Previous errorless sequence-learning promotes subsequent Serial Reaction Time performance in patients with AD

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Introduction

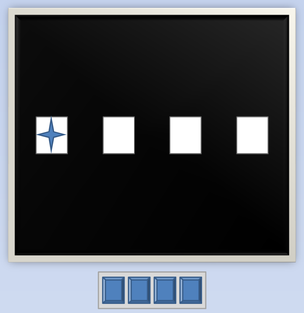
- Several studies have shown relatively preserved perceptual-motor skill learning in mild and moderate Alzheimer's disease (AD) (Willingham et al., 1997). In rehabilitative interventions, it may be useful to exploit these preserved capacities to improve the patients' autonomy in their daily life. However, in view of their usually impaired processes, it is important to find out the most effective learning methods for skill acquisition in AD.
- Recent work has suggested that, in its initial stages, procedural learning does not necessarily depend on controlled (explicit) processes, but could instead occur in an implicit way. Knowing that implicit learning mechanisms are preserved in AD, we must focus on methods that promote the development of an implicit knowledge in this population (Van Halteren-Van Tilborg et al., 2007).
- According to some studies, a reduction in error during the acquisition phase induces the implementation of implicit treatments. So the "errorless learning" method could be an appropriate way to learn new skills to AD patients (Maxwell et al., 2001).
- Objectives: We want to test the advantage of an "errorless learning" method for the acquisition of a perceptual-motor sequence in patients with AD.

Methods

Participants :

	N	Age	Education	Mattis Total Score
AD	12	78.17 ± 4.97	13.58 ± 4.54	120.25 ± 4.39
Control	12	77.77 ± 6.11	15.08 ± 3.55	138.46 ± 4.50

Learning phase:
A stimulus can appear on four different locations on a screen and the participant has to respond to the target by pressing the corresponding key on the keyboard. He has to learn a perceptual-motor 6-elements sequence in two different learning conditions.



Errorfull leaning (EF): The subject has to reproduce the sequence with the four corresponding keys. If he makes a mistake, the correct response appears and he has to correct his error by pressing the good key.

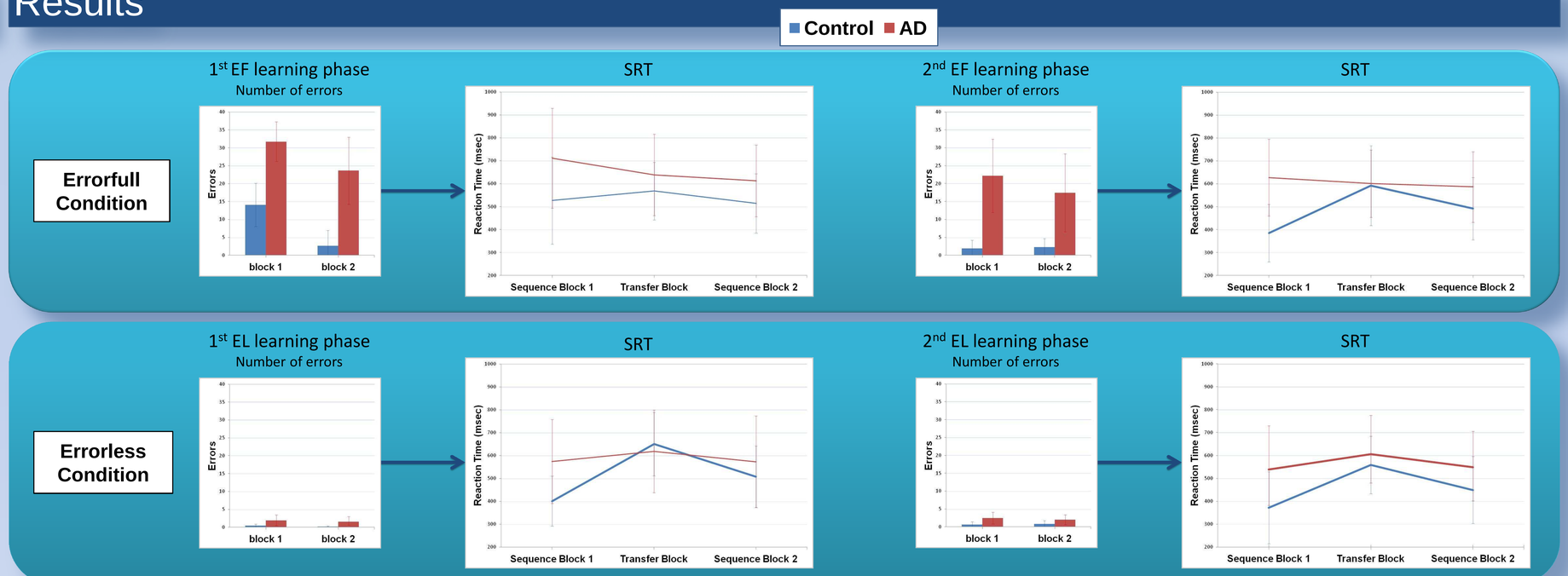
Errorless learning (EL): The subject has to simply follow the sequence by pressing the corresponding key when the stimulus appears. So the participant executes the sequence with a minimal number of errors.

In each condition, there are two learning phases. After each learning phase, we test the sequence knowledge with a Serial Reaction Time task.

Serial Reaction Time task (SRT):

The subject has to react as quickly as possible to the appearance of the target on the screen by pressing the corresponding key. The task consists of three blocks. We compare the reaction times for the learned sequence (sequence blocks) to the reaction times to a new sequence (transfer blocks).

Results



First learning phase:
- Greater number of errors in EF learning than in EL learning (p<.001).
- EF learning phase: significant learning effects in both groups (significant error reduction during learning, p<.001).

Subsequent SRT task:
- Control group:
  - EF condition: no significant RTs improvement (p=.08).
  - EL condition: shorter RTs for the sequence block than for the transfer block (p<.001).
- AD patients: no significant learning effect (EL: p=.12; EF: p=.99).
- Significant Block x Condition interaction in each group (p<.001).

Second learning phase:
- Control subjects: very few errors in both learning conditions.
- AD patients: greater number of errors in the EF condition than in the EL condition (p<.001). However, they continue to improve their performance during this learning phase (p<.001).

Subsequent SRT task:
- Control group: significant RT difference between the sequence and the transfer blocks in both conditions (p<.001)
- AD group: although the EF condition still shows no effect in the SRT task (p=.54), the EL condition reveals a significant sequence learning effect (p=.02).

Discussion

- In both groups, after the first learning phase, the EL learning condition led to a greater learning effect than the EF learning condition.
- Effective learning for the control group in both conditions after the second learning phase.
- In EF learning, AD patients did not get a sufficient knowledge to increase their RTs in the post test.
- In EL condition, AD patients were able to significantly increase their performance in the sequence blocks of the SRT task after the second learning phase.

In conclusion, procedural learning can begin rapidly, on the base of implicit learning mechanisms, without the intervention of controlled processes. And a possibility to avoid the intervention of controlled processes would be the errorless learning method. Moreover, our results confirm that errorless learning is effective in AD. Several ecological studies have already shown benefits from an errorless learning approach in patients with AD for skill acquisition, but it is the first study comparing errorfull and errorless procedural learning with a methodology including a controlled and sensitive task like the SRT task. These results confirm the interest of using this method in a rehabilitation setting.