actions]**. He has a runny nose and is loudly sniffing. He watches the class and keeps sniffing and trying to clear his nose. Again, peers send many nonverbal signals that they are disgusted **[People]**. The teacher asks students to move over to make room and Matt is cued to sit. As he sits, the 2 boys next to him appear agitated by his presence, and although Matt is now sitting, he is not oriented to what they are talking about **[Purpose in moment in Time and People]**. Instead, he lifts a band aid off his knee and shows a boy his scab. A minute later, Matt stands and walks back over the students seated in morning meeting with the intent to find a tissue **[Time and Space]**. He wanders aimlessly about the class occasionally stopping to pick up and look at an object **[Space, Time, Objects]**. When asked what he is looking for, he says, "A tissue," and he needs to be directed to its location in the room **[Space and Objects].**

In considering this is a highly familiar situation that has low complexity, low variability, and high stability, Matt's overall inability to "read a room" and extract the purpose of the space is poor. He shows a primary challenge in the area of space awareness. In the absence of his ability to "read the room" and determine the purpose of what is happening in a given moment in time, he in turn exhibits secondary challenges in his capacity to use the nonverbal communication of his peers to regulate his behavior. Because Matt demonstrates primary difficulties with extracting the features of space, the SLP can now identify the key objective to address in therapy.

Goal 1. When in a small intervention group situation and provided a range of situations to critique, Matt will label the features of space, time, objects, and people in 8 out of 10 trials during the intervention session at the independent level of instruction.

Goal 2. Matt will then use these features beyond the intervention room to "read the room/ situation" in structured classroom settings 60% of the time from his current percentage at 5% for reading the room with carryover rehearsed in the intervention group.

1. Objective 1: When in a small intervention situation and given a declarative statement about a feature of space, time, objects or people, Matt will state an "if. . .then. . .therefore" statement to anticipate his actions 60 % of the intervention session. Example, when Matt is told it is "8:45" (a time feature) he can use SA to state, "**If** it is 8:45, **then** my class has morning meeting, **therefore** I need to think about how the class sits in a circle and I need to find my space to sit."

2. Objective 2: Take this skill beyond the intervention setting: Matt is expected to stop and read the room and create an "if. . .then" statement when asked by teachers or parents ____% of the time.

As perceiving time was a secondary challenge for Matt, he is at risk for struggling with awareness of time in other contexts as well, therefore, example of a time awareness goal and objectives might include:

Goal. Matt will acquire a sense of time and estimate the features of time associated with a task: How long will it take? What can I reasonably accomplish in that amount of time? How long did it take last time? What is coming up? How much time do I need to build in for material management? These skills will improve as documented by the increase in accuracy of time management from current level of being timely less than 10% of the time to goal of 60%.

1. Objective 1: Matt will draw on a clock and show a "pie" of time demonstrating comprehension of the sweep and volume of time and estimating how long tasks are likely to take.
2. Objective 2: Matt will create time markers on an analog clock as a time guideline for determining interim goals for larger tasks (i.e. the student marks the start time, the stop time and midpoint check in to track how time matches progress towards the goal).
3. Objective 3: Matt will set time limits for specific activities and use time-related prompts to maintain awareness of the passage of time.

Conclusion: Clinical Utility

Students with executive-function-based challenges often demonstrate limitations in everyday classroom activities, despite average to above average performance on standardized tests of cognition and language. A functional, context-sensitive, and nonstandardized measure is critical to identify real time classroom performance. While evidence-based practices are favored, the diagnosis of executive dysfunction, and, in turn, the development of executive-function-based interventions by school speech-language pathologists, are just in their infancy. The evidence is spare and surprisingly little research exists on the role of SA in the classroom for effective task execution eventhough extracting and acting on the features of SA are crucial to self-regulation.

Because the SLP is trained in teaching the developing spatial, temporal, sequential, and social concepts, the SLP is the ideal professional to be evaluating a student's awareness and use of these features to demonstrate regulated and goal-directed behavior. Recognizing that "one size does not fit all" when it comes to executive function based treatment, the STOP observation tool enables the clinician to be maximally informed in regards to which features of SA to address in clinical interventions and to see measurable progress in the development of the executive control skills. As research emerges about SA and the executive function skills, the STOP observation tool will continue to change to meet the criterion of being "evidence-based practice". It has yet to be formally researched. The tool is designed to complement, and not be a substitute for, the standardized information provided by rating scales. However, the feedback from school-based SLPs and teachers confirms it is a functional utility and many report how accurately it delineates the observed challenges that students are experiencing in dynamic settings that standardized measures failed to capture.

