

Can Implicit Sequence Learning be based on a Sequence of Response Selections?

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In many of everyday tasks, sequencing of events is involved: sequencing movements in handwriting, sequencing sounds in music or language production, sequencing actions in playing football ... The acquisition of these kinds of sequential information typically occurs implicitly, in the absence of conscious awareness.

A popular tool to study implicit sequence learning is the Serial Reaction Time task (SRT task) developed by Nissen and Bullemer (1987). In the SRT task, participants have to react to successive stimuli that follow a regular sequence. Although participants are not informed about the sequential nature of the task, reaction times (RTs) decrease progressively with training and suddenly increase when another, mostly random, sequence is inserted. The RT disruption with the introduction of a random sequence indicates the presence of sequence learning. Knowledge acquisition in the SRT task is assumed to occur implicitly, as participants demonstrate learning despite their unawareness of the hidden sequence.

One of the central issues in implicit sequence learning research concerns the representational nature of the acquired knowledge: what is precisely being learned during SRT task performance? Do participants primarily learn the sequence of stimuli, or rather the sequence of corresponding responses? Addressing this issue is important, in order to determine whether implicit learning of sequential activities is mainly perceptual or motor in nature. Most investigations show that mainly response related processes are involved during SRT learning (e.g. Deroost & Soetens, in press; Willingham, Nissen, & Bullemer, 1989). In this respect, learning can be based on both the sequence of effectors and the sequence of response locations (Deroost, Zeeuws, & Soetens, in press). Perceptual learning, on the other hand, seems to be restricted to rather specific conditions (e.g. Deroost & Soetens, 2006a; Mayr, 2006; Remillard, 2003).

Besides response related learning and perceptual sequence learning, less is known about the possible influence of intermediate levels of information processing on learning. In a previous study, we demonstrated that response selection processes can have a major impact on sequence learning: more learning occurred with an incompatible stimulus-response mapping (S-R mapping) than with a compatible S-R mapping (Deroost & Soetens, 2006b). This compatibility effect could not be attributed to a difference in level of task complexity between the mapping conditions.

In the present study, we aim to find further support for the involvement of response selection in implicit sequence

learning. To this end, we use a SRT task in which the four stimulus alternatives are mapped onto two responses, in such a way that both the sequence of effectors and the sequence of response locations vary randomly. Participants demonstrate significant sequence learning under these conditions, showing that learning is not restricted to the response level. However, when participants are additionally prevented from relying on the sequence of response selections by randomizing the S-R mapping, learning is absent. Together with the earlier findings of a minor involvement of perceptual learning, the results suggest that implicit sequence learning can be based on a sequence of response selections.

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References

- Deroost, N., & Soetens, E. (2006a). Spatial processing and perceptual sequence learning in SRT tasks. *Experimental Psychology*, 53(1), 16-30.
- Deroost, N., & Soetens, E. (2006b). The role of response selection in sequence learning. *Quarterly Journal of Experimental Psychology*, 59(3), 449-456.
- Deroost, N., & Soetens, E. (in press). Perceptual or motor learning in SRT tasks with complex sequence structures. *Psychological Research*.
- Deroost, N., Zeeuws, I., & Soetens, E. (in press). Effector-dependent and response location learning of probabilistic sequences in SRT tasks. *Experimental Brain Research*.
- Mayr, U. (1996). Spatial attention and implicit sequence learning: Evidence for independent learning of spatial and nonspatial sequences. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 22, 350-364.
- Nissen, M. J., & Bullemer, P. (1987). Attentional requirements of learning: evidence from performance measures. *Cognitive Psychology*, 19, 1-32.
- Remillard, G. (2003). Pure perceptual-based sequence learning. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 29, 581-597.
- Willingham, D. B., Nissen, M. J., & Bullemer, P. (1989). On the development of procedural knowledge. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 15, 1047-1060.