

The relevance of a movement sequence enhances procedural memory consolidation in children

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Introduction

Memory consolidation processes, generating long-term memory for skills ("how to" knowledge), are faster in children compared to adults. Nevertheless, these processes are also susceptible to interference by subsequent competing experiences in children though less than adults, indicating selectivity in what is to be maintained as long-term memory. In adults selectivity may also be biased by reward expectation prior to training. The aim of the current study was to examine whether making a trained sequence of movements more meaningful and relevant, without changing any of the actual training experience parameters, can enhance motor memory consolidation processes in children.

Methods

•**Participants:** Sixty-eight participants (11-12 years old, 34 girls) took part in the experiment. Participants were recruited from schools in a suburban neighbourhood of a middle socio-economical level.

•**The task:** the motor task was the finger-to-thumb opposition sequence (FOS) learning task (Dorfberger et al. 2007). Participants were instructed to oppose the fingers of the left (non-dominant) hand to the thumb in a given sequence of 5 movements "as fast and accurately as possible". Two sequences of equal length and complexity were used, each the reverse of the other.

•**Procedure:** In Experiment 1 (34 subjects, 16 girls) the performance of the trained finger movement sequence was compared in two conditions. One group trained in the standard (Dorfberger et al. 2007), neutral, protocol wherein the children were asked to perform the given FOS as accurately and fast as possible (Neutral). Children in the other group were told that the performance of the FOS was a secret key to obtaining an entry code to a website with many games (Relevant). Then as in the Neutral group children were asked to perform the given FOS as accurately and fast as possible. In Experiment 2 (34 subjects; 18 girls) the same two conditions of training were compared (Neutral, Relevant). However, 10 minutes after the end of the training session with the assigned finger movement sequence, a second FOS (mirror reversed in relation to the first sequence) was introduced and training was afforded on it.

Results:

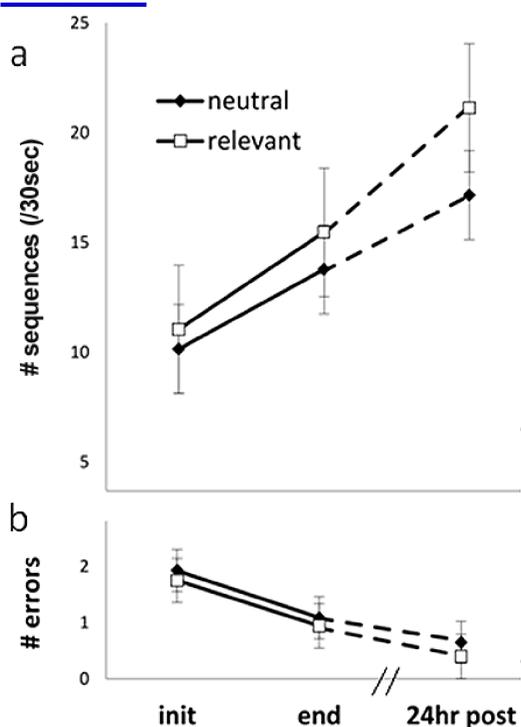


Figure 1: Experiment 1 - training a single sequence of movements without an interference task: (a) group average number of correct sequences per test block, (b) group average number of errors per test block. Bars = standard error.

Children who practiced the sequence of movements in a context more meaningful and of value to them showed a small advantage in performance speed and accuracy within the training session, but in addition were able to express larger delayed gains in speed, by 24 hours post-training, compared to children practicing the movement sequence in a neutral context.

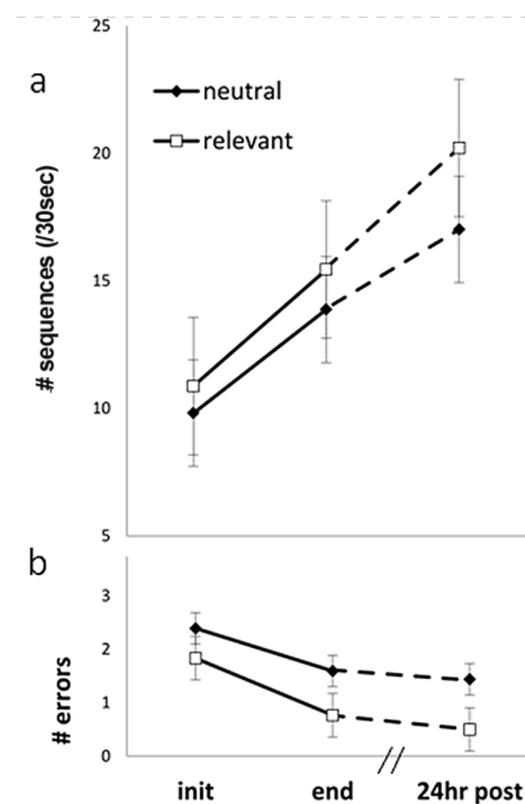


Figure 2: Average performance results for all subjects for the three sessions (in blocks): (a) trial performance time, (b) number of errors.

Practicing the sequence of movements in the more meaningful context resulted in reduced susceptibility of the trained movement sequence to interference by subsequent conflicting motor experience; no costs in accuracy were incurred despite interference.

Conclusions:

• In 12 year-olds, the affordance of a context in which task relevance is increased lead to more robust, and biased, consolidation-phase related (delayed, "offline") performance gains.

• We propose that task relevance biases brain systems to allow experience-driven plasticity in pre-adolescents; thus determining what is to be preferentially maintained as long-term "how to" memory.