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researchreport

Walking and Talking: It's Easy, Right?

by Cheryl Glazebrook, one of the recipients of ASO's Stimulus Grant for Graduate Study in ASD, 2005

Most of us are lucky enough to have the ability to perform many movements without conscious effort. It is not until we attempt a highly skilled movement—a golf swing, the butterfly stroke, a gymnastic tumbling sequence—that we realize how difficult it is to perform some movements. It is easy to become frustrated when we understand *what* we are supposed to do, but are unable to convince our muscles and nerves to do what they are told. Now reflect on what it would be like to find walking or reaching for a glass as difficult as any of the examples listed above. For many people with a variety of developmental and acquired disorders (such as Parkinson's disease and multiple sclerosis), everyday activities are that difficult.

There has been an ongoing debate as to whether individuals with ASD have such problems in planning and executing movements. Successful movement planning is important for both the accuracy of the movement, and for the timeliness of the response. Without good planning, an individual's movements will be slow and inaccurate. But even with perfect planning, the response still needs to be successfully implemented. In some cases an individual may not have any problems planning the appropriate response. However, for a response to be successfully executed, multiple centres in the brain must coordinate and send the necessary information through the spinal cord to the muscles. Normally we are unaware of the integral processes that go into every movement, but there can be serious consequences when any part of this process is interrupted.

Research that focuses on movement planning primarily looks at how much time individuals require to begin an action, depending on what details are known about the upcoming movement. Some of the factors in the environment that affect how quickly we begin a movement are the number of options we have available (for example, it takes longer to decide which of three glasses is yours and then begin the movement compared to when only one glass is on the table) and how complex the movement is (it takes longer to begin a series of movements compared to a single movement). To understand how these different factors influence our ability to a plan a movement, researchers change the kinds of information about the movement that are known in advance (e.g., the hand to be used, if the movement is to the left or right) and measure how much time the participants need to finish planning and initiate the movement. Picking out the relevant information and using this knowledge to improve the timing and accuracy of movements is an important part of successfully navigating our environment.

Of course, it doesn't matter how good a plan is if the means to execute it are not available. For this reason, it is also important to look at how people actually perform their movements. It is possible to create a detailed picture of an individual's movement by recording where in three-dimensional space their limb has travelled. After the limb position data are collected and some calculus is applied to these data (who knew it would ever come in handy?), we are able to generate a profile of how quickly someone accelerated their limb, where in space they reached their top speed, any adjustments they made to the initial movement plan, and so on. Together this information can give us insight into how people control their movements in different situations, as well as alert us to differences in movement performance that may affect an individual's ability to perform everyday activities.

One reason why autism is such a challenging developmental disorder to understand is that social interactions are extremely complex and require a number of neural processes to occur seamlessly throughout development. Although problems with movements are not usually considered part of the ASD profile, in fact, movements are an essential part of every interaction. We use our hands, eyes and facial expressions to convey our intentions and emotions, and of course, we use a large number of muscles to carry on a conversation. Along with performing movements, we must also pay attention to the actions of the people we interact with. Interactions with other people are very complex. They require us to pay attention to the movements others perform, and to produce a complex sequence of our own. For this reason researchers have recently become interested in how persons with autism perform movements. In a thought-provoking article, Leary and Hill (1996) proposed ways in which problems performing movements could lead to many of the behaviours exhibited by persons with autism. The idea is that if from an early age a child cannot generate the appropriate response in time, their experiences with the world are changed drastically. For example, if the infant cannot respond in time to his/her mother's gaze towards an interesting event, the

Professional Feedback

Cheryl Glazebrook has chosen a very interesting topic to research. Planning movement, or motor planning, is a complex function of the nervous system and involves many areas of the central and peripheral nervous systems. Cheryl explains this complex function well and illustrates it with easy-to-understand examples. The ability to plan movement can come to us so naturally that many of us don't even give it a thought. If the planning of movement is not efficient, movement, interaction and function within the environment can be extremely frustrating. Difficulty with the planning of movement can also make the efficiency of movement inconsistent. Sometimes a person can perform a movement, but under different circumstances, the movement may be unavailable. This inconsistency in performance can also lead to misunderstanding of the planning difficulty in the classroom, home and work settings. We need to understand more about the planning of movement and we look forward to the results of Cheryl's work.

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child misses out on the positive reinforcement inherent in the experience. As the child grows up, it may be increasingly difficult for him/her to keep up with the world around them. While this is not to say that a delay or deficit in performing movements is the sole cause of autism, delays in muscle tone have been noted in infants before any traditional signs of autism are present. There is, therefore, the potential for early and continued intervention with enough understanding of what is different about movements performed by persons with autism.

There are many different components involved in even the most straightforward movements. For this reason we have prepared a series of experiments to explore systematically how individuals with autism perceive, plan and execute coordinated movements. The first experiment looked at how people with autism use advance information about an aiming movement to improve how quickly they move their finger from a start position to a target. The primary purpose of this task is to give participants direct information about which target they will be moving towards and to see if they improve their response time based on certain types of input (e.g., the advance information could specify which hand will be used, or the direction, or the length of the movement).

In the next experiment we created a situation that requires participants to develop their own strategy to reduce the time necessary to perform the movements. For this task they had the opportunity to select a start location between two circles, knowing that they could be moving their finger to either circle. The key trials are the ones where one circle is smaller than the other. We wanted to see if the participants selected a location closer to the smaller circle because it typically takes longer to perform a movement to a smaller target (because it requires greater accuracy). In this experiment we also used motion analysis equipment so that we can look in detail at how the individuals with autism performed the movements.

The third experiment took a slightly different perspective. The goal of this experiment was to determine if people with autism are aware of when they performed a movement, or if they are aware of the time when their brain organized and prepared the movement. There is an interesting phenomenon in the general population where people report that they performed a movement earlier than they actually did. One interpretation of this finding is that we believe we executed a movement before we actually did because we are aware of when our nervous system organized the movement, not when we actually executed it. It will be very interesting to see if individuals with autism have the same misapprehension, or if they accurately report the timing of their movements. The results will provide a window into how persons with autism perceive their own actions.

The fourth experiment explores how people with autism perform more complex movements. Using motion analysis equipment we will develop a detailed picture of how eye and hand movements are performed both separately and together. This experiment will provide key information about how persons with autism execute eye movements, and how their performance changes when a coordinated eye-hand response is required. We hope that a better understanding of how persons with autism perceive, plan and execute coordinated eye and hand movements will provide some insight into why social interactions are so difficult for these individuals. It is possible that further insight into how and why coordinated movements are different will open up new avenues for developing interventions and strategies for daily life.

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This research would not be possible without the support of organizations such as ASO, and of course, the individuals with ASD and their families. Because of the continued effort of everyone involved in the *Toonies for Autism Day* campaign, students such as I are able to devote our time and energy to generating new ideas and evidence that will lead to earlier identification, more effective interventions, and perhaps even an understanding of the underlying causes of ASD. I am honoured to have the support of Autism Society Ontario. Thank you.

If you would like to know more about any of our projects, or wish to participate in one of the studies, please contact Cheryl Glazebrook by e-mail or phone: bezalg@mcmaster.ca; 905-525-9140 x26825.