

## Section 8.0

### CRITICAL THINKING:

### Definitions and Teacher Guidance

*“Biology gives you a brain. Life turns it into a mind.” Jeffrey Eugenides*

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## 8.01 Introduction

**Critical thinking** skills are the tools we use to think clearly and rationally. They permit us to go beyond simple memorization of facts into the world of analyzing and understanding the connections between ideas. They give us the ability to distinguish between degrees of importance, solve problems systematically, detect errors in reasoning, and reflect on beliefs and values.

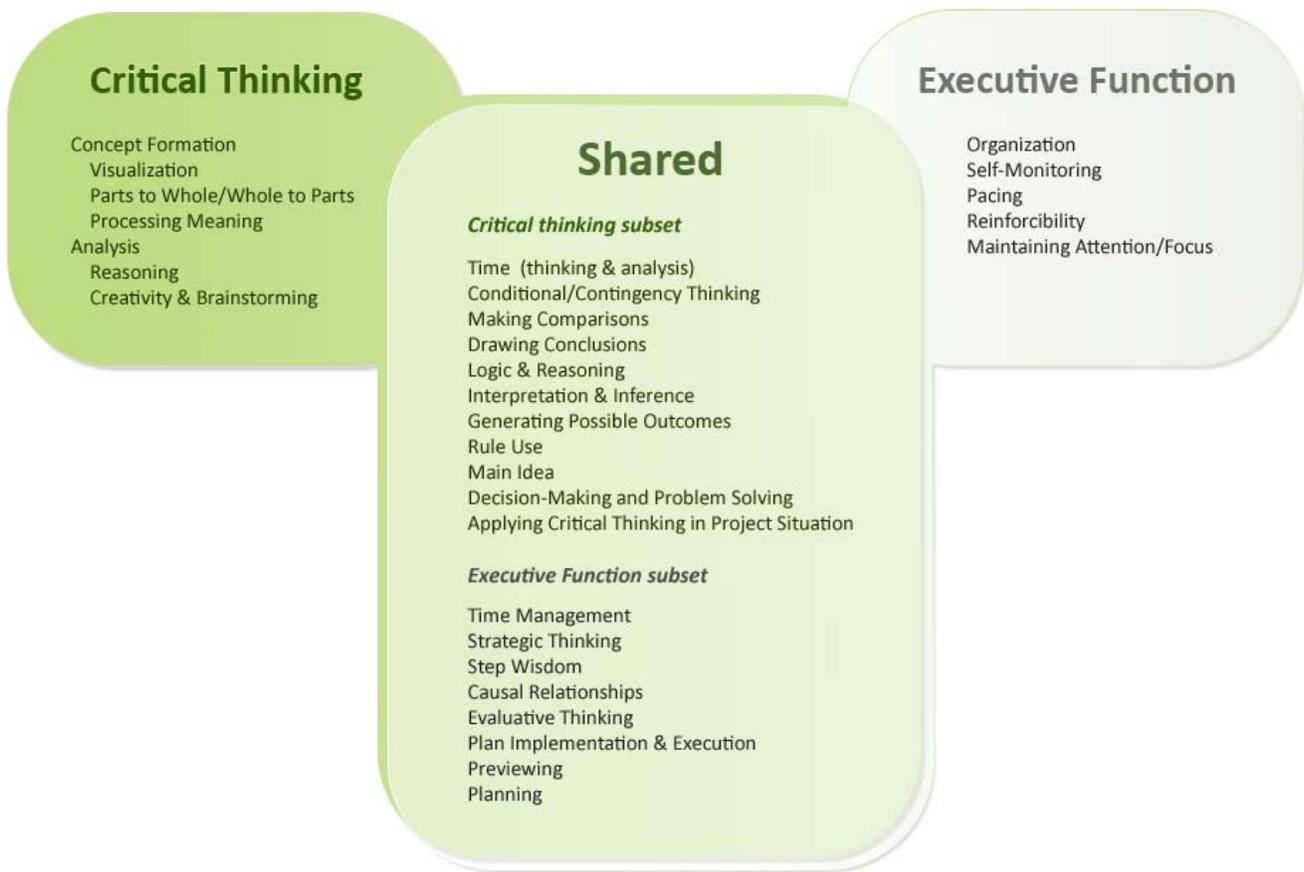
**Executive functions** are closely related to critical thinking skills. Where critical thinking tools are concerned with *thought*, executive functions are concerned with *doing*. Executive functions have to do with planning, organization, and execution of planning.

Critical thinking contributes to executive function by providing clear, logical reasoning abilities. Without clear reasoning, efforts to accomplish most non-automatic tasks could be seriously hindered. When the student is skilled in both executive function and critical thinking, he can become an independent, collaborative decision maker and a real-world problem solver.

This module is designed to strengthen critical thinking skills (also referred to as higher order thinking) within the context of executive functions. Using this material, young adults in transition can become effective thinkers and agents of positive change in their own lives. This dual approach is vital for all individuals with autism and other developmental disabilities, regardless of their individual diagnosis or level of functioning.

Since critical thinking and executive function are essential skill sets for participants to navigate meaningfully through all modules in the transition curriculum, this material is intended for use: (1) whenever the need arises, (2) when opportunities to teach these skills emerge during any activity, and (3) when a participant exhibits critical thinking or executive function challenge in need of explicit intervention.

The overlapping relationship of critical thinking and executive function is illustrated in the graphic on the following page. The skills listed in the SHARED column combine the thought processes of critical thinking and the active processes of executive function.



### Application of Critical Thinking in the Transition Curriculum

At a program-wide level, development of critical thinking and executive function skills is embedded into all activities, classes, projects, events, relationship-building work, formal and informal conversations and interactions, groups, decision-making processes, advisory meetings, and internship experiences. This ensures participants have ongoing coaching, support, and skill building. Brain teasers, riddles, and short critical thinking exercises can be included as warm-ups for classes, used as team building activities, and to get the brain activated before starting challenging tasks.

*“Logic will get you from A to B. Imagination will take you everywhere.”*

**-- Albert Einstein**

Additional program-wide opportunities to embed critical thinking and executive function practice, coaching, and exposure include:

- Event planning
- Collaborative projects
- Conflict resolution
- Debates and discussions
- Group problem solving
- Community outings
- Short classes (first aid and fire drill protocol)
- Competitions and contests
- Voting
- Brain games
- Local scavenger hunts
- Improvisation and role play
- Learning how to research a question (who to ask, trusted sources, internet, what key search words to use, etc.)

For participants who need more intensive critical thinking or executive function skills work, support or remediation should be built into their program schedules. For example, an individual who cannot conceptualize time will need work to build the foundation. The student can then go on to develop skills in estimating, managing, and planning time-related activities and projects. Remediation or compensatory techniques can be provided by staff or by outside resources and professionals, such as OT, SLP, or learning specialists.

Specialized program-based interventions to build concepts such as sequence, frequency, and duration can be integrated into the student's daily schedule using interactive software (see 8.07 Sources and References for other suggestions.)

In the sections that follow are definitions and other teacher guidance for each of the major critical thinking and executive function skill areas.

## 8.02 Concept Formation

includes...

- Visualizing the Concept
- Parts-to-Whole / Whole-to-Parts Thinking
- Processing Meaning

When we are able to visualize and comprehend both concrete and abstract ideas, we are able to be stronger communicators, thinkers, and problem solvers.

**Concept formation** is the result of grasping the properties of objects, events, or qualities using the processes of **abstraction** and **generalization**.

**Abstraction** involves identifying and extracting a non-tangible notion or essential characteristic from a concept or its properties.

**Generalization** has to do with drawing a unifying principle, rule, or notion from a wider body of data or experience.

*For example, apples can be characterized by their physical qualities (shape, feel, size, taste), their context (hanging on a tree in an orchard, in a pile in the produce department of a grocery store), or their uses (dipped in caramel and put on a stick to eat, given to teachers by students).*

### Individuals challenged by concept formation tend to demonstrate difficulty in

- Object identification (*Example: Student has trouble identifying what a hat is. He may have difficulty identifying by verbal, visual, tactile or other means*)
- Object usage (*Example: Student has trouble understanding a hat is used to keep one's head warm, block out glaring sun, prevent sunburn, for protective purposes, or as a fashion statement. He may have difficulty grasping the main use and alternative usages.*)
- Applying the object to a context (*Example: Student has difficulty drawing a picture of someone wearing a hat that holds clues as to why he is wearing it; has trouble including a hat in a verbal description of a whole concept such as a policeman or someone he knows, like his mom; has trouble incorporating hat into a story in a way that reflects understanding of its purpose or use*)

### How to approach concept formation when working with students

The basic guiding question is: *What is it?* The focus should be on building and using descriptive language. Begin with broad terms and comparisons. Help the student build his base of detailed descriptive terms he can understand and use in conversations and stories, and can apply in speaking and writing. Increase

his descriptive ability to enhance the richness of his concept formation (big vs. little, enormous vs. tiny). Through concept formation, we are able to deepen our understanding of the world around us.

**Concrete Concepts** are physical objects such as chair, rain, ice cream, and bedroom. They have physical dimensions that can be identified through the main five senses (sight, taste, touch, hearing, smell).

**Abstract concepts** are ideas, thoughts, or theories that extend beyond concrete realities, specific objects, or actual instances. Justice and poverty are examples of abstract concepts. (Dictionary.com)

Individuals who struggle with concept formation tend to display three predictable learning profiles:

1. Challenges with concept formation across the board, and in need of support that builds the skill from the foundation upwards (concrete to abstract)
2. Intermittent challenges – sometimes they are able to form and manipulate concepts and other times they are not, making it difficult to identify what needs support and remediation
3. Solid understanding of concrete concepts but great difficulty with abstract concepts.

Students with profile #1 will benefit by working with concrete concepts until they demonstrate they are stable with concrete concept imagery, detail/big picture thinking, and processing meaning. Once stable, they can be supported in applying those skills to abstract concepts.

Students with profile #2 will benefit from beginning in the concrete realm so teachers can identify areas of strength and areas in need of strengthening (*Example: Student is strong with visualization and meaning but struggles with parts-to-whole/whole-to-parts thinking*). Once the areas of challenge are identified, they can be concentrated on as the teacher moves between work in both the concrete and abstract realms, shoring up areas in need of support and practice.

Students with profile #3 will likely need guidance to understand how to visualize an abstract concept. Practicing simply visualizing abstract concepts is the recommended starting point until the student demonstrates an ability to think abstractly. Once this skill is established, deeper work in abstract concepts is likely to be more effective because the individual has a stronger foundation upon which to build new skills.

### **Individuals challenged in the area of concrete concepts tend to**

- Struggle to identify objects (on paper, in 3D, through words)
- Tend to get quickly confused in discussions and when receiving instructions or explanations
- Mix objects up when speaking or when asked to retrieve or identify something
- Have low reading comprehension
- Get frustrated or emotionally dysregulated by games involving object identification, matching, and other concept word play.
- Have difficulty guessing an object based on clues and cues

### How to approach concrete concepts when working with students

If a student struggles with basic concrete concepts it is important to rule out challenges in other domains before assuming the difficulty is rooted in concrete conceptualization. Students with slow processing speeds, language processing challenges, and auditory processing challenges will struggle with concept formation. In these cases, it is recommended that the approach to concept formation work be formed based upon the appropriate learning strategies and accommodations.

Individuals with a low fund of knowledge or exposure to concepts will appear to be weak in concept formation when in fact they need to work on expanding their vocabulary and being exposed to a wider variety of concepts. In such cases, work on vocabulary building and experiential learning should come before explicit concept building work begins.

