The Toad and the Centipede

Is an internal or external attentional focus better for improving performance?

The fable goes something like this:

> A centipede was happy, quite!
> Until a toad, in fun
> Said, "Pray, which leg moves after which?"
> This raised her doubts to such a pitch
> She fell exhausted in the ditch
> Not knowing how to run.

Athletes have used the toad's ploy for years. If you are losing your tennis match, try asking your opponent if she is doing something different today, such as coming over the top of the ball to put extra spin on the backhand, or ask your golfing partner whether that right elbow position at the top of the golf swing is something he has been practicing recently. The goal of such a comment is to direct the performer to think about the movement itself, which is not normally a part of movement control, especially in more skilled athletes. Research suggests that athletes who use this ploy might be on to something.

Researchers have speculated about the role of attentional focus in movement control for well over a century, and yet, the concept remains elusive. One reason for this elusiveness is that the concept of attention itself has so many connotations. For example, we can think of attention as something that we *divide*, as when performing two or more actions at the same time. Driving a car while talking on a cell phone is a classic example of dividing your attention between two activities that have different purposes (arriving at a destination versus communicating), sensory modalities (watching traffic versus listening to what someone is saying), and movement systems (using your hands and feet to control the car versus holding a phone and speaking) (for more on this topic, see "Gumbo"). Patting your head while rubbing your belly also requires divided attention. However, this particular activity raises additional motor control concerns because the actions themselves are different. Patting your head and patting your belly, for example, is easy to do even though it involves similar divisions of attention (see "Party Tricks" in chapter 7 for more discussion on this).

A closely related attentional issue concerns selecting to attend to something. For example, if you use a grocery list to shop, then you probably walk up and down the aisles in the store, looking at the shelves with the

purpose of finding particular items. The grocery list makes your search very purposeful and specific. Some researchers use the concept of a spotlight as a metaphor for selective attention: we scan the shelves with a rather wide spotlight when we get into the canned goods section, then narrow in when we see the grouping of canned tomatoes, then fine-tune our spotlight even more on the diced tomatoes section as we hone in on the object of our search. The spotlight serves the purpose of both focusing on the object of the search and filtering out the objects that either are neutral to our search (the canned beans) or conflict with the narrow limits of the search (e.g., canned whole tomatoes).

In contrast, think about how you search for groceries if you have forgotten to bring your grocery list. Instead of a very purposefully directed search, you tend to cruise up and down the aisles looking at the shelves for clues about what might have been on that list. In this case, the spotlight has been broadened to include a wider range of potential objects that might meet your search criteria until one object successfully contacts an item in memory, resulting in a narrowing of the spotlight.

Research in motor skills addresses similar issues, although the motor control spotlight often concerns whether attention is focused on the movement itself or the anticipated consequence of the movement. For example, in tennis you might think about how far back to take the racket on the backswing, or how to roll the forearm to impart a downward spin on a forehand shot. Some have labeled this an internal focus of attention because you are directing your mental spotlight inward on how to perform the movement. The attention is internal because the focus is on some combination of the specific motor commands that will result in movement, the sensations that are predicted to result from movement, or the sensations that actually result from the movement. In contrast, instead of focusing on the motor commands and sensations of the movement, you might think about what your intentions are with respect to the environmental impact of your action, such as where you want the ball to go. Researchers refer to this as an external focus of attention because the mental spotlight is moved outside of the body, to an object, destination, impact, or effect that the action will have on the environment.

So what is the relative effectiveness of an internal versus an external focus of attention? The research suggests that their effectiveness depends on the performer's skill level. An internal focus of attention is better suited for beginners, whereas an external focus is more appropriate for experienced performers. The development of motor skill is conceptualized as a process that goes through several stages. Movement control in the earliest stage of learning is highly verbal and proceduralized. For example, when first learning to play the Wii Sport bowling game, I needed to keeping reminding myself to use my index finger to press the B button, on the underside of the remote, at the point of ball release. Fortunately, this verbal, step-by-step type of

From T.D. Lee, 2011, *Motor control in everyday actions* (Champaign, IL: Human Kinetics).

movement control does not last very long, and we move on to the next stage of learning relatively quickly, depending on the complexity of the task.

