How Attention and Memory affect Learning and Performance

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Introduction

Children learn basic fundamental motor skills from a young age, and develop these skills further as they grow. When learning new skills, learners are told by their teachers or coaches to pay attention or they won't know what they are doing. We have all been told at one time or another to pay attention, and we know if we don't pay attention we won't learn what is being taught, and won't remember anything for future reference. From this statement, it is suffice to say that attention and memory go hand in hand in motor learning and when acquiring new skills.

So what does paying attention really mean? What is the relation of Attention to Memory and what roles do they play in motor skill learning and performance? Is there a way we can direct our attention in certain ways, and if so can that have an impact on learning and performance of motor skills? Furthermore, how does a loss of attention impact negatively on performance, even in elite professionals?

These are all important questions and focus areas for teachers to explore and understand. Although the relation of Attention to Memory is important,

This piece will aim to identify how attention and memory can affect performance, and also identify ways teachers can guide learners to direct their attention appropriately. It will explore how moving from more internal focus to external focus, and moving in to a more automatic controlled processing of movement can enhance performance. It is important however to begin with a definition of attention, according to different reports.

What is Attention?

Various reported definitions of what attention is has led to extensive debates, effectively rendering the definition elusive (Spittle, 2013). William James’ (1890) definition of attention has been the most widely reported one (Spittle, 2013), claiming that attention is taking possession of the mind in clear form, with concentration, consciousness and focalisation being its essence (pp. 403-4). James states that everyone knows what attention is, however goes on to reveal the complexity behind it. In hind sight, we can think of attention as relating to consciousness, being that if we are consciously thinking about something then we are
using attention (Spittle, 2013). Schmidt & Lee (2014) offer different ways to think about attention. They state that attention could be thought of as a “pool” of resources that can be used for various purposes (pp. 41), or even as a bank account which contains financial resources for us to use to perform activities of daily living. The ways in which we allocate these resources can define how we use attention. It is suffice to say that no matter the type of definition, attention is a fundamental process in theories of learning and memory, and paying attention to information is the basis for storing vital information in memory (Spittle, 2013). This includes when we learn new motor skills. What role does attention play in learning new motor skills and what impact does that then have on performance?

**Attentional Capacity**

Almost everything we do requires some sort of attention (Wulf, 2007), and how/why we pay attention can have a large impact on the execution of certain motor skills. Often learners lose attention and miss information when receiving instructions. This is in large part due to our attentional capacity.

Attentional capacity is the amount of information learners can attend to at any one time (Fairbrother, 2010). Our attentional capacity can have an impact on learning and performance outcomes, and limitations in our attentional capacity can be the cause of this. Our attentional capacity can be defined by three roles: Alertness, Limited Capacity and Selectivity. All three work hand-in-hand to explain how we attend to certain tasks.

Alertness is related to the level of arousal we have when attending to a task. The more aroused we are, the more we are paying attention. Our limited capacity, however, limits the amount of information we process and forces us to choose what to pay most attention to, which leads us to using selectivity. All three roles will be elaborated on below:

**Alertness (arousal and performance)**

Howland (2006) suggests that the levels of arousal of athletes can impact on their cognitive functioning. There are levels of optimal arousal within learners, and the closer to this level they are, the better they will perform. An individual or athlete who is beyond their optimal level of arousal is more susceptible to bad decision making, impaired memory and rushed thinking (Howland, 2006).
Limited Capacity

A way to think of attention is relevant to the amount of things we can do at one time (Schmidt & Lee, 2014). It is often hard to perform two different actions at the same time due to the limitations in our information processing. Limited capacity can be defined as the management and allocation of our limited ability to attend to tasks and activities (Spittle, 2013). As mentioned earlier, learners can’t pay attention to absolutely everything, and research backs up this statement by identifying how learners have limitations in the amount of information they can process at any one time.

There are a number of theories which explain why learners have a limited capacity to pay attention, including bottleneck theories and central resource capacity theories, however for the purpose of this piece, focus will be put on Limited Capacity and Automaticity, and dual task procedures:

Limited Capacity and Automaticity

- As the name suggests, automaticity is related to doing things *automatically*.
- Involves performing actions without conscious control (Schmidt & Lee, 2014), allowing the performer to focus on other things.
- Having automaticity when performing skills means there is more attention left over to focus on other things. For example, if a basketballer needs to pay most of his attention to dribbling the ball, he is less aware of his surroundings and opponents. However if he has developed his skills, his automaticity allows him to dribble the ball almost *automatically*, which means he can put more attention into where his teammates and opponents are in the court.
- A key for coaches and teachers is to develop this automaticity, so learners can focus their attention on more external factors. This would improve performance.
- Developing automaticity comes with a significant amount of practice.

Dual-task procedure

- The dual-task procedure tests performers’ abilities to perform more than one task at the same time.
- It is a useful test for teachers to use to identify how much interference a secondary task has on a primary task.
- Allows teachers to identify how much attention the learner requires to perform the primary task.

**Selectivity**

The ability to direct our attention to certain things is important for dealing with our limited attentional capacity (Fairbrother, 2010). Selective attention allows us to pay attention to some things while ignoring others. When there is a lot of information being presented, it is hard to process everything. This is when selectivity plays an important role, as performers must select what to pay more attention towards. This can greatly affect performance, and could be the difference between missing a shot at goal or making it.