### Individuals challenged in the area of abstract concepts tend to

- Gravitate to concrete stories, movies, games, entertainment, and conversations and may avoid or resist situations, stories, or experiences they perceive as “too hard” or “too confusing”
- Get lost in a lecture or conversation if the topic moves into abstraction
- If confidence, self-awareness, and/or self-advocacy is low will not likely ask for clarification or identify when they are not understanding something
- May ask a lot of questions that interfere with the flow of conversation or activity
- Use overgeneralized vocabulary rather than descriptive language containing more detail

### How to approach abstract concepts when working with students

Understanding each individual’s language capability, vocabulary base (receptive and expressive), and visualization skills provide clues to how teachers should engage students on this topic. *For example, a student with challenges in language processing and expression may need approaches that incorporate visuals and movement. A student with vocabulary difficulties may need approaches that incorporate visuals, three-dimensional manipulatives, and movement. A student who struggles with visualization will need visualizing and verbalizing techniques.*

#### 8.02.1 Visualizing the Concept

**Visualization** is the ability to construct an image or represent an idea in the mind’s eye. However, the notion of “visualization” can go beyond imagining just physical characteristics. Visualization of an object or abstract principle can include meaning, function, and qualities that help create a deeply meaningful, multi-dimensional representation. These representations allow us to think critically, preview what is to come, and form our own unique view of the world.

**Concrete example:** When asked to picture a circus, the student conjures up a scene of a parade with elephants, people in costumes, imagines the smell of peanuts and hay, hears the man yelling “ladies and gentlemen,” hears lions roar, can describe the big tent and clown’s make-up, etc.

**Abstract example:** When asked to picture democracy, the student imagines a town meeting with people in lively discussions, people waiting in line at a polling center, ballot boxes, etc.

### Individuals challenged in the area of visualization tend to

- Have difficulty constructing a picture in the mind's eye based on someone else's words
- Be overly dependent on images made for them in order to understand. They may need to see a picture of a shoe, or have someone point to a shoe in addition to hearing the word to be able to imagine one
- Have weak reading comprehension, especially if there are few or no illustrations to match what the words say
- Have weak recall of plots, stories, and characters from books read. By contrast, they may have excellent recall of visual information – movies, TV shows, things they saw happen
- Omit, sporadically use, or misuse descriptive language
- Show little interest and demonstrate weak skills in making up stories
- Have difficulty and/or lack independence with activities that include brainstorming
- Omit key details in artwork
- Have difficulty conceptualizing what the end result of a project, activity, or event would look like
- Not use gesturing to supplement meaning (Examples: The fish was this long – show with hands; The old man walked this way – imitate hobbling slowly)
- Have difficulty with visual memory. Visual memory is the ability to hold images in the mind's eye for a sustained period of time and conjuring them up again as needed.
- Be delayed in forming object permanence. Object permanence is the ability to know something exists when it is hidden from view.
- Have difficulty making a map or constructing a bird's eye view of an area

### How to approach visualizing concepts with students:

Guiding questions include:

- Identifying and breaking down concepts into their observable parts: *What is it? How big is it? What colors should I see? How many? What shape does it look like? What sound would it make? etc.*
- *What should I picture/imagine/see in my mind based on your description of a (frog, chair, circus, angry policeman directing traffic, etc.)?*
- *How can you use your words, gestures, and movements to help me see the picture you have in your mind/are holding in front of you?*

Visualization can be supported in many ways throughout the day: capitalize on teachable moments in conversations, emphasize in classes and group work, engage in visualization-based games and activities, make use of materials from visualization-based programs, and utilize visualization board games and interactive

online games. Very effective, engaging approaches to visualization enlist the body and the senses as well as thinking and language.

### 8.02.2 Parts-to-Whole / Whole-to-Parts Thinking

**Parts-to-whole thinking** is the ability to experience internally the parts that make up an object or idea and then how those parts combine or integrate to create that object or idea.

**Whole-to-parts thinking** involves grasping an overall concept first and then moving on to grasp the details or parts that make up the idea.

If parts of an object or circumstance are examined in isolation from one another, the resulting understanding is limited. If the whole is examined without recognizing that each of the parts is distinct and has its own role, understanding is again limited. A wider understanding becomes possible if both deconstruction (whole-to-parts) and synthesis (parts-to-whole) are used

When we are able to deconstruct ideas and concepts into their parts to examine and synthesize those parts back together to find greater meaning, we become big picture thinkers. The better we are as big picture thinkers, the more we can contribute to group collaborations in a positive and meaningful way.

**Cognitive-based example:** When examining paintings using parts-to-whole thinking we can break those works of art into styles, uses of colors, uses of perspectives, and moods to understand how the various genres are defined. Alternatively, we can use whole-to-parts thinking to examine each genre in detail by studying its components.

When we have the capacity to break things into parts, we can discover aspects of an idea or experience in which we feel particularly drawn. We may want to expand on or explore them as potential new interests or passions. We can also understand what elements may be dysregulating or undesirable.

**Being able to grasp details and the whole picture enables us to explore our personal preferences and opinions in creative ways. We can become more flexible, comprehensive thinkers and learners.**

**Social-emotional based example:** A student reacts poorly to going to a circus. When the experience is broken down into parts the individual discovers it was not the whole circus experience that was upsetting but a particular sensory experience that made it for him (smells, noises, sounds). However, the elephants were very compelling and he wants to learn more about them (where they come from, facts about them, how they are trained).

#### Individuals challenged in the area of parts-to-whole thinking tend to

- Have difficulty drawing conclusions based on a series of facts
- Focus too much on details and are unable to conceptualize the main ideas
- Leave out key parts of a multi-step or multi-component project or approach to a task

### Guiding questions to use with students

- *If I break an idea or object down into its parts and lay them out side by side, what would I include? When we put them together, what does it make?*
- *What role does each part have in making the whole object or idea work?*
- *When all parts are together, what is the resulting object or idea?*
- *If any parts were missing, how would it change the whole?*
- *How can we use our creativity to represent visually or act out through movement the relationship among all the parts and the whole?*
- *Are there parts to which I am particularly interested or drawn?*

### Individuals challenged in the area of whole-to-parts thinking tend to

- Have difficulty breaking down a concept, idea, or object into its parts and identifying the role and value each one plays
- See the main idea but have difficulty identifying and understanding key components that make up the main idea
- Struggle to see how changing one part of a concept, idea, or object makes changes to the whole outcome (*Examples: if I remove a part, the object will work differently or not work; if I change the time of day we schedule the picnic, how does that change what we pack to eat or bring?*)
- Have trouble seeing how the parts of a concept, idea, or object work together when in isolation (Example: how just the pedal and gears work together on a bike) and altogether (Example: all individual bike parts make up a whole bicycle)
- Have difficulty because they focus on one aspect of an object, idea, or concept (*Examples: just talking about clowns at the circus, looking at many styles of seats a bike can have, examining the role a dispatcher has in an emergency response*)
- Find making revisions, omissions, substitutions, and other changes difficult because it is challenging to isolate the change and conceptualize how it may improve the result. This may include things the student has created as well as other objects, ideas, concepts. (*Examples: changing an element in a story to alter the outcome and improve the overall piece, changing one of the ingredients in a recipe, modifying a piece of art*)

### Guiding questions to use with students

- *When we break this object, idea, or concept into parts what is the significance of each part? (What role does each part play and why is it important?)*
- *If we take out one part of something, how does it change the result? If we add something, how would it change the result?*
- *If we want to make a change or improve on an object, idea, or concept, what should we focus on? Where would we start? How would it affect the whole?*

- *If we examine your favorite gadget, object, idea, story, or concept and break it down into parts can you tell me why each is there/what each does? (Literally take it apart, do it as a visualization exercise, draw out on a whiteboard or poster)  
Is there one part of this object, idea, or concept you like best; you think makes the whole thing work well?*

There is a natural repetition in wording and activities when working on strengthening big picture thinking. As students become familiar with the questioning process and a predictable approach to constructing and deconstructing concepts is established, the process becomes easier. As skills increase, students can be pushed further with more challenging questions that stretch their ability to analyze, solve problems, and think creatively.

Using student interests (favorite objects, stories, concepts, etc.) as starting points for this work can increase likelihood of engagement, enthusiasm, and receptiveness. Once the student is more adept at parts-to-whole and whole-to-parts thinking with familiar concepts that have positive associations, staff can begin expanding to less familiar and more complex material. This helps students stretch their thinking.

### 8.02.3 Processing Meaning

Meaning is processed by sorting through a collection of related data (memories, facts, emotions, etc.), identifying how the pieces connect, and how they are relevant to the individual. This process can result in greater understanding and may lead to improved critical thinking.

When we are able to process efficiently and have the capacity to analyze, make connections, and draw conclusions, we become meaning-makers. As those skills solidify, we internalize the process and become more cognitively active, alert, and observant. As a result, we become motivated to seek even greater understanding.

**Example:** The individual looking at a painting is able to identify parts, how each part relates to and affects the meaning of the painting. If he steps back mentally, he can take in the painting as a whole, integrated image. The next step towards sophisticated thinking is to explore more abstract concepts such as symbolism, political messages, historical significance, how the piece compares to other works from the same artist, etc.

#### Individuals challenged in the area of processing meaning tend to

- Get lost, confused, or otherwise have difficulty participating in, following, and understanding conversations (1:1 or group)
- Need instructions, explanations, and other verbal information repeated several times
- Have difficulty generating inferences, opinions, or arriving at sound conclusions based on facts
- Deliver convoluted explanations
- Confuse meanings of words, especially those that sound or are spelled similarly
- Have difficulty writing creatively, creating story summaries, generating alternative endings, etc.
- Have difficulty telling stories cohesively or recalling an event verbally

- Miss or misinterpret significance, metaphor, analogies, underlying meaning, and other more subtle and abstract aspects of comprehension
- Misinterpret the meaning of social situations

### Guiding questions to use with students

- *What is the purpose of this object or idea?*
- *What does it do?*
- *Where would I likely see or use this object or idea?*
- *In what situations would this object or idea be helpful?*
- *Who would likely use this object or idea and in what situations?*
- *How does the presence of this object or idea affect other things around it?*
- *If this object or idea were missing, how would it affect a given situation?*
- *Need non-object related examples*

### 8.03 Analysis

includes...

- Reasoning
- Main Idea and Supporting Details (Big Picture Thinking)
- Categorizing
- Making comparisons
- Drawing conclusions
- Logic and Reasoning
- Interpretation and Inference
- Creativity and Brainstorming
- Generating Multiple Possible Outcomes
- Rule Use

**Critical thinking** is a series of steps one can take to reason clearly and arrive at useful conclusions about what to do or what to believe. The steps consist of gathering knowledge or information about a topic or issue; comprehending the information; analyzing it to determine its completeness, validity, etc.; evaluating it to draw conclusions; and drawing conclusions. The process is not always linear, as critical thinking often requires us to revisit known information, add new knowledge to it, and re-evaluate any new meaning that may arise.

**Analysis** consists of breaking something down into its basic elements to make a detailed examination of them.

When we possess and systematically practice critical thinking skills, we are able to go beyond the basic recognition of meaning. We can engage in more sophisticated processes, such as: questioning meaning, applying meaning, generating new meaning, and so much more.

#### **Individuals challenged in the area of critical thinking and analysis skills tend to**

- Have difficulty knowing where to start or how to approach a critical thinking-based discussion
- Have difficulty knowing what facts, ideas, examples, and concepts to include to express an idea clearly and comprehensively, support a suggestion, or offer an explanation
- Give elaborate explanations or analyses lacking sequence or marked by other gaps in logic
- Have difficulty explaining, backing up, or defending their thoughts, beliefs, or opinions (in general or on a specific topic)
- Struggle to arrive at either concrete and/or abstract conclusions
- Often miss meaning in a story, anecdote, event, or discussion
- Struggle with writing, problem solving, decision making, and other activities that require critical thinking or analysis
- Generate ideas that lack creativity and insight
- Have difficulty understanding social situations

### How to approach critical thinking and analysis with students

Simply providing specific guiding questions in the Critical Thinking and Analysis section will not be particularly helpful as analysis and critical thinking are so contextual. When working with an individual in these two domains, questions need to be tailored to find gaps in understanding, interpretation, and logic. Helpful approaches often include:

- Following a student's chain of logic to its conclusion (can be done verbally, with pictures, drawing, or concept mapping)
- Eliciting opinions, asking the student to defend his conclusions or options (through debate or questions)
- Having the student draw a concept map; represent ideas through images and drawings; orally explain, write, act out, or otherwise represent his understanding of the topic at hand. **Concept mapping** (also called mind mapping) is a means of visually representing information using words and pictures related by lines drawn among them in a similar way to how sentences are diagrammed in English grammar textbooks.
- Answering inferential or interpretive questions generated by the teacher
- Brainstorming, then evaluating ideas generated
- Modeling creative ways to look at and evaluate an idea

#### 8.03.1 Reasoning

**Reasoning** allows us to make meaning of objects, ideas, contexts, and experiences. When we are able to **compare, contrast, describe, analyze, categorize, and integrate** new information with prior knowledge we build our ability to be active and effective learners. As this skill is strengthened, our confidence and motivation to learn increases.

