Implicit and explicit learning: two different systems?

Implicit and explicit learning: Two different systems? Implicit and explicit learning methods have been empirically tested over many years and the debate still goes on, are they connected to one another or are they two separate systems? This essay aims to evaluate studies on both sides and come to a conclusion based on current research. Implicit learning was first defined as, how one develops intuitive knowledge about the underlying structure of a complex stimulusenvironment, without a conscious effort (Reber, 1967).

This in Lehman's terms is essentially unconscious learning, meaning that certain things are learned without our brain being actively used to learn them. Explicit learning on the other hand is defined by Mathers et al (1989) as being very similar to the conscious problem solving processes, this is because our brain attempts to form a mental representation of the task and searches memory for previous knowledge before testing mental models of task performance. Grant & Berg (1948) showed just how clear implicit learning is when they created the Wisconsin card-sorting test (WCST).

The participants had to categorize cards but were not told how to categorize them, but only if it was right or wrong. After a few tries the participants were able to successfully match the cards to the right categories however when asked why they could not explain why they matched the card to that category, showing that this learning was done implicitly and is hard to explain how they came to that conclusion. A clear example of explicit learning is when a child is learning their math timetables because they are consciously participating in a new learning exercise.

Cleeremans & Jimenez (2002) describes implicit-explicit learning as a continuum whereas Aizenstein et al (2004) suggests that different areas of the brain are active during different types of learning. As there are different types of learning, there are also different types of memory and learning and memory are inextricably linked with one another. Therefore neurologists and psychologists have argued that if there are 2 separate systems of memory then surely, as memory and learning are so closely interlinked, learning must also have a similar system (Kihlstrom, Dorfman & Park, 2007).

Grammar learning has being at the centre of the majority of research as the human brain deciphers grammar through both memory and learning. This was shown in Reber (1967) study or artificial grammar learning, where he presented participants with a string of artificial sentences that have been created by using a complex set of grammatical rules. Reber concluded that while all the sentences across both groups technically made no sense, participants identified that there was a set of grammatical rules behind the sentences.

When the sentences changed and some were grammatically correct and some were not, participants knew that there was something wrong about the sentence however they could not explain what this was. This is because the participants were unconsciously learning the set of rules while reading the sentence. During different types of learning, different areas of the brain become active and have increased blood flow, this presents a solid platform for a multiple system view of learning in humans.

This debate has been discussed in the context of memory as well as learning systems. Goschke (1998) provides evidence for this when he studied the

implicit learning of motor sequences. Goschke discovered, through brain imaging, that different domain-specific areas of the brain became active during motor sequence learning, areas that suggest the different areas of the brain become active through one learning task. Consequently proposing the theory for independent learning systems.

This theory was reinforced when Aizenstein (2004) used moderntechnologyin the form of fMRI scans to measure regional brain activity during concurrent implicit and explicit sequence learning, this study found that brain activity was very similar in both types of learning. With the visual cortex and the striatum showing activity in both conditions, however the main difference between the conditions was direction of activation change in the visual cortex. In the implicit condition the visual particle had a negative ? indicating a reduced response related with the learning trials. The prefrontal cortex was also activated more in the explicit condition. Although Aizenstein found a difference in the regional brain activity, there was also an overlap in activity in the two conditions, replicating the findings of Willingham, Salidis & Gabrieli (2002) and Schendan, Searl, Melrose & Stern (2003). There has been evidence found in studies on amnesia patients that strongly suggests that implicit and explicit memory is two very distinct systems.

Levy, Stark & Squire (2004) discovered that, through a series of experiments on memory-impaired patients, implicit priming (the identification of an item is improved from an earlier encounter) is still intact in the patients. However new priming proves to be difficult for them. This is due to damage to the hippocampus and other related structures in the medial temporal lobe

consequently amnesiacs find a task difficult if it depends on the linking of unrelated items.

As there are many models of multiple learning systems that have being empirically tested over the years, this has become the most commonly accepted model of learning. This is also due to modern technology such as fMRI also reinforcing certain factors that suggest a multiple system view, as Aizenstein (2004) showed. Consequently not many researchers take it on themselves to go against the majority and opt to research a singular system view of learning. However, despite a small amount of valid research on this topic, there is still substantial evidence that prolongs this debate.