Successful task execution requires the complex orchestration of a multitude of cognitive linguistic skills. It is at the core of what makes us human and even a subtle delay or impairment in executive control can have an enormous impact on everyday function and classroom performance. The STOP observation tool is a first step in teasing out the complex features of SA that contribute

to executive control in dynamic settings and in helping the school based SLP develop a treatment plan that can support student's in navigating daily learning settings more independently.

Resources

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Appendix A: The Downfalls of Testing Conditions

Our Tests often Compensate for Executive Function Deficits[1]

The test environment may be neat, quiet and isolated: the variables are controlled

Compensates for: attention or concentration problems, self-regulation and frustration tolerance

A series of short test sessions

Compensates for: reduced endurance and persistence, capacity to push through fatigue, to endure the 'boring' or 'difficult' moments from tasks which take time to achieve

Clear and Scripted Test Instructions

Compensates for: poor task orientation, mental flexibility and/or lack of initiation in spontaneous problem solving. Very little to NO novel thinking is required of the student.

Examiner acts as the "Executive" and determines the goals and objectives and the order of what how things will occur

Compensates for: an individual's ability to identify a relevant goal, derive a plan and sequence their actions to achieve a goal within a reasonable time frame

Test items do not include real life amounts of information to be processed or the rate of delivery

Compensates for: weak integration and generally reduced efficiency of information processing. Tests fail to elicit the difficulties an individual may have generalizing newly acquired skills to novel contexts

Independent test sessions

Compensates for: weak and long term storage and retrieval of new information "from day-to-day"

A supportive and encouraging examiner

May compensate for: an inability to cope with interpersonal stress or perception of demands

[1]Assessment and Treatment of Traumatic Brain Injury with School-age Children and Adults by Mark Ylvisaker

Appendix B: Executive Function Situational Awareness Observation Tool

Executive Function Situational Awareness Observation Tool

Space	Time	Objects	People
❑ Extracts : Reads The Room – Knows what's going on ❑ Purpose: Understands the function of the Space for the situation ❑ Predicts: Navigates the space efficiently ❑ Flexibility: Can shift and transition between spaces	❑Extracts: Knows the Time Demonstrates expected activity in specific time ❑Purpose: Aware of kind of time and time available ❑Predicts: uses If-then reasoning to envision future moment in time, has sequence of actions and time markers, and anticipates what is coming up ❑Flexibility: Can shift Pace ❑ Reduced Initiation ❑ On pace ❑ Rushing ❑ Reduced Pace	❑ Extracts: Gathers all the expected materials/objects for given situation ❑ Purpose: Objects are organized within the personal space based on purpose of the task and functional use of the objects ❑ Predicts: Can recognize how same but different objects can be ❑ Flexibility: Sees the Necessities and relevancy of objects needed to meet a future goal and can inhibit use of objects that are not related to goal.	❑ Extracts: Recognizes Role for the given situation ❑ Own ❑ Other's roles ❑ Purpose: Recognizes and expresses the key purpose of communication exchanges ❑ Predicts: Makes inferences about communication and anticipates changes in situation based on communication from others ❑ Flexibility: Regulates actions based on awareness of others ❑ To Verbal Prompts ❑ To Nonverbal Prompts

	Low 1	2	3	4	High 5
Stability of the situation: How changeable is the situations? **Low** stable and straightforward **High**: likely to change suddenly	•	•	•	•	•
Complexity of Situation: How complicated? **Low**: simple and straightforward **High**: Complex with many interrelated components	•	•	•	•	•
Variability of Situation: How many variables are changing within the situation? **Low**: few variables changing **High**: large number of variables	•	•	•	•	•
Arousal: How alert is the student? **Low**: low degree of alertness **High**: alert and ready for the activity	•	•	•	•	•
Concentration of Attention: How much is the student concentrating on topic at hand in the situation? **Low**: Absent to limited focus on only one aspect **High** concentrating on many aspects of the situation	•	•	•	•	•
Degree of Distractability: How distracted is the student in the situation? **Low**: focused on only one aspect **High**: A high degree of shifting attention from stimuli to stimuli	•	•	•	•	•
Spare mental capacity: How much mental capacity does the student have to spare in the situation? **Low**: nothing to spare at all **High**: sufficient to attend to many variables	•	•	•	•	•
Information Quantity: How much information has the student gained about the situation? **Low**: very little **High**: received and understood a great deal of knowledge	•	•	•	•	•
Familiarity with the Situation: How familiar is the student with the situation? **Low**: a New situation **High**: A great deal of relevant experience	•	•	•	•	•

Situation Awareness Rating technique (SART) (Adapted from Taylor 1990)