When working with students on strengthening reasoning it is important to reinforce both **verbal** and **non-verbal reasoning skills**. **Verbal reasoning** enlists receptive language (understanding) and expressive language (oral communication) as the main tools for approaching understanding and communicating a concept. **Non-verbal reasoning** enlists symbols, patterns, gestures, pictures, etc. as the main tool for approaching, understanding and communicating a concept.

It is important to strengthen language-based, verbal reasoning with individuals on the autism spectrum to the extent they are able given their language and language processing capabilities. It is essential to strengthen **non-verbal reasoning** skills alongside work on verbal reasoning skills, especially with individuals vulnerable to language-based challenges.

**Non-verbal reasoning skills open doors to communication, understanding and creative expression that would otherwise remain closed for those who possess inherent language challenges.**

When we can detect patterns, understand sequencing, see things spatially (in relation to each other), and conceptualize time concretely and abstractly, we have strong non-verbal reasoning skills. These non-verbal skills expand our career options and we feel more prepared to participate in groups and collaborative hands-on projects.

Reasoning can be divided into two categories: **concrete reasoning** and **abstract reasoning**:

**Concrete reasoning** means thinking with information derived from the physical senses and tangible experiences. This form of reasoning is often associated with the literal use of words.

*For example, if we look outside at midday and the sky is dark, wind is blowing, and everything is wet, our concrete reasoning skills tell us it is raining outside. If we want to be sure, we may walk outside and put our hands out to feel the raindrops. This concrete reasoning leads us to a related concrete realization that an umbrella or raincoat is needed if we wanted to be outside and not get wet.*

Difficulty with concrete reasoning can extend to one- and two-dimensional visual and auditory information as well. *(Examples: Illustrations in a story that represent the words; instructions given in picture form; visual charts using pictures to explain a sequence, process, or rule; symbolic representations such as signs intended to guide behavior such as poolside symbols, signs near electrical or construction work, and road signs; some graphic novels, cartoons, movies, and TV.)*

#### **Individuals challenged in the area of concrete reasoning tend to**

- Miss obvious, observable clues
- Do not connect concrete facts together to arrive at a logical conclusion
- Are dependent on others to help them understand and draw conclusions based on observable information

**Abstract reasoning** is the ability to extract generalized principles or ideas from concrete experiences and use those ideas to develop additional understandings or meanings.

A person who can only reason concretely might be able to speak of the chair, table, and stools in a room. Another person with the ability to reason abstractly might see all the same objects but refer to them as “the furniture in the room.”

Once the foundational ability to reason abstractly is active, the student’s reasoning can be stretched beyond the boundaries of the initial topic. The student can be coached to apply meaning in related ways that deepen and expand understanding. This opens doors for opportunities to make the process more active and complex. For example, when the student can see the various objects in the room as “the furniture”, the next skill level would be drawing conclusions and evaluating opinions about the furniture.

### Individuals challenged in the area of abstract reasoning tend to

- Struggle with concepts related to time (see below)
- Struggle with concepts related to spatial ordering (see below)
- Struggle with contingency/conditional thinking (see below)

### How to approach improving concrete and abstract reasoning

These activities develop mental flexibility and adaptability, especially in the presence of limiting circumstances or group dynamics. If a student has trouble making basic observations, he needs more practice visualizing and verbalizing. If a student struggles to form opinions or draw conclusions, he needs more practice in those specific areas. In such cases, it is wise to delay abstract reasoning work until their foundational skills are stronger and they have the tools to be more successful abstract thinkers.

Example of how both concrete and abstract reasoning can be approached in different ways, illuminating how individual learning profiles affect the way one approaches the reasoning process:

**Scenario A:** *“I like the furniture because it has a modern look and makes the room look cool.”*

This student’s comment reveals he is familiar with contemporary style of furniture, is having a positive reaction to what he sees, and uses emotions to process experience. Discussions about happiness with the current furniture situation can lead to larger discussions about preferences regarding room arrangements, picking favorite chairs, and brainstorming what uses the room could have in the program (great place to be quiet and study, consider making this the student lounge, etc.).

**Scenario B:** *“I hate the colors. Some of the pieces are old or slightly damaged. They don’t match each other.”*

This student also infuses emotions into his thinking, is having a negative reaction to what he sees, allocates his attention to small details, and prefers things to be in order or look a certain way.

In a group context, compare and contrast opinions. Discuss how different rooms “should” look depending on desired usage. Discuss if any pieces could be repaired or cleaned up. Discuss if there is a budget for the furniture and, if so, engage students in brainstorming and voting how to use it (buy or sew slip covers, what to keep, going to thrift stores or yard sales to look for replacements, do some online comparative shopping). If there is no budget, discuss potential options and encourage creative solutions.

**Scenario C:** *“I like the separate furniture pieces but they are in awkward places in the room.”*

This student demonstrates parts-to-whole thinking strength, an inclination to have things in order according to preferences. He demonstrates some visualization skills (has a vision in his mind the room does not fit and is “awkward”), but he may not be as emotionally driven to form opinions.

Decide what does not work well, what the room will be used for, then draw alternative floor plans, vote on changes, move objects around, and experiment, etc.

Key components needed for effective abstract reasoning are **Time, Spatial Reasoning,** and **Contingency/Conditional Thinking**. These three aspects of abstract reasoning are fundamental. They us understand and organize abstract elements that play major roles in understanding, thought organization and logic.

### Time

In its simplest application, the notion of **time** has concrete aspects – such as when used as a position on a continuum (the calendar date March 12, 1895) or when speaking of duration (the vacation lasted two weeks). It can refer to the position of the hands on an analog clock, the series of numbers on a digital clock, or the starting and ending points of events.

However, time also has a more abstract nature that tends to be more difficult for many students with disabilities. It can be used to approximate the passage of time – an “era”, a “phase”, or a distinct period of one’s life (*Example: “my time in the military”*). It can be used colloquially (*Examples: “Time’s up!”*, *“It’s about time!”*) or metaphorically or descriptively (*Example: “Watching this movie is like watching corn grow”*).

To further complicate matters, time can be fixed (*Example: “You have 20 minutes to complete this quiz”*) but it can also be conditional or fluid (*Examples: “Take all the time you need”, “We don’t have enough time to ride the rollercoaster and the Ferris wheel”*). Time can be contingent on other factors and sometimes adjusted according to external logistics and limitations. In these cases, it requires an even higher level of understanding and cognitive flexibility.

### Individuals challenged in the area of time concepts tend to

- Be poor estimators of time (*Examples: how long it takes to complete a task*)
- Be unaware of the passage of time (both in general and specifically)
- Be dependent on others to manage their schedules and make plans
- Be surprised when told something is ending or transitioning into a different activity, and possibly overwhelmed emotionally when told to stop, clean up, or finish
- Be frustrated, impatient, or dysregulated by waiting (feels endless)
- Have difficulty projecting into the future or estimating how long ago something happened  
Struggle with time-related academic subjects, such as history
- Avoid or react negatively to activities with time parameters (*Examples: races, timed tests, etc.*)

### How to approach time when working with students

Since time is such a difficult concept for many, activities should be tailored to individual need, have experiential components, and be spread throughout the day.

- Raise awareness of time throughout the day (*Example: physical education lasts 50 minutes*)
- Draw attention to passage of time and track it (*Example: use a stop watch to time something*)
- Consider time as a factor in decision-making (*Example: we don't have time to bake cookies from scratch but we could use pre-made dough and bake them before the party*)
- Build time management practice into the day (teachable moments and responsibilities managing one's schedule)

If an individual struggles with telling time and reading clocks, the student will need a lot of experiential work supplemented with reflection and discussion. If an individual can read a clock but struggles with conceptualizing the passage of time, the work should be a combination of

- Using visual aids, cards, games, and storyboarding to illustrate passage of time through visual cues
- Reading stories with illustrations to support story elements related to time
- Activities and discussions to expand and practice the skill of marking time
- Frequent and ongoing practice estimating time (*Examples: How long will a task take? How long will it take to get somewhere?*)
- Frequent and ongoing practice evaluating the passage of time (*Example: Before an activity or experience giving the marker of time, "It is now 2 o'clock; we will do xyz for 15 minutes." After the activity, discuss the experience in relation to time: "Did that 15 minutes go by fast, slow, or about what you expected 15 minutes to feel like?"*)
- Frequent and ongoing practice identifying factors that affect time to increase awareness of contingencies and flexible thinking (*Example: "We have a lot planned today so we need to pay attention to our time; If you decide to take a longer break now, you may be rushed later"*). Note that oral information is best understood and retained when accompanied by visual information (*Example: having a poster up reminding students of a change in schedule*).

The last three are particularly helpful since they focus on estimation, prediction, and reflection. Have the student perform actions and estimate how long they took. Have him repeat the same action with someone else timing it. Do comparison and reflection on the difference between the student's internal sense of the passage of time and an external standard such as a clock. This activity supports self-monitoring and time management simultaneously – both vital executive functions.

**Note to the reader:** Some individuals are stable in their basic understanding of time when there are visual or other supportive cues but still struggle with the passage of time in the absence of obvious time cues. *For example, as long as a clock is visible in the classroom, the student knows how long an activity is taking. However, without that clock, he may imagine he has only been on the computer for a few minutes when in fact it has been several hours.*

## Spatial reasoning

In general, **spatial reasoning** involves the ability to judge three-dimensional relationships and visualize them in the mind's eye. (refer to 8.02.1 for more information on visualization).

Dr. Gerald Grow describes spatial intelligence:

*“The spatial intelligence manifests in a variety of ways. Transforming mental images is a spatial skill that engineers and designers depend on. When a hiker pauses with map and compass, it is the spatial intelligence that conceptualizes the path. Through the spatial sense, a painter ‘feels’ the tension, balance and composition of a painting. Spatial ability is also the more abstract intelligence of a chess master, a battle commander, or a theoretical physicist, as well as the familiar ability to recognize objects, faces, and details.”*  
(Sarno 166)

### Spatial reasoning is needed to

- Identify shapes
- Perceive objects and their position/location in space
- Recognize scenes or faces
- Notice fine differences and details
- Draw objects or scenes that make sense from a spatial standpoint
- Conceptualize math problems
- Move objects in a room in the mind's eye
- Navigate large spaces
- Imagine a cohesive and spatially accurate scene or object in the mind's eye
- Create art
- Understand and judge personal space
- Read body language

Like time, **spatial reasoning** is challenging to define because it combines both concrete and abstract elements. The concept was expanded into the broader notion of spatial intelligence by Dr. Howard Gardner. (Gardner 6-7, 14, 215-216)

### Individuals challenged in the area of spatial reasoning might exhibit

- Generalized difficulty in visual processing
- Difficulty finding objects in one-, two-, and three-dimensional space
- Difficulty judging distance between objects, between themselves and objects or other people, and judging distance in general
- Difficulty understanding direction (in two-dimensional space, what direction is the line on the page pointing; in three-dimensional space, which direction is someone facing)
- Difficulty understanding, reading, and using maps
- Difficulty reading body language

- Lack of recognition of familiar places
- Needing physical help to orient oneself in space (touch the wall when walking down a hall)
- Difficulty visualizing something in action

### How to approach spatial reasoning when working with students

The approach, language level, and complexity of how to engage students with spatial reasoning issues will depend on the specific areas of challenge.