Later in learning, movements that had at one time been verbally prompted now seem to be under another level of control, one that no longer requires conscious attention. Some researchers use the term *automaticity* to refer to this level of control. After hours of playing Wii Sport bowling, I no longer had to consciously remind myself to press the B button to release the ball, where the button is located, or what finger to use to press the button. Instead, all of these actions became subservient to higher-order actions or intentions. In games that are more complex than this video example, or in many activities of daily living, these higher-order intentions might include specific strategies or goal-related actions. For example, we don't think about the movements involved in walking when crossing a busy street, but focus instead on the flow of pedestrian traffic and curbs to step over to ensure a safe passage.

Accordingly, some researchers have predicted that having experts focus on the mechanics of their actions would be detrimental to performance because they are naturally performing in an externally focused manner. This was the thinking of Sian Beilock and her colleagues when they asked a group of highly skilled golfers and a group of novice golfers to make putts under various experimental conditions. In one experiment, Beilock and her colleagues asked golfers to either take their time and try to be as accurate as possible with the putt or execute the putt as soon as possible after the setup. The effects of these instructions were entirely dependent on the skill level of the golfer. For novice golfers, the accuracy instruction resulted in better putting than did the speed instruction. However, the reverse was true for the experts: spending *less* time thinking about the putt produced better performance than spending more time.

A second experiment by the Beilock research group confirmed and extended these findings. In this experiment the groups of golfers putted either while thinking about the putt or being distracted by a secondary task (monitoring an auditory tone). As in the previous study, the novices benefited most when thinking about the putt. The opposite was true for the experts: being distracted from thinking about the putt produced their best performances.

These findings, along with other studies published from Rob Gray's lab and our own lab, support the idea that focus of attention effects are specific to the skill level of the performer. The beginner needs to focus on the movement itself because of both the uncertainty of what needs to be done and how closely the actions of the body will respond to the person's intentions. More highly skilled performers no longer have such uncertainty; they have a good idea of what needs to be done and how to do it. Focusing on the intended consequences of the action leaves the details of movement control to a level that is very well learned and no longer requires conscious monitoring.

The task of coordinating all those pairs of legs would seem impossible if the centipede were thinking about which leg moved with which. Like the

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clever athlete who asks her opponent how she is producing such good shots today, the toad is trying to get the centipede to shift her thinking from an external to an internal attentional focus. The toad appeared to take great delight in messing with the centipede's mind.

Self-Directed Learning Activities

1. Define *attentional focus* in your own words.
2. What do the terms *top-down processing* and *bottom-up processing* refer to when describing visual attention theory, and how do they relate specifically to the example of shopping in the story?
3. Suggest reasons why an internal focus of attention might disrupt the performance of a skilled musician.
4. Describe another sport task or activity of daily living that could be performed with either an internal or an external focus of attention. Devise a research methodology to investigate the effects of these focus-of-attention conditions on performance.

Notes

- The author of the fable is unknown.

Suggested Readings

Beilock, S.L. (2010). *Choke: What the secrets of the brain reveal about getting it right when you have to.* New York: Free Press.

Beilock, S.L., & Gonso, S. (2008). Putting in the mind vs. putting on the green: Expertise, performance time, and the linking of imagery and action. *The Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 61,* 920-932.

Castaneda, B., & Gray, R. (2007). Effects of focus of attention on baseball batting performance in players of differing skill levels. *Journal of Sport & Exercise Psychology, 29,* 60-77.

Perkins-Ceccato, N., Passmore, S.R., & Lee, T.D. (2003). Effects of focus of attention depend on golfers' skill. *Journal of Sports Sciences, 21,* 593-600.

Schmidt, R.A., & Lee, T.D. (2011). Attention and performance. In *Motor control and learning: A behavioral emphasis* (5th ed., pp. 97-132) Champaign, IL: Human Kinetics.

Wulf, G. (2007). *Attention and motor skill learning.* Champaign, IL: Human Kinetics.

From T.D. Lee, 2011, *Motor control in everyday actions* (Champaign, IL: Human Kinetics).