Cleermans & Jimenez (2002) present research that indicates the learning process is not two separate systems of implicit and explicit learning, but that it is a continuum. This continuum runs from weak learning, implicit learning, along to strong learning, explicit learning, therefore proposing learning not as two separate systems but as a single loop of learning. Perruchet & Amorim (1992) ran a series of experiments on sequence learning and the effect of conscious knowledge on changes in performance.

Through these experiments they concluded that, although many claims have being made for dissociations between learning systems, Perruchet & Amorim regarded these as groundless. Meaning that although there might have been experiments created to thoroughly test the hypotheses, Perruchet & Amorim argued that these tests failed to provide reliable empirical support for dissociation. Stanton & Nosofsky (2007) also provided evidence against the multiple learning systems hypothesis.

In this study, Stanton & Nosofsky aimed to reverse the dissociations already established by Reber (1967) and Goshke (1998). He aimed to do this to demonstrate how the earlier studies failed to provide solid evidence for a dissociation, by reversing the dissociation Stanton & Nosofsky showed just how invalid the previous results were. They concluded that a better research strategy would be to create more fully specified versions of both multiple and single system models of learning therefore being able to evaluate them more wholly.

Another key point raised by Willingham & Goedert-Eschmann (1999) is that despite learning being a multiple system, there is evidence for a single system connection. They provide evidence that connects the two systems by parallel learning. When a participant is explicitly learning a sequence, their implicit knowledge of the task is improving alongside explicit learning, consequently signifying a connection between the two systems.

Willingham & Goedert-Eschmann focused this research on the parallelism of the two structures as little research had been done on this theory because of the amount of researchers focusing their resources on the separability of the two systems. In evaluation, the literature reviewed in this essay has being quite compelling, with the majority of research on a multiple system view of learning it seems to be the most widely accepted theory despite no concluding evidence. As there has been a vast amount of research on a multiple system view, there is little on a single system view thus making it hard to evaluate both systems fairly.

Despite this, using the literature I have discovered, a conclusion can be made that there is more evidence for a multiple system of learning.

Especially in neurophysiology shown by Aizenstein's (2004) results from the fMRI scans did show some slight differences in brain activity when different tasks were presented that required implicit and explicit knowledge/learning. On the other hand Cleermans & Jimenez (2002) suggest that there are slight differences, similar to Aizenstein (2004), however this is due to a singular system in the form of a continuum.

As memory and learning are closely connected and there has being different types of memory established, short-term memory and long term memory, there has been many researchers looking for a link betweenmemoriesand learning processes. As learning is defined as the process of laying down some sort of memory trace, there is no reason to suspect that different memory systems will be able to identify certain categories of learning (Ashby & Maddox, 2005). Despite all of the research up to date, no single piece of research has been able to show that different types of memory and learning are directly linked to one another.

However Ashby and Maddox did conclude that different memory types (for example sensory and primary memory, short term and long term memory) could identify different categories of learning consequently suggesting that more research needs doing into this phenomenon. Willingham & Goedert-Eschmann (1999) provided an interesting explanation of the learning system, they hinted at two separate systems of learning, an implicit system and a completely separate explicit system, that were connected. This was through parallel learning.

For example as we explicitly learn a sequence, our implicit system is learning concurrently with our explicit system. Providing evidence for a new theory

that, although they are two separate systems, they still work together. Finally, judging from the research that has being done, a conclusion can be made that although the majority of literature out there is focusing on trying to separate the two systems and support the multiple system theory of learning, there are still unanswered questions that have arisen from research.

Cleermans & Jimenez (2002) provide a very interesting approach to these theories and propose an idea of a learning continuum, this question is still unanswered 10 years after the theory was proposed. Willingham & Goedert-Eschmann (1999) also have an input into this debate, they suggest that while explicit and implicit learning systems are separate, they are still constantly synchronized because whilst we are explicitly learning something, our implicit system is working to store the knowledge so we do not need to consciously engage our brains next time we come across the same or similar problem.

The final question that is still unanswered is a debate that has gone on for decades, is learning and memory connected? The final answer to that question is yes, yes it is however researchers are still looking into whether certain types of learning go to certain areas of the brain to be stored as memory or whether memory types cannot distinguish category learning. In conclusion, from current research, the most widely accepted theory is that there are multiple learning systems and that it is not a singular system for both explicit and implicit learning.

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