### Activities and resources to use with students

- Following directions: Activities that start as one-dimensional on paper, then move to two-dimensional on a whiteboard, then three-dimensional space in a room
  - start with 2-3 directions that are concrete and slowly increase complexity and number of steps as the student experiences mastery
  - first say directions, have the student repeat them back, and then have the student follow the steps to reinforce memory and step-wisdom
  - activate visualization as much as possible to bolster memory (*Example: "First, I see you draw a yellow circle in the middle of the paper. Second, I see you fold the paper in half. Tell me what you see yourself doing..."*)
- Scavenger hunts
- Treasure map games
- Art projects (on paper, models, etc.)
- Brain teasers, visual puzzles, and board games based on recognizing spatial clues
- Specific exercises (Wieder & Wachs, 2012)

### Conditional or contingency thinking

In **conditional or contingency thinking**, a conclusion is based on a provisional, or "if...then" proposition. Also known as *deductive reasoning*. This ability to reason from cause to effect or general to specific enables one to compare options, connect related aspects of a concept or situation together, and use logic to navigate experiences.

Deductive reasoning skills allow us to be more independent and strategic thinkers because we can assess the facts of a situation and draw accurate conclusions.

Deductive reasoning gives us the tools to manage the past, present, and future: why an event played out as it did, what is going on in a current situation, and what may happen in an upcoming experience.

Deductive reasoning plays an important role in decision-making, problem solving, and executive function (refer to section 8.04 for more information).

A great benefit to thinking conditionally and being able to identify contingencies is that individuals become more flexible and adaptable to change. This ability provides them with a method for approaching

unexpected changes as they arise. In this way, deductive reasoning skills help to maintain emotional regulation because they prepare individuals for impending changes. They provide a means of understanding change when it arises.

### Individuals challenged in the area of conditional thinking tend to

- Have difficulty drawing conclusions if contingencies are involved
- Struggle with generating multiple possible outcomes
- Struggle in situations requiring a change of direction from what was expected
- Have challenges making plans that require anticipating and preparing for possible obstacles
- Lack preparedness or become dysregulated if details of a situation change
- Have difficulty understanding how changing something may impact the outcome

### How to approach conditional thinking when working with students

Use "if...then" formatted questions whether it is a visual representation or posed with words. Use role-play scenarios and other creative, humorous, and interactive exercises since much of contingency thinking leads to changes in behavior or actions. By seeing contingencies in action, students can better understand the abstraction and make connections. The emphasis on creativity and humor keep students engaged and enlivened, which bolsters learning.

#### 8.03.2 Main Idea and Supporting Details (Big Picture Thinking)

**Main ideas** surface in cartoons, stories, books, conversations, jokes, literature, videos, commercials...they are everywhere. Our ability to detect them, whether obvious or subtle, simple or complex, directly affects the meaning we draw from them.

The main idea in a Disney vacation commercial is "Pick Disney for your next family vacation". The main idea in Dr. Seuss' The Lorax is, "We must care about and care for nature because without it we all suffer." The main idea in a story or article is the point the author wants you to remember most. Sometimes the central theme is stated directly, sometimes it must be inferred

**Supporting details** are "... facts, statements, examples, specifics which guide us to a full understanding of the main idea. They clarify, illuminate, explain, describe, expand and illustrate the main idea..." Our ability to identify and examine supporting details is what helps us understand how we got to the main point or central meaning. It provides us with a road map to how the author, cartoonist, video game designer, etc. made their creation. (Langan, 14-37)

Understanding supporting details

- Permits us to break an idea down into its important parts
- Helps us identify an aspect of a work that we want or need to understand better
- Provides us with points of discussion, analysis, or questioning  
(Langan)

### Individuals challenged in the area of main ideas and/or supporting details tend to

- Exhibit gaps in understanding
- Avoid longer stories, movies, and conversations
- Hesitate to participate in discussions or attend lectures
- Have difficulty following visual, oral, and written information
- May appear to have difficulty maintaining attention while being read to, watching a movie, hearing a lecture, or reading a book
- Have weak memory recall
- Get confused or overwhelmed if they get lost conceptually
- Have difficulty generating reasons for choices or defending ideas

### How to approach main ideas when working with students

The traditional educational approach for identifying the main idea and supporting details is verbally-based using worksheets, quizzes/tests, or class discussions. Heighten student engagement by incorporating visual images, emotional content, physical manipulatives, humor, role play, graphic organizers, concept maps, games, etc.

#### 8.03.3 Categorizing

**Categorizing** involves examining ideas, objects, feelings, places, experiences, etc. and classifying them in groupings of similar qualities. Categories can be broad or specific and subtle. They can be based on concrete criteria (*Example: make a list of mammals*) or abstract (*Example: list countries with democratic governments*). They can be based upon a single criterion (*Example: list things that are red*) or multiple criteria (*Example: list expensive watches made in Switzerland*).

When we can categorize information, we are able to begin bringing order to confusing situations.

### Individuals challenged in the area of categorization tend to

- Be more comfortable with broad, concrete categorization such as “point to all the big items”
- Lack the ability to generate strategies for how to approach and navigate categorizing
- Classify things, ideas, people together that do not have similar qualities
- Select illogical basis for categorizing
- Avoid activities where categorizing is required (sorting objects, debating, compare/contrast games, and exercises, etc.)

### How to approach categorization when working with students

As with main ideas, the traditional educational approach for working on categorization tends to be verbally-based, often in a worksheet format. Widen the approach using visual images, physical manipulatives, role play, graphic organizers, games, etc. If possible, avoid activities where categorizing is a core element of success (sorting objects, debating, compare/contrast games and exercises, etc.)

The first step is to identify a basis or strategy for categorization. Students can be engaged in deciding which category an item fits because it supports strategic thinking (*Example: “Let’s organize these jobs in two categories – dangerous and not dangerous. Be ready to point out why you think a job is dangerous if someone in the group disagrees with you.”*)

#### 8.03.4 Making comparisons

A **comparison** is an examination made between two or more objects, people, places, ideas, etc. Making comparisons require quite a bit of cognitive activation and flexibility in thinking. When we are skilled in making comparisons, we:

- Understand the concept of sameness and difference
- Understand the concept of categorization
- Can identify sameness and difference according to specific criteria (*Example: those individuals in the room who have glasses, those who do not*)
- Can identify similarities and differences in the concrete realm
- Become flexible in applying the skill.

More advanced comparison skills include:

- Identifying similarities and differences in the abstract (ideas, opinions; possible, projected, or imagined scenarios)
- Understanding similarities and differences can be both general and broad (*Example: string instruments vs. wind instruments*) or specific and small (*Example: guitar can make low sounds that are soothing and a ukulele only makes higher pitched sounds that can be over-stimulating*)
- Comparing not only by category but within a category (*Example: chemistry and philosophy are both school subjects, but learning chemistry requires memorization of facts and formulas whereas learning philosophy requires understanding ideas and concepts*)
- Making comparisons about one concept that may vary because of a change in mood, situation, need, etc. (*Example: When my cat is hungry she is affectionate and wants my attention. She often crawls in my lap and purrs. When my cat feels playful or restless she knocks things over to get my attention and wants me to throw her toys and play fetch.*)

#### Individuals challenged in the area of making comparisons tend to

- Shy away from debates and discussions involving comparisons
- Struggle with decision-making, as comparisons play a crucial role in the process
- Have difficulty making choices
- Have difficulty explaining preferences (Joe may know he feels more comfortable around Sara than Jack but he may not be able to explain why because that involves comparing two people)
- Have difficulty constructing an argument. Because of this, they often have difficulty persuading others to agree with their choices.

### How to approach making comparisons when working with students

Add in visual images, physical manipulatives, role-play, graphic organizers, games, etc. It is also important to incorporate comparison-based observations throughout the day in different contexts. This gives students a wider range of opportunities in which to apply this way of thinking and raises their general awareness.

Students usually need practice making comparisons and judgments regarding their thoughts and feelings. One might start with what they like, how they might rate something on scale of 1-10, ordering preferences or emotional experiences, etc.

#### 8.03.5 Drawing Conclusions

**Drawing conclusions** means coming to a logical judgment, interpretation, explanation, or inference based upon reasoning and evidence. It is a complex process of evaluating all the major factors or forces relevant to a situation. It requires one to gather various types of information, sort the information into categories, make comparisons, determine the relevance and relative value of the data found, and draw on earlier experiences.

Without the ability to draw conclusions, we are left to float in a sea of facts. This ability strongly influences the success of our:

- Academics
- Social choices
- Decision making
- Opinion formation
- Beliefs about ourselves and the world
- Career choices

### Individuals challenged in the area of drawing conclusions tend to

- Struggle with analysis, writing, and reading comprehension
- Experience anxiety when making even small decisions
- Be overly dependent on or influenced by others when making decisions
- Be hesitant to join a conversation, offer an opinion, or state a preference
- Develop a passive style of relating to peers in group decision-making situations
- Be led into problematic behaviors by others because cannot anticipate the consequences of various actions/scenarios

### How to approach drawing conclusions when working with students

For students who struggle to draw even the most basic of conclusions, give them practice drawing simple conclusions using a limited amount of concrete details. Once basic skills are established, gradually increase the complexity of activities by adding more facts. When the timing feels appropriate, begin to

incorporate a written component and increase the writing expectation according to the student's individual writing capability. For example, first expect fragmented sentences, then complete sentences, then short paragraphs, then longer paragraphs, and so forth.

Incorporate visual images, physical manipulatives, role-play, graphic organizers, games, etc. Concept mapping is a wonderful strategy for illustrating visually the process of arriving at conclusions. Role-play by taking another person's role can also be beneficial.

For those individuals who are adept at writing but struggle with oral language, begin with writing. Later, when ready, get them to begin verbalizing.

A staff member can act as a scribe for a student who struggles with graphomotor difficulty (an accommodation) or one who thinks more effectively if the written component is removed so he can focus on generating the ideas (a strategy). Assistive technology tools provide students with support in generating language and wording.

#### 8.03.6 Logic and Reasoning

**Logical reasoning** is a thinking process using a systematized series of steps to arrive at a conclusion. Logical reasoning is useful for deepening understanding, drawing conclusions, and making inferences.

It is important to note some individuals are stronger in non-verbal logic and reasoning whereas others excel in the verbal realm. Both are important skills to master and can be worked on through individual or group exercises and activities. Note each student's abilities with verbal or non-verbal logic and reasoning. Find ways to capitalize on strengths when planning program schedules, internship options, projects, extracurricular activities, and hobbies. Strengths also inform educational strategies, accommodations, and career development.

Keep in mind there is no one "right" way to think through something. If a student uses an unusual logical pathway to arrive at conclusions, remember the quality and usefulness of the outcome is more important than how the individual arrived at it. Non-traditional systems of thinking should be respected. In cases where a student has difficulty arriving at useful conclusions, the teacher can query the student about his process and explore it with concept mapping and other tools. The teacher helps the student uncover where his logic has failed him and find other ways of approaching the task. The student can then practice the new approach through specifically tailored activities and discussions.

Logical reasoning affects how we think, feel, act, learn, and interact with others. It applies not only to critical thinking but also to other critical neurodevelopmental domains: expressive and receptive language, social cognition, executive function, emotional regulation, mindset, resiliency, attention, motor planning, and sequential/temporal/spatial ordering.

