No trade-off between Declarative and Procedural Memory in Children with Specific Language Impairment

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Procedural deficit hypothesis (PDH) attributes language phenotypes of children with specific language impairment (SLI) to their affected procedural and relatively intact declarative memory systems. The declarative compensatory hypothesis (DCH) is an extension of PDH which claims that the relatively intact declarative system in SLI compensates for their procedural loss commensurately. The present study's major aim was to examine the claims of DCH by examining the relation between these potentials in SLI. However, while doing so, it proposed to reiterate SLI's procedural deficits, and to examine the effects of encoding and retrieval procedures on their declarative performance.

Methods

Thirty Kannada (agglutinating language of Dravidian family) speaking children each with and without SLI in the age range of 8-13 years were the participants. Participants were assessed on their procedural learning using serial reaction time (SRT) task (Figure 1).

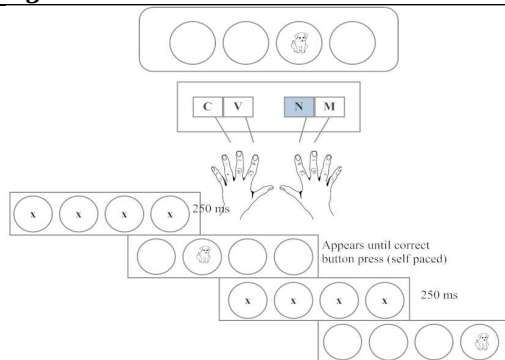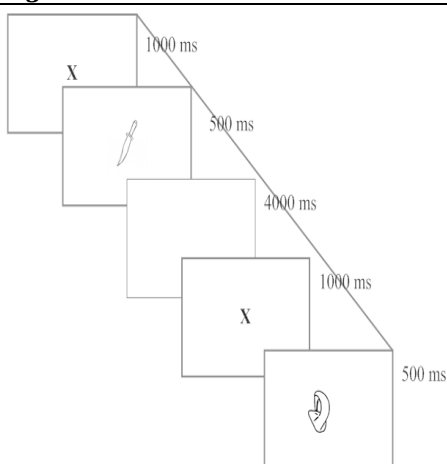| *Figure 1. SRT task-Trial illustration*	*Description*
	Figure shows a single trial. Participants were asked to track the location of the stimulus as fast and accurately as possible. The locations appeared randomly (no scope of learning) or followed specific pattern (scope of procedural learning). The difference between RTs of random and pattern was considered a measure of procedural sequence learning.

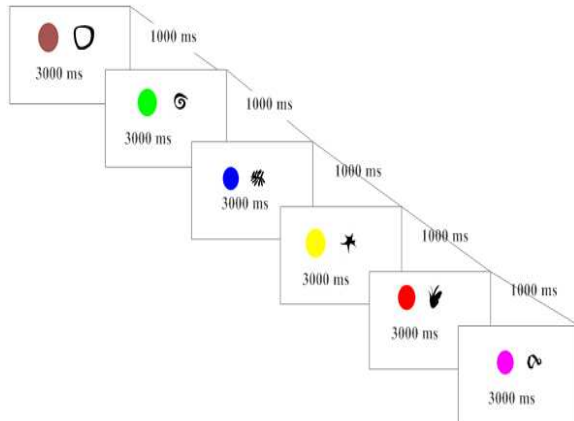| *Figure 2. RMIE task- trial illustration*	*Description*
	Participants were first exposed to set of objects in an object/ non-object categorization framework, incidentally (encoding stage). On the recognition stages the objects were presented randomly and the participant had to decide if the object shown was 'seen' or 'not seen' on encoding stage.

Their declarative memory was assessed using two non-verbal tasks that differed at the level of encoding and retrieval (a recognition memory task after incidental encoding-RMIE and a recall task after intentional encoding, a visual paired associate-VPA) (Figures 2, 3, and 4). Retrieval was examined after 10 (short delay) and 60 minutes (long delay) interval after encoding on each of these declarative tasks.
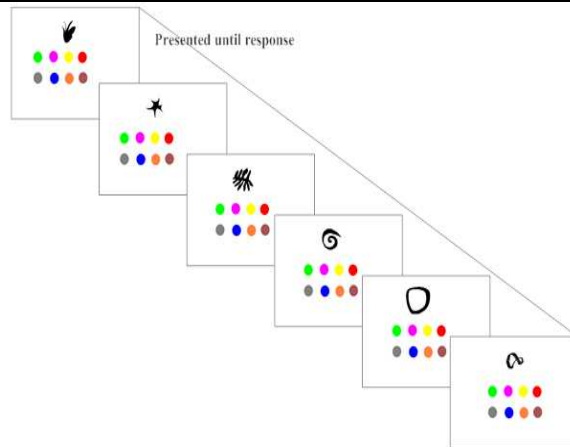
Figure 3. *VPA task, encoding stage*	*Description*
	Six colours and abstract shapes were shown for the participants to remember the association. They were told that after a delay they will be asked to link the shape to colour. The pairs were exposed three times each.

Figure 4. *VPA task, recall stage*	*Description*
	In this stage they were asked to match the abstract shape to right colour (among foils).

Results

Findings on SRT showed poor procedural learning in SLI. On RMIE (encoding: incidental, retrieval: recognition) SLI children encoded and retrieved the objects significantly poorer than typically developing (TD) controls. Both the groups retrieved better at short compared to long interval and retrieved real objects better than novel objects. Further, real objects were retained better at long delay compared to novel objects. On VPA (encoding: intentional, retrieval: recall) encoding was not measured, and on retrieval children with SLI were poorer than TD children (even after controlling for IQ and age). However, both the groups lost information similarly between the delays. When the effect of retrieval type was examined, children with SLI were though generally poorer than TD, the groups performed recognition better than recall and information was better retained on recognition compared to recall after the delay. The correlation results did not support relation between these memory systems.

Conclusions

Findings reiterated the major claim of PDH-procedural learning deficit in SLI. However, fails to support an intact declarative system as per PDH, despite using tasks that is least processing demanding. It is not clear from the data, if declarative system is actually better than procedural in SLI. Correlation findings showed that these systems' potentials do not trade-off between them.

Implications

Since, neither of the systems are fully functional, the present findings open up new cluster of clinical experiments that advises to recruit the system that is readily made for learning grammar (i.e., procedural) for remediating complex grammar errors in children with SLI.