For example, a basketballer trying to make a free-throw will have distractions coming from different places. Selectivity allows the player to block out irrelevant distractions and concentrate on the task at hand. If however he fails to block out the irrelevant cues, he will fail in making the shot.

**Attentional focus: Internal and External Focus**

Attentional focus is consciously attending to specific information during movement under the influence of instructions. The adoption of attentional focus during the execution of a motor skill can have a significant effect on performance outcomes (Gray, 2011), which deems it important for instructors and teachers to direct learner’s attention to the most relevant focus area. There are two types of attentional focus – internal and external – and the shift of focus to either one of these could have a significant impact on performance outcomes.

**Internal Focus**

When a learner’s attentional focus is directed solely on their movements, it is though that there is an internal (or inward) shift of their attention (Gray, 2011). This inward shift has been suggested to actually hinder performance and learning (Fairbrother, 2010), because it encourages a conscious control of movement, making the performer’s movements less automatic.
**External Focus**

An external focus of attention is evident when a learner’s attention is directed at the effects of their movement, rather than the execution of their movement (Gray, 2011). Research suggests that focusing on movement effects could provide more reliable and succinct execution of a skill, especially under pressure (Gray, 2011). Making movements more automatic for the performer can lead to more successful outcomes. How then, does this difference in internal and external focus look in a practical sense?

**Practical Example: “Choking Under Pressure”**

Scientists believe that pressure to perform well initiates distractions, meaning performers either miss vital cues that are relevant to the task, or put emphasis on things that aren’t relevant to the task (Wulf, 2007). This pressure to perform creates increased levels of anxiety which tends to reduce ‘controlled’ selective attention activities of the performer (Schmidt & Lee, 2014), which means the performer’s attention is diverted away from what they would normally do automatically in that scenario.

There is also evidence that suggests that the cause of choking can also be from individuals becoming too concerned with the steps of the execution of the task, disrupting automaticity and effecting performance (Wulf, 2007). This is an example of an inward (or internal) shift of attention, and as mentioned earlier an internal shift of attention can hinder performance and learning (Lohse, Wulf & Lewthwaite, 2012). This internal shift could be the difference between a professional golfer winning a major tournament or missing a short putt.

An inward shift in attentional focus could be a primary cause of ‘choking under pressure’ (Gray, 2011). When in high-pressure situations, skilled performers tend to shift their attention inward so their focus is purely on movement execution (Gray, 2011). As mentioned earlier, an internal attentional focus can hinder learning and performance, and this could be a large part of a cause of a professional golfer missing a short putt to win a tournament.

**Memory**

Both attention and memory aren’t simple or straight-forward processes (Bornstein, 1989). Our memory systems allow us to store and retain information over short and long periods of
Atkinson & Shiffrin (1968) explain that there are 3 stages of memory. These three stages are sensory, short term and long term memory. Sensory memory is the first stage of the memory system that involves information from the environment entering our memory system. This stage of memory has an unlimited capacity to what it can process, however this only occurs for a brief duration of around 1 second and if it does not pass onto the short term memory stage, the information will be lost and not be able to be remembered. Short-term memory has a limited capacity to which how much memory can be held without forgetting the information (Spittle, 2013). It holds just enough for us to recall it in order to use it. This stage of memory engages in rehearsal and repetition practices in order to transfer information from the short-term memory system to the long-term memory system. Finally, the long-term memory system is the memory system that stores relatively permanent information, including our experiences and knowledge on the basis of learning throughout the lifespan.

Forgetting

In order to remember, it is encouraged that information we want to remember is transferred to the long-term memory system through the processes of rehearsal and practise. Trace decay and interference are two methods researchers commonly proposed as explanation for forgetting (Wixted, 2004).

Trace decay is when learners forget as time passes. Memory of information decays or deteriorates and the more time that passes, the harder it is to recall the information. It is possible that memories simply fade but it is too difficult to measure this, as it would form other memories in the meantime.

Interference explains the reasons we may forget due to an interfering with other information we are trying to remember. Interference has 2 stages, proactive interference and retroactive interference. Proactive interference is where old memories interfere with new memories, and retroactive is where old memories interfere with new memories.

Relationship between practice and performance:

Memories of a skill are easily learned and remembered when the practice and performance contexts are similar. Not only does that help learners remember the practiced skill but other
elements too, including contextual details such as environmental characteristics and characteristics of the person. The encoding specificity (Tulving & Thompson, 1973, as cited in Spittle, 2013, pp. 255) suggests that the test performance will be better when the relationship between practice and the test contexts are similar. It is important that when testing a skill it is matched to which the context of which skill will be performed in, therefore meaning when assessing a skill it is important to keep it as close to the game context as possible in order to transfer the skill into the game.

**Conclusion**

Despite many distractions happening in everyday life, most of the time we are able to concentrate on the important things while ignoring the irrelevant things. Attention involves processes of selection, and it is because of this that we are able to focus our attention on the most relevant things. Due to limitations in our attentional capacity we can’t pay attention to everything, and this is why selective attention is so important. Teachers need to attend to these notions and facilitate development of automaticity and selective attention to allow learners to pay attention effectively. By doing this, as well as matching learning contexts with performance contexts to prevent forgetting in game situations, both the learning and performance of individuals could be enhanced.
References


