

Summary – “Thinking” about Mito: Neuropsychological Problems in Mitochondrial Disease

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Executive functions are the operations and skills that lead to the ability to strike out on our own as we enter young adulthood. Executive functions have often been associated with the frontal lobes of the brain but we now think of the brain as a system and it is not only the frontal lobes but also the many circuits and pathways connecting region to region in the brain that provide an important role in higher cognitive functioning. Executive functions may be divided into two clusters of skills. The first cluster might be called cognitive skills; these skills include organization, planning, the ability to transition from task to task with some flexibility, from classroom to classroom, from book to book, working memory and self-monitoring. The other cluster of skills is more self-regulatory in nature and have to do with motivation, social and emotional processing, self-awareness, the ability to identify and complete goals, and to make informed choices.

Our neuropsychological tests address the cognitive skills most clearly, although some of the behavior rating scales that we use address both. In our tests we can look at how people approach a new task. One test we have, and some of you may have taken this, involves learning a rather lengthy word list. Some people try to memorize this long list, an arduous task. Other people stop and think, develop a strategy that might best fit the task, and then proceed. In this case, clustering words together in a fashion that is meaningful, might be one such strategy. Then the task is transformed by the choice of strategy. It is no longer straight memorization, it is an organizational task. The ability to develop an awareness of one's learning strategy and adjust it to the task at hand is called 'metacognitive'. You are standing back and looking at your own thinking, seeing if it fits the situation and applying what does. **The good news is that you can learn how to do this more effectively and this learning can be helpful when work becomes more complex, when you have more of it, and when each task is more conceptually demanding.**

Other kinds of organizational skills may be more related to daily operations such as being sure that you put your assignments in your backpack before you go to school and not leave them at home, bringing home the right books so that you might do your next set of assignments, and keeping track of where things are at all times, or, if you are at home, keeping your assignments in order and having a schedule about when to do what.

A different kind of cognitive ability is called **working memory**. One example of this is doing arithmetic word problems in your head. Another would be if I read you a series of numbers and asked you to say them back to me but backwards. In this case you have to hold the numbers in your head long enough to reverse their sequence. This is a challenging kind of task for most people. Working memory plays a role in learning new operations in math and recalling those formulas when you sit down to take an exam. It plays a role in remembering to put a schedule in your backpack or purse after you have

been distracted by a phone call. It even may play a role in learning a foreign language. So, working memory is another core executive function that affects both academic and daily living.

Transitioning is also an important capability. Moving from class to class, letting go of one assignment and moving onto the next when doing homework, not getting too bogged down in anticipatory anxiety when many tasks are ahead or when preparing for a test all require skill at transitioning. Neuropsychological tests help us measure specific abilities such as these.

While some of the same principles apply in the evaluation of students and young adults with mitochondrial disorders as with many disorders, there is one difference. Some of the cognitive problems are intermittent. There are good days and bad days. Fatigue can rule the day in one occasion while clear thinking can follow the next. So how do we understand this?

For most people, there is a baseline substrate of functioning intellectually. Provided they have a reasonable diet, they've had caretaking throughout development and reasonable education, they may be functioning close to their best with a certain complement of strengths and weaknesses. For some people, certain executive functions may be a problem such as with working memory or organizational skills. Difficulties in these areas are not specific to mitochondrial disorders and in fact there are many pathways to developing problems in executive functioning and we cannot always assume that these problems come from the mitochondrial disease. It is possible to have a mitochondrial disorder and other neurodevelopmental disorder such as ADHD, or other contributory medical issue. For students with mitochondrial disorders, the overlay of fatigue, autonomic dysfunction and other multiple physiological assaults can also result in quite variable functioning in all kinds of task and arenas. So, when we are developing a plan for a transition to college the accommodations need to address the specific deficits that have been identified through neuropsychological testing and those variabilities of functioning due to the physiological issues experienced by the student.

One of my interests now is to get better at doing both. Cristy has been kind enough to allow me to say a little about some research I am doing involving executive functioning in adolescent and young adult students with mitochondrial disorders. This study involves the completion of two questionnaires, each for the student and for the parent, looking at executive functioning, both cognitive and self-regulatory functioning. Students can reflect and report themselves what they think about their strengths and weaknesses. Parents, doing the same, may have a different perspective or a similar perspective, depending on the family. This sort of **information provides a substrate to help colleges understand what they need to do to support students with mitochondrial disease when they enter school. It may also help with high school as students traverse increasingly complex academic hurdles.**

Learning more about how you see the problems is the first step. To learn more or participate in this study, please [contact Dr. Schreiber](#)