### Individuals challenged in the area of logic and reasoning tend to

- Ask questions, make assumptions, and arrive at conclusions that are illogical or do not consider all the relevant factors (*Example: overlooking the obvious – what can be detected in the moment with senses, facts, or what is generally known to be true*)
- Have difficulty seeing and making connections both on concrete and abstract levels (*Examples: struggle with cause-and-effect relationships, have difficulty bridging from one idea to a related idea, etc.*)
- Experience challenges with problem-solving and decision-making processes
- Initiate behavior, say things, or react to stimuli, ideas, or requests in ways that do not logically match what was asked of them, presented to them, or expected of them in a given situation
- Struggle to understand or completely miss the meaning behind abstract representations and ideas (analogies, metaphors, jokes, puns, etc.)
- Lack the ability to sequence logically and prioritize objects, ideas, actions, or plans
- Have difficulty accomplishing tasks even if they are following directions
- Tend to avoid or get dysregulated by logic-based games, puzzles, brainteasers, etc.
- Experience difficulty brainstorming and being creative – tend to gravitate to very concrete or well-known activities that have very obvious and predictable guidelines and sequences
- Hit impasses and show inflexibility when attempting to debate, defend actions, negotiate, compromise, or socially solve problems
- Be dependent heavily on others to organize, plan, prioritize, etc. (weak executive function)
- Not be able to interpret intentions behind a gesture, decision, or expression of emotion
- Have difficulty knowing how to allocate their attention during an activity, task, or experience
- Produce illogical visualizations that impact comprehension negatively (reading, discussions)
- misunderstand cues and clues that typically would help lead one to arrive at a logical guess (*Examples: academic work, social interactions, games*)
- Become rigid and inflexible, insisting that something has to occur that cannot

### How to approach logic and reasoning when working with students

Teaching logic and reasoning has well-established conventional methods, many of them involving written language. However, there are many ways to enliven this traditionally linear process using non-verbal and verbal puzzles, jokes and riddles, board games, role-play and improvisation, art projects, group exercises, watching video scenes, creative writing, and other inventive methods.

#### 8.03.7 Interpretation and Inference

**Interpretation** is the act of drawing meaning or a conclusion based on what is known or can be observed. A **premise** is something offered for consideration; a point being discussed. **Inference** is the process of deriving conclusions from premises known or assumed true.

Inference and Interpretation are needed in all contexts and interactions, especially in social situations. They allow us to detect subtleties, clues and cues that help us understand the complexity and underlying messages in what is being said or what is happening around us. They help us detect the emotional states of others, especially in situations where someone has not overtly stated how she feels.

When we are able to see beyond the literal or obvious and recognize hidden meanings within what someone has said or done:

- We draw greater understanding from the things people say and do
- We are less likely to miss information that could impact us
- We are less confused about interactions and situations where there is a difference between literal statements and what was intended
- We are able to understand the importance of non-verbal cueing such as tone of voice, gestures, facial expressions, body language
- We are able to catch underlying emotional messages and detect words or actions that reveal or hint at another's motivation or intention in a given situation

All this strengthens emotional intelligence.

#### **Individuals challenged in the area of interpretation and inference tend to**

- Be unable to elaborate on their thoughts, ideas, and opinions
- Avoid philosophical and abstract discussions
- Gravitate to movies and stories that have concrete or finite endings
- Avoid brain teasers, mental games, and academic activities that have more than one correct answer
- Have difficulty "reading between the lines" both in written language and social situations
- Have difficulty interpreting humor (especially wit or dry humor), plays on words, double entendres, etc.

#### **How to approach interpretation and inference when working with students**

Interpretation and inference skills can be challenging for individuals on the autism spectrum because of their abstract nature. For that reason, techniques that use visuals to illustrate the flow of thought processes are very useful (*Examples: concept mapping, graphic organizers, etc.*) as are physical exercises that enlist movement and body positioning to represent the flow of ideas.

### **8.03.8 Creativity and Brainstorming**

**Creativity** is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, or entertaining ourselves and others. (Franken 396)

Franken claims there are three basic reasons why people are motivated to be creative:

1. The need for novel, varied, and complex stimulation
2. The need to communicate ideas and values
3. The need to solve problems (Franken 396)

Creativity involves being “able to view things in new ways or from a different perspective” to generate new possibilities or new alternatives. Tests of creativity measure not only the number of alternatives people can generate but the uniqueness of those alternatives. The ability to generate alternatives or see things uniquely does not occur by chance; it is linked to other, more fundamental qualities of thinking, such as flexibility, tolerance of ambiguity or unpredictability, and the enjoyment of things heretofore unknown. (Franken, 394)

**Brainstorming** is the creative process of generating multiple ideas, additions, changes, modifications, or solutions based on a given topic, activity, guideline, or item. An individual can brainstorm or as part of a group process.

When we are able to use brainstorming, creativity, flexible thinking, and humor we increase our ability to be innovative and enjoy creative processes, expanding career options, opening avenues for recreational activities, and infusing social interactions with more playfulness.

#### **Individuals challenged in the area of creativity and brainstorming tend to**

- Become overly attached to the first idea presented to them or to ideas they generate, and may become agitated if engaged in a process of “what else”
- Show inflexibility in all areas of their life: learning, play, interactions with peers
- Insist on doing things the same way they were done the last time
- Engage in and gravitate toward predictable experiences, routines, games, topics of conversation, etc.
- Prefer models, puzzles, and other activities that have a prearranged procedure and explicit end result
- Avoid activities and discussions that inherently have varied outcomes
- Reject ideas and possibilities they might actually enjoy, therefore limiting their experiences and options
- Become confused and or dependent on others during creative activities that require making choices or generating ideas

#### **How to approach brainstorming when working with students**

Experience with creativity and brainstorming can enrich and enliven an experience. As much as possible, staff would follow the lead of student-generated creative expression and provide support they can pursue and expand upon their creative ideas.

- For students who have difficulty embarking on creative activities, staff should be on the lookout for glimmers of interest or curiosity whether expressed verbally or nonverbally in any context (Examples: during a class, in a conversation, during an activity, while watching a movie, while cooking dinner, etc.). Something a student finds compelling or interesting, even momentarily, can often be expanded upon to awaken a new or underdeveloped passion or interest.
- A staff member may notice an emerging interest in the process of working or engaging with the student one-on-one. These observations should be shared in staff meetings so the whole team can collaborate on creative ways to nurture and expand on it.
- Remember that each individual expresses creativity in his own way and develops his passions and interests in his own time. Some interests and passions will be fleeting, while others may take hold and become lifelong activities or career options. All hold value in the student's evolution of self.
- Students may find aspects of creative exploration to be anxiety-producing. For some individuals on the autism spectrum, novelty can be fun and compelling. For them, trying new things or doing a familiar activity in a different way feels fun and exciting. Others are fearful in the face of novelty. For them, a gentle approach can make them more open to trying new things. Fostering and strengthening creativity and brainstorming in all activities, group work, and courses can help individuals on the autism spectrum to:
  - collaborate with others
  - increase their capacity to be flexible in thought and action
  - strengthen their ability to see more possibilities and options both in their daily lives and in planning for the future

#### 8.03.9 Generating Multiple Possible Outcomes

The skill of generating multiple possible outcomes contributes greatly to our ability to be flexible and adaptable mentally and emotionally. If we understand *an outcome is not fixed but instead depends upon events that came before it*, we are less likely to become stuck, frustrated, anxious, or emotionally overwhelmed by the unexpected.

A **contingency** is an event that may happen but cannot be predicted with certainty. An outcome is uncertain if it depends upon an event that may or may not happen. Being able to think contingently means one is able to see connections among items, scenarios, and ideas and use that understanding to predict possible outcomes based upon each possibility. This is what is meant by "thinking with multiple possible outcomes".

Contingent thinking requires an ability to understand the concept of causal relationships – that is, if one factor changes, what effect might it have on related parts or on the whole? It also requires the ability to think sequentially – to follow logically a trail of thought to an identifiable conclusion. It requires conditional thinking – “if...then” scenarios – and the ability to hold several pieces of information in memory while they are manipulated.

When we can predict multiple outcomes based on the information we have available, and if we can understand and apply the concept of cause and effect, we have access to logical thinking. We can then mentally run “what-if” scenarios to identify potential obstacles. In this way, we become skilled problem solvers and decision makers. Effective problem solvers are more independent, flexible, and adaptable in managing difficulties.

It is important to recognize the role creativity plays in generating possible outcomes. Creative thinkers can navigate decision-making – especially decisions that involve many contingencies – more adeptly and with less anxiety.

### Individuals challenged in the area of generating multiple possible outcomes tend to

- Become overly attached to one outcome and may become angry, anxious, or upset at even the thought it may not happen the way they imagined
- Be weak in brainstorming skills
- Be rigid thinkers in general
- Be sensitive to or dysregulated by change and unpredictability
- Seek excessive reassurance from others about how “it’s going to be” or seek a guarantee it will play out as expected
- Become argumentative or resistant when others try to engage them in a discussion about what else might happen
- Have a pattern of being surprised in the face of change in an outcome even if they are warned sufficiently or witnessed the element that changed the outcome
- Repetitively watch and/or read a beloved story, movie, or TV show. They may get very excited as it nears its predictable conclusion. They may over-focus on the story and want to talk about it a lot.

### How to approach generating multiple possible outcomes when working with students

- Watch video clips (one-on-one or in small groups). Pause them at meaningful points to highlight and discuss: What do you think will happen next? Why? What problems are the characters facing? How did they choose to resolve them? Is there something else they could have done? How would that have changed the outcome?
- Create a concept map of the situation as it evolves so students have visuals to refer to. This deepens their understanding of connections and results that spring from choices, actions, and thoughts.
- Role-play, do improvisations, and have discussions based upon scenarios (in groups). Give students practice generating and managing multiple possible outcomes in lively, creative, and fun ways.
- Use books and other educational resources that give students a starting scenario and then introduce influencing factors. Have students select from a pool of possible outcomes.

- There are also several popular fiction books that work well, especially young adult mystery series such as Encyclopedia Brown, or multiple ending books such as Choose Your own Adventure and Goosebumps
- Work on emotional regulation and coping skills in the face of change or the unexpected

### 8.03.10 Rule Use

**Rule use** is the ability follow and apply an external set of rules, whether they be stand-alone (*Example: look both ways before crossing a street*) or in a specific sequence (*Example: steps to bake bread*). Rule use applies to:

- Procedures (such as science experiments)
- Principles for navigating predictable processes more adeptly (such as grammar rules)
- Guidelines for behavior (poolside do's and don'ts)
- Safety parameters (when operating equipment)
- Guidelines of a project to reach a prescribed result (*Example: steps to write a paper*)

When we understand the rules of processes, groups, and the society around us, we are usually safer, less likely to be caught by surprise, and better able to predict outcomes. We understand more about what others expect of us.

#### Individuals challenged in the area of rule use tend to

- Have trouble with rule-based academic subjects (math, science, grammar, spelling, etc.)
- Experience difficulty planning, organizing, and executing projects because they lack guidelines or don't attend to guidelines that are given
- Get lost or stuck in the midst of an activity
- Struggle with procedures and sequentially-based activities
- Be overly dependent on others to tell them when and where a rule applies
- Get lost or confused in social situations where social rules apply
- Have difficulty understanding why something went awry where a vital rule was skipped
- Struggle with rule-based games that lead to emotional distress, avoidance, frustration, etc.
- Avoid solo and group activities and recreational experiences that have a lot of rules
- Staunchly insist on doing things their way because following rules makes their experience "not fun" (*Example: want to do abstract art instead of lesson plan-based art because it has too many steps and rules, and the outcome has to look a certain way*)
- Have difficulty playing a game or doing an activity a different way

Other areas of ambiguity in rule use relate to situations where rules are negotiable. In those cases, students need support in understanding the rule and clarification on which specific aspects of the rule are up for negotiation. *For example, one may be able to negotiate with the waiter to have him change the ingredients in a menu item but the price listed may not be up for negotiation.* Explicit rules need to be established for the negotiation process itself, which includes the verbal and non-verbal social aspects involved.

For many individuals on the autism spectrum, unspoken rules present the most difficulties, especially unspoken social rules. These rules tend to make what is already confusing (especially social interactions) even more confusing, frustrating, and anxiety producing.

Individuals who are overly concrete in use of rules may run into difficulties as they attempt to control peers' or staff behavior.

### How to approach rule use when working with students

- Rules that apply to a specific activity or environment should be explicitly discussed and posted for visual reference
- In residential programs, rules grow exponentially to address evenings, weekends, house rules, safety rules, etc. Engage students as much as possible in making of rules (where appropriate)
- Students will need to have rules explained to them at a level of language and complexity that meets their cognitive and processing capabilities
- Social rules can be addressed in a multitude of ways ranging from social peer group work, 1:1 work, conflict resolution situations, role play, improvisation, etc.
- Some young adults are overly attached to rules. Work towards transforming automatic compliance, dependency, and rigidity into thoughtfulness, flexibility, and appropriately independence.

