Websites and Silly Walks

How do redundancies help us solve motor problems?

One of the features of an effective web page is redundancy: websites often have two or more routes that you can take to achieve the same result. For example, suppose you wanted to order the CD recently released by your favorite band. On the band's website is a picture of the new CD, and clicking on that image will take you to the order page. Off to the right side is a flashing pop-up advertising the new CD; clicking on it will also take you to the order page. Along the left side is a list of website options, including one that says, "Merchandise." Clicking it will take you to a page that lists the CDs available for purchase, including the new one. The redundancy in the website provides multiple ways to achieve the same result: ordering the CD.

Our motor control system is built like an effective website. Consider the goal of removing a screw cap from a bottle of water, for example. You can hold the bottle in your left hand and turn the cap with your right, or hold the cap and turn the bottle. You can hold the bottle in your right hand and turn the cap with your left, or the other way around. You can turn the cap using the palm of your hand; you can use your thumb and index finger; in fact, you can grasp it between any two fingers. You can hold the bottle close to your chest or with outstretched arms. You can open the bottle while sitting down, standing up, walking, or running a marathon. You can open it quickly or slowly. In fact, you can open the bottle in an infinite number of ways—and these are just the observable differences! We can open a thousand bottles using what looks to be the same method, and still the way the neuromuscular details are organized by the central nervous system will differ every time. And yet, through all of these myriad ways, we never fail to find a solution to the problem of opening the bottle of water.

Locomotion provides us with another example of redundancy. Humans typically use one of two gaits to get from point A to point B—walking or running. However, we can also hop or skip if we so choose. But these are just four of the infinite number of ways we can locomote. One of the most memorable sketches of the English comedy series *Monty Python's Flying Circus* was called the "Ministry of Silly Walks." It featured John Cleese and the cast members performing hilarious yet motorically quite inventive adaptations to the ways we normally walk. These were all achieved because of the redundancies in our central nervous system, the ability to flexibly solve the problem of locomoting from point A to point B.

People with movement constraints provide good examples of how redundancies are used to solve motor problems. Those who are born without upper limbs develop an amazing ability to use their legs and feet to solve the problems that most people solve using their arms and hands. Those without the use of an opposable thumb devise strategies, learn capabilities, and use substitutions to provide the opposition that many take for granted in such activities as grasping. And we have probably all seen artists who paint masterful works by holding paintbrushes in their mouths. These are just a few examples of how the central nervous system can be reorganized to solve motor problems.

The environment can also limit our ability to exploit our motor system's redundancies. Taking the cap off the water bottle, for example, requires a counterclockwise turn of the cap. The environment (human made, in this instance) has put some constraints on what actions will be successful in solving the problem. Extremely tight-fitting pants would have constrained some of John Cleese's silly walks. In fact, the very nature of some situations can restrict our movements. The mouse pad I am using right now has a workspace of 6 by 8 1/2 inches (15 by 21.6 cm). The size of the mouse pad workspace constrains the way I navigate around the desktop on my computer. For example, I could use my left hand to navigate the mouse, but doing so would be awkward, inefficient, and prone to errors. Nevertheless, I have an immense number of possible solutions available to me for using my right arm and hand to solve the navigation issues.

Constraints on the flexibility of our motor solutions can also be intentional or learned. As children, we are taught to hold our pens and pencils in our hands in a certain way. There are endless numbers of ways to hold our writing instruments, but many of us have either not learned these options or were actively discouraged from using them in childhood. The golf swing has about as many solutions as there are golfers in the world. And yet, most instructors try to encourage their students to adapt their swings to match a particular model. Constraints on motor solutions are imposed on us so that our movements conform to a common solution.

The point here is that humans have vast flexibility in the way they solve motor problems. When constraints are few, the adaptability of the system seems endless. When constraints are many, we tend to solve the problems in more stereotypical ways. Regardless, we possess a central nervous system that uses many redundancies and modes of control to find and optimize solutions. The following stories describe some of these modes of control.

Self-Directed Learning Activities

1. Define *movement redundancy* in your own words.
2. Describe a system other than a website in which a solution can be achieved in two or more ways.

3. Provide a different example of how the motor system solves problems in redundant ways.
4. Describe three environmental constraints that would influence the creation of a new silly walk.

Notes

- Some YouTube videos of Monty Python's routine:
  www.tinyurl.com/montypython1
  www.tinyurl.com/montypython2
- Create your own silly walk!
  www.sillywalksgenerator.com

Suggested Readings

Davids, K., Button, C., & Bennett, S. (2008). *Dynamics of skill acquisition: A constraints-led approach*. Champaign, IL: Human Kinetics.

Turvey, M.T. (1990). Coordination. *American Psychologist, 45,* 938-953.