The fundamental things apply... as time goes by: Students' long-term memories from an ecology field excursion

The aim of this study was to investigate and analyse what biology students remembered a long time after being out on an ecology excursion. The students’ memories were tested during a stimulated recall interview and analysed using the dual memory system model of learning.

Already after 6 months we found that the students had forgotten a lot of the scientific content. Very often they showed a familiarity (recognition) with the situations and objects showed to them but they were unable to identify (recall) and label them. However they did remember some spectacular moment, the sudden appearance of a fox and a moose. They did also remember things and situations when they were active themselves, digging, smelling, using their hands or their feet’s in the difficult balancing and walking on a pet bog. From literature we identified two different types of memories, depending of the question asked: recall and recognition. We connected memories used in recall to the explicit memory system (declarative knowledge), and memories used in recognition to the implicit memory system (tacit knowledge). The Explicit memory has a short retention but the implicit system is very stable and this will explain the difference in recall and recognition abilities. Since the implicit memory incorporates emotional, somatic, markers we were able to explain the specific flashbulb memories. The implicit system is active when we are doing things, using our senses and this may explain why those memories still were strong even after a full year. The strong memories of patterns stored in the implicit system seemed to act as indices to the declarable labels and facts in the explicit system. Implications for research, education and type of assessment are discussed.

Summary

Synopsis

Introduction

Science education research very often focuses on teaching and examination is in most cases done close to the learning occasion and is rarely tested after a long time. There are not many studies on what students remember on long-term bases. Traditional memory models, like Tulving’s (1987) “Procedural, Semantic and Episodic memory model”, will not explain these result. Therefore researchers add models of motivation, emotions and affect.

Theoretical framework

Dual system-processing is a psychological model of two different cognitive systems for reasoning, making judgments and social cognition (Evans, 2008). There is a distinct difference between rapid, automatic and non-conscious processes (implicit memory system) and a slow and deliberate explicit memory system. Additionally, neuro physiological research has identified two biologically separated memory systems in the human brain, namely the non-declarative and the declarative memory systems (Squire, 2004). Merging psychology and neuro physiological research allows for the idea of two separate systems for memory and learning to be strengthened, namely the dual memory system model (Björklund, 2007, 2008). Björklund has proposed the use of “implicit” and “explicit” memory systems as synonyms for Squire’s non-declarative and declarative systems. This proposal is also supported by neurological research on social cognition (Satpute & Lieberman, 2006). The explicit
memory system is characterized by dealing with what is traditionally referred to as facts, events, rules and labels in pedagogy and science education (Evans, 2008; Schilhab, 2007; Squire, 2004). The explicit knowledge is possible to verbalize and communicate (Evans, 2008). Associated to the explicit memory system is working memory, which is our conscious system (Sweller, van Merrienboer, & Paas, 1998). However, the explicit memory system is constrained by the limited capacity of working memory (Lieberman, Gaunt, Gilbert, & Trope, 2002; Marois & Ivanoff, 2005). Working memory may hold about five units at a time and the addition of any further units can lead to cognitive load (Cowan, 2000; Ross, 1969; Sweller & Chandler, 1991).

The implicit memory system deals with non-conscious knowledge (Berry & Dienes, 1993; Evans, 2008). Implicit memories are stored as multimodal sensory patterns of phenomena that we perceive, even non-consciously, in a specific situation – what we hear, feel, see and smell. Logan (1988) suggested that, “subjects store and retrieve representations of each individual encounter with a stimulus”. It is therefore feasible to suggest that each representation is stored in the implicit memory system as an unique holistic pattern (Björklund, 2008). The implicit memory system will constantly perform pattern matching processes. When we re-experience a situation, the match will help us feel and act in the same way as we did the last time (Lieberman, 2000). Hence, we will experience a feeling of familiarity with the situation. Pattern matching is an automatic and rapid process which can impact behaviour directly without being constrained by the processing limitations of working memory. Since the use of implicit memories should be considered as knowledge that is “hidden” from the practitioner it could be characterized as tacit knowledge (Björklund, 2008; Polanyi, 1966). Even though the process of pattern matching is non-conscious, the implicit memory system may trigger a corresponding declarable label in the explicit memory system (Figure 1).

The explicit and implicit memory systems have different retention properties. Explicit memories degrade fast (Fleischman, Wilson, Gabrieli, Bienias, & Bennett, 2004). This may serve as one possible explanation to why recall items, which request a declarable answer, have a shorter retention (Tunney, 2003). Implicit memories have shown to be long-lasting, and even lifelong (Dennis, Howard Jr, & Howard, 2006; Jenkins & Hoyer, 2000). This would imply that the feeling of familiarity, or recognition, is more long-lasting (Tunney, 2003). Our starting point for this study is that recall tasks require explicit memories, while recognition tasks call for implicit memories.

We have formulated the following research questions to frame the study:

1. How can the dual memory system model be used to understand the cognitive process behind recognition and recall in this empirical data?

2. What kind of context and circumstances will modulate the strength of memories

Method

The original data collection took place during an ecological field excursion in southern Sweden. A biology teacher at university level brought his class out into the woods as a mandatory part of an ecology course. The excursion with a focus on the teacher was analysed in a recently reported study by the present authors (Stolpe & Björklund, 2012a). The present study is focusing on the students and their memories 6 and 12 months later. The excursion was video recorded and from the video, we identified 16 important episodes. Each episode was then represented by a picture or a short film clip
to be used as cues in a stimulated recall interview (Lyle, 2003). 6 months later four female students and one male student volunteered to participate in the interview. The interview lasted between 45 and 60 minutes and was video recorded and fully transcribed. In every first encounter with a student we asked them “Could you please tell me what happened during this day?” They gave us a more or less comprehensive account of what took place. In the next step we gave them cues consisting of pictures or video clips and asked: “Could you please tell me something about this picture?”. We define this as a recall question. Later on, the questions were more focused (“Do you remember if anything special happened here?” or “Do you remember what the teacher talked about?”). At this stage the questions were still of recall character. Finally, if the student did not remember the situation or species at hand but showed a familiarity with the situation, a recognition question was posed. For example, “If I tell you that this is Ptilidium, is that familiar to you?” Twelve months following the excursion, all five students participated in a follow up interview. Three pictures related to the two categories of memories were selected as stimuli for this second interview, which was done by telephone. The interviews lasted for 10 to 15 minutes and were audio recorded and fully transcribed.

Data analysis

The six months interviews were analysed by looking for examples of when and where the students did recall the names of species or when they were able to tell what was happening. We also searched for examples where the students recognized species or were familiar with a situation. Factors that may have influenced learning was noted, were the students active doing things, what was their mood, hunger, affect etc. Degradation of memories of a specific narrative told by the teacher during the day was analysed and have been published elsewhere (Stolpe & Björklund, 2012b).

Keywords    Affect

Appendices
Results in a graphical representation

Recall

Figure 1. The process of recall. Stimuli from outside will constantly be matched in the implicit memory system. If there is a match (A) with an already experienced pattern, working memory may be activated. We will become conscious aware that we recognize the situation (B). The pattern matching process will also trigger the corresponding explicit knowledge (C). In this case, the corresponding explicit knowledge does exist as Label 1 and hence we will become conscious about the label (D). We will be able to verbalize the label (E) (Stolpe & Bjorklund, 2012a).
Recognition

Figure 2 The process of recognition. Patterns will be constantly matched in the implicit memory system. If there is a match (A) with an already experienced pattern, we will become conscious about that we recognize the situation (B). We are able to express a feeling of familiarity (C) but since no label in the explicit system is invoked we will not be able to identify or verbalize our knowledge tacit.