It is important to note that making decisions and solving problems are often anxiety producing for individuals on the autism spectrum. For some the entire experience is rife with anxiety, whereas others may not experience emotional difficulty until the consequences of their choices present themselves. These processes enlist all of the critical thinking components listed in section 8.02 and 8.03, and thus can create stress and overwhelming feelings in individuals who possess challenges in these areas. When emotional reactivity surfaces it further complicates the process of arriving at a decision or resolving a problem. Therefore, successful approaches to teaching these higher order thinking skills incorporates emotional regulation support alongside critical thinking and executive function support.

Individuals with low self-confidence or a history of making poor choices might find the entire decision-making/problem solving process emotionally challenging. Because they do not trust themselves to make good choices, they will need confidence building support throughout the process so they can begin to feel more comfortable exerting their preferences and their will.

### Summary List of Executive Functions

#### Planning

Being able to come up with approach to solve a problem

#### Strategic thinking

Being able to think in a manner that best uses existing or emerging resources or possibilities

#### Step wisdom

Ability to visualize what one is trying to accomplish and the steps needed to arrive at that objective

#### Organization

To arrange resources and events in such a way as to obtain a desired result efficiently

#### Time management

Ability to use time in a way that makes work more efficient, easier to complete

#### Self-monitoring

Being able to watch, analyze, and evaluate oneself while completing a task

#### Plan implementation/execution

Carrying out a plan

#### Pacing

Ability to adjust the speed of work to make it appropriate for the circumstance

#### Causal relationships

Ability to understand events in terms of cause and effect

#### Evaluative thinking

Ability to reflect upon or judge the value (positive or negative) of some event or experience

#### Reinforcibility

Ability to use previous experience to guide or correct behavior; learning from experience

### 8.04 Higher Order Thinking: Decision Making and Problem Solving

includes...

- Identifying Decisions to be Made/Problems to Address
- Motivations and Intentions
- Applied Logic and Reasoning
- Applied Interpretation and Inference
- Generating Possible Decisions/Solutions
- Anticipating Likely Outcomes: Visualizing Results
- Managing and Evaluating Results

**Decision-making** is a process that leads one to reach an answer or conclusion that may then lead to an action. Although much of the process is linear, some decisions require revisiting certain facts that may shift thinking and ultimately change the final decision.

Whether deciding on a menu item, choosing which shirt to buy, considering whether to join a club – all decisions require a process. For many people, the process is impeded by cognitive challenges, language difficulties, low self-confidence, anxiety, and dysregulation. Therefore, incorporate into all teaching any supports, strategies, or accommodations needed for these issues.

Remember to establish *reflection* as a distinct step in all decision-making work. Since the act of reflection is an abstract concept, many students require explicit instructions on how to do it. Many people reflect internally and in silence. Students who are new to the act of reflecting will need the process externalized. With teacher support and modeling, students learn to articulate their thoughts and work through the process of examining their own decision-making. Reflection is indispensable for self-evaluation, managing emotional reactions and unwanted results, and setting goals for future decision-making.

**Problem solving** involves identifying the varying components of a situation that are not working well and require action to change course, make adjustments or resolve. Prior to any action taken, effective problem solving requires applying advanced critical thinking skills and executive function. Without them, it becomes very difficult to visualize the desired end result, identify what changes need to be made, generate possible solutions, and assess which solution is the best fit for a given situation.

In order to be an effective decision-maker and problem solver an individual must

1. Understand the decision/problem at hand
2. Understand what factors need to be included in order to make an informed decision/resolve a problem (*Examples: facts, needs, goals, intentions of self and others, desired outcomes, opinions or guidance from others, past experiences*)
3. Assess whether he has all current information required
4. Decide what additional information is needed
5. Figure out where or from whom he can get the needed information
6. Be able to find the information and fill in the gaps

7. Revisit the facts once he has what is needed to arrive at a decision/solve a problem
8. Enlist others if needed for feedback, suggestions, etc.
9. Make a decision/decide on a solution
10. Act on the decision/solution
11. Manage and evaluate its results
12. Manage his emotions and acknowledge his expectations both during the process and in reaction to the end result

Not only do decision making and problem solving engage one's critical thinking systems, they also draws upon executive functions. The ultimate goal of making a decision is an action or choice. It is our executive function system that determines the sequencing, quality and effectiveness of that action. Therefore, be prepared with strategies and activities that support the executive functions as students master the decision-making/problem solving process.

### Individuals challenged in the area of decision-making and problem solving tend to

- Get confused, emotional, reactive, overwhelmed, or dysregulated when facing a decision/problem
- Impulsively gravitate to the first suggestion made by others or first idea that pops into their minds regardless of its merit or applicability to the issue at hand
- Approach a current decision or problem in a manner they have used before without paying attention to the change in context. They may not factor in other relevant aspects either not present in earlier contexts or that were different in the previous situation (overgeneralizing)
- Be overly dependent on others to navigate decisions and address problems
- Avoid situations where decisions have to be made or problems are likely to arise
- Select experiences that will present familiar and comfortable decisions (go to same restaurant because they understand the menu and can find the same meal they always order)
- Adopt a high stakes mentality surrounding the impact the decision or solution will have on their lives, increasing anxiety levels and becoming overwhelmed
- Become paralyzed both in making and acting upon decisions and solutions
- Become upset when results are not what they wanted, even if they chose the course of action

### How to approach the decision-making and problem-solving process with students

- Executive function support (how to navigate, how to change course/adjust, how to repair or "fix")
- Emotional regulation support (how to receive emotional help from others as well as self-regulate)
- Strengthening ability to manage unexpected decisions and problems through role play, improve, social stories etc.
- Brainstorming and creative thinking support

- Trial runs – picking clearly contrasting decision/problem possibilities and run them through the critical thinking and executive processes to predict the end results (a great way to infuse humor by adding some silly or obviously poor decisions)
- Visual maps, flow charts, and other ways to represent the decisions/problems and possibilities visually in terms of choice and outcome to increase comprehension and organize thoughts
- Role-play scenarios that illustrate and break down the various aspects of making a decision/solving a problem
- Facilitate post-analysis of decisions/solutions and outcomes (discussion, storyboard, etc.). This creates opportunities to reflect on how to do things differently next time
- Keep a decision log to track decisions and outcomes that can be reviewed later for deeper learning and identifying patterns in decision making
- Preview and predict possible decisions that will need to be made and problems that may arise across many scenarios and contexts, in particular prior to an upcoming event, outing or situation
- Reassurance and perspective shaping (most decisions are not permanent, and many solutions to problems can be shaped once the initial problem has been addressed)
- Infuse the process with excitement, humor, creativity, play, and fun (many students who find decision-making/problem-solving hard can get very serious and it can color their entire experience)
- Help them get more information. Often people are stuck when making a decision or solving a problem because they don't have all the information they need.
- Provide necessary accommodations and strategies for any cognitive or language weaknesses that might be interfering with the decision-making/problem-solving process (*Example: Instead of starting with an open-ended process, narrow down viable choices and present to student.*)

#### 8.04.1 Identifying Decision to be Made/Problem to be Solved

For decision-making/problem-solving to be organized, efficient, and relevant, one must first clearly identify what needs to be decided or solved.

Deciding which factors to consider during the process involves narrowing down one's focus to the most relevant elements. This helps the individual concentrate on what is most important.

**Examples:** Should I get chocolate or vanilla ice cream for dessert? Would Target or Home Depot be more likely to sell the object I am looking to buy? If I need to be home by 5 pm, what time do I need to catch the #3 bus? What should I do if it rains on the day I have scheduled my birthday picnic party?

The experience of having a problem, making a decision or facing an obstacle typically includes experiencing intense emotions (frustration, anxiety, embarrassment, etc.). These can negatively affect one's critical thinking and decision-making skills significantly. Defining a problem or obstacle and clearly identifying the associated factors:

- Supports the individual's executive function by helping him approach the problem in an organized fashion
- Increases the individual's ability to access his critical reasoning skills
- Helps the individual become aware of and manage interference from disturbing emotions

Executive functions needed in this step of the process are typically previewing (using visualization to bolster understanding), organization (of thought and details), and strategic thinking.

### **Individuals challenged in the area of Identifying decisions/problems tend to**

- Be disorganized in their thinking
- Struggle to keep their attention on the details of a situation (often it is the details that help a person arrive at a decision or solution)
- Experience overwhelm or anxiety when asked their opinion or thoughts about a decision or problem
- Seek predictable situations where decisions are either easy or repeatable
- Hesitant or avoidant of situations where a decision will need to be made or problems arise
- Prefer being given a limited choice (do you want this or that?) rather than open-ended scenarios (what do you want?)
- Avoid situations involving a lot of choice (big menus, buffets, arcades with lots of games and prizes to choose from, etc.)
- Defer to others

### **How to approach identifying a decision/problem with students:**

- Preview situations and expectations surrounding decisions/potential problems beforehand, discuss what to look for and what to expect
- Enter into decision making and problem solving scenarios with a written list/symbols that a student can refer to if they get confused or anxious
- Rehearse and role play identifying a decision/problem across many scenarios
- Make decisions ahead of time and generate a list of possible solutions to predicted problems
- Use concept maps or other visuals and charts to support critical thinking and visualization
- Watch video clips and read stories surrounding decisions and problems so the student can identify key factors while not under pressure
- Review decisions the student has made previously and problems the student has solved successfully before
- Non-verbal and verbal games, puzzles and scenarios focused on identification of a problem (Example: "What's wrong" visual puzzles and scenarios, etc.)

## 8.04.2 Motivations and Intentions

Often a decision-making or problem-solving process requires awareness and understanding of personal motivations, intentions, and desires that might influence a direction or outcome. In this step, students reveal short- and long-term desires and goals specific to a decision/problem at hand. All goals should be discussed and written down so they can be expanded upon or revisited later, and to support comprehension through visualization. Some students may need guiding questions to identify underlying, unspoken, or unconscious motivations, intentions, and goals.

**Decision making example:** Do I eat an apple or chocolate ice cream? I want chocolate ice cream but I am trying to lose 10 pounds...how does that affect my decision? If I eat chocolate ice cream instead of an apple how does that affect my goal of losing weight so I can fit into my clothes better?

**Problem Solving example:** The kids at my birthday party do not want to play the game I wanted to play. Do I come up with a game everyone wants to play because I want everyone to have fun? Do I persuade/insist we play my game because it's my party and my day to be in charge?

Motivations and intentions typically have an emotional component. Exploring the underlying or associated emotions is critical. Executive functions begin to play a larger role now because the concept of goals and goal setting begins to emerge. Using example above, the immediate motivation is to have self-control with sweets, the overarching intention is to lose weight, and the underlying goal emerging is the student wants to fit into his clothes.

### Individuals challenged in the area of understanding the role motivation and intention play in making a decision or solving a problem tend to

- Have difficulty self-reflecting on their own motivations and intentions
- Find it challenging to identify the desires and motivations of others
- Struggle with identifying emotions (theirs and others) and connecting emotions to events and contexts
- Have lower levels of self-awareness
- Have difficulty generating reasons why they said something or acted in a particular way
- Often do not see patterns and predictability in their choices
- Miss context clues such as tone of voice, gestures, body language, hints, etc. that reveal underlying motivation/intention

### How to approach understanding the role motivation and intention play in making decisions and solving problems with students

- Watch video clips and identify character motivation/intention based on actions, gestures, facial expressions, tone of voice, and words
- Role play and improvisation scenarios that give students practice in both identifying and displaying motivation/intention through words, body language, and actions

- Creating storyboarding and reading cartoons, both of which make use of thought bubbles that symbolize hidden or subtle motivations and intentions
- Guessing games aimed at providing hints and clues to underlying motivation/intention
- Creating lists, collages, and art with words or symbols that illuminate a student's desires and wishes
- Watching video clips and attending to how the soundtrack gives clues to a character's motivation/intention
- Selecting music, colors and other creative ways to represent motivation or intentions and apply them in role play contexts or the making of a short film clip
- Look at decisions made and problems solved by famous people or fictional characters and guess what their motivation/intention was given what we know about them and their situation

### 8.04.3 Applied Logic and Reasoning

A process of logic and reasoning is required to evaluate relevant information and ideas related to the decision/problem at hand. The individual has to be able to assess how the various factors may affect the final outcome (*Example: Deciding which ice cream flavor to buy may have to include considering how one is going to get to the store that has that particular flavor*).

In order for individuals to arrive at decisions or solutions effectively, they must depend upon their logic and reasoning skills to weigh, compare, and contrast. These functions are used to identify factors contributing to problems, to assess what roles those factors play, and to determine what changes need to be made to bypass, reduce, or remedy problems.

Executive functions engaged in applying logic and reasoning to evaluating each option include maintaining attention and concentration, previewing, strategic thinking, step-wisdom, planning, organization, time management, and pacing.

#### **Individuals challenged in the area of applying logic and reasoning to the decision-making or problem-solving process tend to**

- Be impulsive, inconsistent, or random in arriving at a decision or solution
- Tend to rush the process and go for a singular approach rather than weighing, reflecting, and generating multiple options
- Overgeneralize strategies, even when they do not fit the context in which the decision or solution needs to be made
- Show disorganized thinking
- Jump over important steps or not connect related aspects of the situation
- Struggle to prioritize in the situation (what to attend to, what to ignore, what to weigh heavily, what is a small or inconsequential factor)
- Not draw from previous similar experiences to help inform thinking about the current situation

### How to approach applied logic and reasoning related to making decisions and solving problems with students

- Use concept maps, flow charts and other visual aids that represent a chain of logic and connect salient points together
- Slow down the decision-making/problem-solving process to better examine its parts (with scenarios or past events)
- Present small decisions and problems to be addressed that have limited components to build skills, increasing complexity as their ability strengthens
- Watch video clips, pausing to break down each step in logic. Write down or visually map the scenario to bolster comprehension.
- Practice through discussion (scenarios and stories), role play and improvisation
- Have student instruct teacher or fellow students on how to navigate a decision or problem – communicating through words, gestures and actions
- Anticipate upcoming decisions and problems (start small) and generate plans for how to navigate them
- Provide students with a list of things to think about that they can carry with them and refer to as needed when out and about

#### 8.04.4 Applied Interpretation and Inference

Interpretation and inference come into play in subtle ways during the decision-making process. If the student has difficulty with these skills, outcomes can be troublesome. Interpretation and inference can be used to reflect on solutions, how they played out, how effectively they solved problems they were applied to, etc. Interpretation and inference help by generating thoughts, opinions, and ideas about what went wrong, how it could have gone differently, and what could be done the next time to prevent difficulty from reoccurring.

##### Interpretation

When a decision lies before us, we are often required to conceive the meaning of abstract, emotionally charged, or unfamiliar words. *For example, "rich" chocolate cake does not refer to money but to taste. "Delicious" strawberry crunch ice cream is only delicious if one likes strawberries and enjoys crunchy objects in smooth ice cream (a possible texture issue).*

##### Inference

Inference is drawing a conclusion using evidence and reasoning. It engages an equally subtle cognitive process that involves memory recall, self-reflection, and drawing conclusions to arrive at a decision.

When a decision is before us, we usually draw from our experiences in similar contexts as well as consider our preferences. Then we compare these factors to our current options.

Individuals on the autism spectrum often become stuck when making inferences because they are required to juggle several factors, evaluate them separately and together, incorporate knowledge of self, and then synthesize all that understanding to arrive at a decision.

*For example, Johnny is invited to a party. His first response, which is impulsive, is to refuse to go. If he receives help addressing the anxiety and is supported to reflect on similar parties he has attended (and enjoyed), he may recall that two of his favorite people will probably be attending. He reads the invitation more carefully and discovers there will be bowling – an activity he loves. He may then infer he would like to go to the party after all.*

By helping students, such as Johnny, break down, identify, and visually represent all components involved in the decision-making process and how they connect, we provide them with the tools they need to begin making decisions more independently.

The executive functions engaged during the interpretation and inference phase of a decision-making process typically include previewing, planning, strategic thinking, causal relationships, and evaluative thinking.

#### **Individuals challenged in the area of applying logic and reasoning to the decision-making or problem solving process tend to**

- Miss key signals/information that could inform thinking surrounding a decision or problem at hand
- Jump to conclusions that often do not factor in subtle yet important information
- Display linear thinking that is more concrete in nature
- Struggle to extract meaning or draw conclusions
- Miss abstract or complex meaning in a situation (verbally and non-verbally)

#### **How to approach applied interpretation and inference related to making decisions and solving problems with students**

- Many of the strategies in 8.04.2 Motivations and Intentions will apply in working with students on inferences and interpretation to help ferret out unspoken, subtle, or underlying meaning
- Practice drawing interpretations and inference based on a few clues and cues, slowly expanding in complexity as the student strengthens their skills
- Visual puzzles and games designed to help students infer and interpret
- Role play and improvisation activities that give students practice in real time
- Reverse the process, starting with a given interpretation or inference and then building a story or scenario that could reflect it (*Example: Someone is displeased...what are all the ways they can show it with words, gestures and actions without outright stating “I am displeased”?*)

### 8.04.5 Generating Possible Decisions/Solutions and Anticipating Likely Outcomes

As outlined in 8.03.10 *Generating multiple possible outcomes*, the ability to generate multiple outcomes is a vital critical thinking skill and plays a specific role in navigating the complex, and often stressful, process of making a decision and solving a problem.

Staff can be very helpful in guiding students to generate possible decisions and solutions that apply to their specific situations. This reduces stress by limiting the possibilities to a manageable number so the process is not bogged down by too many options. Making concept maps, decision flow charts, or other visual representations of the process can be very calming (emotional regulation), organizing (executive function), and help individuals allocate their focus towards fleshing out the most viable choices.

Creativity, brainstorming, and research took place earlier in the decision-making process to expand ideas and open up options. At this point, they are valuable in narrowing down and becoming more specific as final decisions are approached.

Anticipating outcomes involves using a combination of visualization and the ability to understand situations. Strategic and evaluative thinking are executive functions often used while visualizing results. These executive functions involve:

- Comparing and contrasting images
- Visualizing concepts to help increase meaning and assessment
- Using visualization to activate creative thinking
- Using visualization to help generate multiple possible outcomes, and visual problem solving.

**Individuals challenged in the area of generating possible decisions/solutions and anticipating outcomes tend to**

- Become anxious, impatient, or overwhelmed when asked to come up with more than one idea
- Display inflexibility when decisions and problems arise
- Tend to overgeneralize approaches from past experiences even when they do not fit the current context
- Over-rely on others to generate ideas, suggestions and solutions
- Rush to the decision or solution that is easiest, most accessible in the moment even when other options are better and available
- Become frustrated with or resistant to engaging in discussions initiated by others that slow down the decision making or problem solving process to reflect on possibilities and weigh options
- Become anxious when faced with multiple decisions or problems
- Have difficulty visualizing potential scenarios

### How to approach generating possible decisions/solutions and anticipating outcomes with students:

- Use visual aids to map out decisions/problems and their corresponding outcomes and solutions
- Practice visualizing and verbalizing decision making and problem solving scenarios
- Begin small with a simple decision/problem – with peers or a teacher, brainstorm as many solutions and outcomes as possible. Slowly expand in complexity as skills strengthen
- Incorporate movement as a way of helping students see the difference between options (*Example: designate decision/problem spots in the room and then move towards the solution/outcome spots in the room as ideas are generated*)
- Watch video clips and pause tape after decision/problem is revealed. Generate possible solutions and outcomes, then watch how the character chooses to resolve their situation. Discuss.
- Preview upcoming situations ahead of time where the student could benefit from mapping out strategies and choices ahead of time
- Working on emotion regulation and self-soothing techniques for staying calm in situations where decisions have to be made and problems may arise. Role play and practice what to do.

#### 8.04.7 Managing and Evaluating Results

Managing and evaluating results is a process of:

- Being able to identify both direct and indirect results of actions, choices, or situations
- Identifying all direct and indirect consequences of actions, choices, situations, etc. (making connections and understanding what happened in a sequential or relational manner)
- Drawing conclusions about the roles positive, negative, or neutral factors had on the result
- Identifying whether any action is necessary in the present to fix or make changes to the outcome
- Identifying what can be learned from an experience – my role, the role of others, outside factors, timing, etc. (*What would I do differently if I did it again to increase my chances of having the desired outcome?*)
- Identifying and managing feelings elicited from the experience
- Evaluating what was learned

The executive functions that come into play while managing results are evaluative thinking (How did that go? How did I do?) and reinforcibility (What can I learn from this situation that will change my thinking and actions in a similar situation in the future?)

### Individuals challenged in the area of managing and evaluating results tend to

- Be overcome with challenging emotions once results are apparent
- Habitually blame others or factors in the situation or outside themselves for undesired results
- Have difficulty learning from their choices and mistakes in the moment and carrying this understanding forward into future similar situations
- Be limited in their ability to self-reflect
- Resist taking ownership or seeing their personal responsibility in how a situation played out
- Get stuck in the concept of external fairness rather than reflecting on the role their choices played
- Feel powerless when outcomes are not as they wished - not realize that a change in choices in the future can change the results (it doesn't always have to turn out this way)
- Be hesitant to enter into future situations where a similar outcome may occur

### How to approach managing results when working with students

Work on managing results should be varied and include 1:1 reflection discussions, small group peer feedback sessions, group discussions, stress management exercises, visualization exercises, etc. It is important that work in this area not be solely cognitive and verbal.

There is a strong emotional component to managing and evaluating results. Managing results in situations where the outcome is not desired means facing disappointment, frustration, anger, blame, and other difficult emotions. Evaluating results that were undesirable often means looking at oneself and reflecting on what one wishes they had not done or done differently. Both experiences expose vulnerability that can be hard for individuals on the autism spectrum to manage. Therefore, it is recommended that an equal amount of time be allocated to the emotional aftermath of a decision or problem as is spent on the facts of the situation. By doing so, teachers can model healthy ways to manage difficult emotions and how self-reflect and still be kind and understanding of one's own mistakes and challenges.

### 8.05 Conclusion: Applying Critical Thinking in Project Situations

The skills presented in this module will require much real-world practice. One of the best ways to engage individuals in practical applications of critical thinking is through *projects*. Here are some tips on selecting projects and how to best engage students in the critical thinking:

#### Staff Guidelines

- Draw upon areas of strength and interest
- Select/adjust projects to the appropriate level of difficulty in light of challenges
- Incorporate flexibility needed to modify and accommodate according to individual needs
- Select project options that capitalize on available support (advising, mentoring, coaching)
- Select projects that draw upon available physical resources and fit budget constraints
- Assess need for coaching/mentorship to support regulation, organization, and constructive problem solving

#### Staff/Student Coordination Guidelines

- Engage and increase buy-in and motivation through collaboration in all phases (brainstorming, planning, and implementation)
- Research similar projects online to generate ideas and activate visualization
- Preview project to identify and anticipate challenges and generate a list of strategies and needs. Include having the student predict aspects of the project that might:
  - prove the most challenging
  - be the easiest
  - be likely to cause frustration
  - trigger dysregulation
  - trigger overwhelming feelings
- Anticipate time-related issues (length of project, level of commitment, competition with other current activities, and commitments)
- Generate list of potential collaborators/mentors, materials needed, and other resources
- Visualize desired result, possible outcomes, potential roadblocks, contingency plans
- Assign project responsibilities: student, staff, community partners, etc.
- Identify fixed and flexible/negotiable aspects of project
- Establish strategies for navigating social/relational aspects of project (delegation, collaboration, negotiation, communication, conflict-resolution, etc.)
- Infuse process with enthusiasm, humor, creativity, and stress-management techniques
- Discuss managing expectations (distortions, misunderstandings, unrealistic ideas)
- Develop organization, prioritization, motivation, and self-assessment tools and tricks for successful completion (especially key in longer-range projects). Examples include:
  - time management schedule
  - feedback (formal and informal)
  - progress check-ins
- Condense work into a user-friendly visual format that can be posted where the student has ongoing access to promote independence and organization

## 8.06 References

### Quotes

- Einstein: Creative Creativity: Inspiration and Tools for Creativity. (n.d.). 'Creative Creativity: Inspiration and Tools for Creativity'. Retrieved November 7, 2013, from <http://www.creativecreativity.com/2007/11/einstein-on-cre.html>
- Eugenides, J. (2002). Middlesex. New York: Picador/Farrar, Straus, Giroux.

### Defining Critical Thinking

- Ennis, Robert H. "Critical Thinking Assessment", Robert H. Ennis, Theory Into Practice, Special Issue: Teaching for Higher Order Thinking, 32(3), 1993
- Lewis, A., & Smith, D. (1993). Defining Higher Order Thinking. Theory Into Practice, 32(3), 131-137. Retrieved November 9, 2013, from <http://www.jstor.org/stable/1476693>

### Creativity and interactive teaching approaches produce better results

- Cotton, K. (2001). Teaching Thinking Skills, *Series VI Close-Up. School Improvement Research Series (SIRS)*, 11, 5.
- Learning: creative approaches that raise standards. (n.d.). *Creativity, Culture and Education (CCE)*. Retrieved November 9, 2013, from <http://www.creativitycultureeducation.org/wp-content/uploads/learning-creative-approaches-that-raise-standards-250.pdf>

### Learning and brain development

- Understanding How The Brain Learns. (n.d.). *National Dissemination Center for Children with Disabilities*. Retrieved November 7, 2013, from <http://nichcy.org/schoolage/effective-practices/brain101>

### Definitions

- Critical Thinking Glossary. (n.d.). *Critical Thinking Glossary*. Retrieved November 7, 2013, from <http://www.philosophy.uncc.edu/mleldrid/ct/glos.html>
- Dictionary.com. (n.d.). *dictionary.com*. Retrieved November 7, 2013, from <http://www.dictionary.com>
- Freedictionary.com. (n.d.). *freedictionary.com*. Retrieved November 7, 2013, from <http://www.freedictionary.com>
- Piaget/object permanence : Sensorimotor Stage. (n.d.). - *Object Permanence*. Retrieved November 7, 2013, from <http://www.simplypsychology.org/sensorimotor.html>
- Visual memory. (n.d.). *TheFreeDictionary.com*. Retrieved November 7, 2013, from <http://medical-dictionary.thefreedictionary.com/visual+memory>

### Ways to develop concept of time

- Teachers. (n.d.). *Scholastic Teachers*. Retrieved November 7, 2013, from <http://www.scholastic.com/teachers/article/ages-stages-how-children-develop-sense-time>
- The influence of affect on higher level cognition: A review of research on interpretation, judgement, decision making and reasoning. (n.d.). *Taylor and Francis*. Retrieved November 7, 2013, from <http://www.tandfonline.com/doi/abs/10.1080/02699930903132496#Ub90B-t4NA0>

### Visualization Resources

- Visual. (n.d.). *Visual*. Retrieved November 7, 2013, from <http://www.pspb.org/blueribbon/games/visual/Visual.html>
- Visualizing & Verbalizing for Language Comprehension and Thinking® (V/V®). (n.d.). *Reading Comprehension Programs*. Retrieved November 7, 2013, from <http://www.lindamoodbell.com/programs/visualizing-verbalizing.html>
- Visualization Games. (n.d.). *Smart Games*. Retrieved November 7, 2013, from <http://www.smartestgames.com/classic-games/vizualization-games>

### Concept map resources

- Concept Mapping Homepage. (n.d.). *Concept Mapping Homepage*. Retrieved November 7, 2013, from [http://users.edte.utwente.nl/lanzing/cm\\_home.htm](http://users.edte.utwente.nl/lanzing/cm_home.htm)
- Concept Map Templates in Word and PowerPoint. (n.d.). *Master of Science Agronomy*. Retrieved November 7, 2013, from <https://www.http://masters.agron.iastate.edu/classes/502/intro/fyi/mapTemplate.html>
- How to construct a concept map.. (n.d.). *How to construct a concept map..* Retrieved November 7, 2013, from <http://www.udel.edu/chem/white/teaching/ConceptMap.html>
- Kidspiration - The visual way to explore and understand words, numbers and concepts. (n.d.). *Develop elementary reading comprehension, writing and math skills with Kidspiration®*. Retrieved November 7, 2013, from <http://www.inspiration.com/Kidspiration>

### Spatial reasoning

- Board Games invoking spatial reasoning:
  - Tangram. (2013, October 28). *Wikipedia*. Retrieved November 9, 2013, from <http://en.wikipedia.org/wiki/Tangram>
  - Q-bitz. (n.d.). *MindWare*. Retrieved November 9, 2013, from <http://www.mindware.com/p/Q-bitz/44002>
  - Jenga. (2013, September 11). *Wikipedia*. Retrieved November 9, 2013, from <http://en.wikipedia.org/wiki/Jenga>
  - Chutes and Ladders. (2013, October 27). *Wikipedia*. Retrieved November 9, 2013, from [http://en.wikipedia.org/wiki/Chutes\\_and\\_Ladders](http://en.wikipedia.org/wiki/Chutes_and_Ladders)

- Logic Game - Tangrams. (n.d.). *Logic Game - Tangrams*. Retrieved November 7, 2013, from <http://www.mathplayground.com/tangrams.html>
- Processing Speed and Efficiency Remediation Tools
  - Fast ForWord
    - Scientific Learning - Fast ForWord Reading Program | Educational Brain Fitness Software. (n.d.). *Scientific Learning - Fast ForWord Reading Program | Educational Brain Fitness Software*. Retrieved November 8, 2013, from <http://www.scilearn.com>
  - Interactive Metronome (non-verbal)
    - Patients & Family. (n.d.). *new home slideshow RSS*. Retrieved November 8, 2013, from <https://www.interactivemetronome.com>
- Science Behind Lumosity. (n.d.). *Brain Games & Brain Training*. Retrieved November 7, 2013, from <http://www.lumosity.com>
- Spatial Reasoning Games. (n.d.). *Zoodles Kid Mode*. Retrieved November 7, 2013, from <http://www.zoodles.com/free-online-kids-games/spatial-reasoning>
- Wieder, S., & Wachs, H. (2012). *Visual/Spatial portals to thinking, feeling and movement: advancing competencies and emotional development in children with learning and autism spectrum disorders*. Mendham, N. J.: Profectum Foundation.
- Zentangle - Zentangle. (n.d.). *Zentangle - Zentangle*. Retrieved November 7, 2013, from <http://www.zentangle.com/>

### Increasing meaning positively impacts engagement, motivation, and awareness

- Cartwright, S., & Holmes, N. (2006). The meaning of work: The challenge of regaining employee engagement and reducing cynicism. *Human Resource Management Review, 16*(2), 199-208.
- Cunningham, W. S., Duffee, D. E., Huang, Y., Steinke, C. M., & Naccarato, T. (2009). On the Meaning and Measurement of Engagement in Youth Residential Treatment Centers. *Research on Social Work Practice, 19*(1), 63-76.
- Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Education and Educational Research, 74*(1), 59-109.
- Rothbard, N. P. (2001). Enriching or Depleting? The Dynamics of Engagement in Work and Family Roles. *Administrative Science Quarterly, 46*(4), 655-684.
- Schueller, S., & Seligman, M. (2010). Pursuit of pleasure, engagement, and meaning: Relationships to subjective and objective measures of well-being. *Journal of Positive Psychology, 5*(4).
- Thomas, K. W., & Velthouse, B. A. (1990). Cognitive Elements of Empowerment: An “Interpretive” Model of Intrinsic Task Motivation. *Academy of Management Review, 15*(4), 666-681.
- Winstead, L. (2004). Increasing Academic Motivation and Cognition in Reading, Writing, and Mathematics: Meaning-Making Strategies. *Educational Research Quarterly, 28*(2), 29-47.

### Critical Thinking and Executive Function

- Adam, M., Cherkassky, V. L., Keller, T. A., Kana, R. K., & Minshew, N. J. (2007). Functional and Anatomical Cortical Underconnectivity in Autism: Evidence from an fMRI Study of an Executive Function Task and Corpus Callosum Morphometry. *Oxford Journals: Cerebral Cortex*, 17(4), 951-961.
- Alvarez, J.A., & Emory, E. (2006). Executive Function and the Frontal Lobes: A Meta-Analytic Review. *Neuropsychology Review*, 16(1), 17-42.
- Brennan, M.A. (2008). Conceptualizing Resiliency: An Interactional Perspective for Community and Youth Development. *Child Care in Practice*, 14(1), 51-64.
- De Luca, C.R., Wood, S.J., Anderson, V., Buchanan, J.A., Proffitt, T.M., Mahony, K., Pantlis, C. (2003). Normative Data From the Cantab. I: Development of Executive Function Over the Lifespan. *Journal of Clinical and Experimental Neuropsychology*, 25(2), 242-254.
- Engel, R.W. (2002). Working Memory Capacity as Executive Attention. *Current Directions in Psychological Science*, 11(1), 19-23
- Osonoff, S., & McEvoy, R. E. (1994). A longitudinal study of executive function and theory of mind development in autism. *Development and Psychopathology*, 6(3), 415-431.
- Fernandez-Duque, D., Baird, J.A., Posner, M.I. (2000). Executive Attention and Metacognitive Regulation. *Consciousness and Cognition*, 9(2), 288-307.
- Gil, L.A. (2007). Bridging the Transition Gap from High School to College. *Teaching Exceptional Children*, 40(2), 12-15.
- Hannah, S.T., Sweeney, P.J., Lester, P.B. (2007). Toward a courageous mindset: The subjective act and experience of courage. *The Journal of Positive Psychology*, 2(2).
- Rueda, M.R., Posner, M.I., Rothbart, M.K. (2005). The Development of Executive Attention: Contributions to the Emergence of Self-Regulation. *Developmental Neuropsychology*, 28(2).
- Scardamalia, M., & Bereiter C. (2009). Higher Levels of Agency for Children in Knowledge Building: A Challenge for the Design of New Knowledge Media. *Journal of Learning Sciences*, 1(1), 37-68.
- Wehmeyer, M. L., & Powers, L. E. (2007). Self-Determination. *Exceptionality: A Special Education Journal*, 15(1).

### Improved Coping Strategies and relational skills, reduction in conflict

- Chen. C. (2010). Information Visualization. *Computational Statistics*, 2(4), 387-403.
- Bresiani, S., & Eppler, M.J. (2009). The Benefits of Synchronous Collaborative Information Visualization: Evidence from an Experimental Evaluation. *Visualization and Computer Graphics*, 15(6).
- Eppler. M.J., & Platts, K.W. (2009). How visualization bolsters strategic and evaluative thinking Visual Strategizing: The Systematic Use of Visualization in the Strategic-Planning Process. *Long Range Planning*, 42(1), 42-74.

- Fogarty, R., & McTigue, J. (2009). Educating Teachers for Higher Order Thinking: The Three-Story Intellect. *Theory Into Practice*, 32(3), 161-169.
- Trad, P.V. (1992). Applying Developmental Principles to Diagnosis and Treatment of Conflict. *The Journal Of Psychotherapy Research and Practice*, 1(2), 147-159.
- Wood, K.D., & Endres, C. (2004). Motivating Student Interest With the Imagine, Elaborate, Predict, and Confirm (IEPC) Strategy. *The Reading Teacher: Journal of Research Based Classroom Practice*, 58(4), 346-357.
- Woods, D.R. (2013). An Evidence-Based Strategy for Problem-Solving. *Journal of Engineering Education*, 89(4), 443-459.