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STEPS in Sign Language: the Pattern of Errors Made by Sign Language Users with Impaired POB

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The pattern of errors made by sign language users with impaired POB

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Introduction

In spoken languages, individuals with Phonological Output Buffer (POB) impairments make phonological errors (i.e., substitutions, omissions, and insertions of phonemes) in production, repetition, and reading aloud of morphologically simple words and nonwords, whereas they make whole-unit errors (i.e., substitutions, omissions, and insertions of whole-units from the same category) in morphological-affixes, function-words, and number-words (e.g., substituting a function-word with another function-word, a morphological-affix with another morphological-affix etc., Cohen et al., 1997; Delazer & Bartha, 2001; Dotan & Friedmann, 2015; Gvion & Friedmann, 2012), a phenomenon called STEPS – Stimulus Type Effect on Phonological and Semantic errors (Dotan & Friedmann, 2015). This pattern can be explained by assuming that these categories are stored as pre-assembled phonological units in dedicated mini-stores within the POB.

Sign languages exhibit some unique morphological structures, such as classifier constructions, morphological facial expressions, agreement-verbs, and numeral incorporation (NI), which may be susceptible to whole-unit errors. In this study we aimed to identify for the first time deaf signers with low/impaired POB and examine how the STEPS phenomenon is expressed in a language of the visuo-spatial modality.

Methods

We tested deaf native-signers of Israeli Sign Language (ISL) using 5 sequence-recall tests we developed to identify LOOPS – participants with LOw Output Phonlogical Spans suspected to have impairment to the POB. Then, we compared the performance of the LOOPS and the controls in 3 tests including structures suspected to be sensitive to whole-unit errors:

(1) “Triplets” test – production of classifiers and morphological facial expressions. The participant was presented with sets of 3 pictures of a similar object differing in one feature (e.g., three chairs of different sizes). One of the objects was marked. The participant was requested to sign to the experimenter which object was marked. The different features were selected such that they would elicit the use of classifiers and morphological facial expressions (adjectives/adverbs).

(2) Repetition of sentences with morphological structures (classifier constructions, facial-expressions, and NI) and with function-signs.

(3) Comprehension and production of agreement-verbs –the experimenters perform an action (e.g., giving the participant a strawberry). Then, the experimenter signs a sentence that describes the action, and the participant decides whether the sentence correctly describes the action, and if not produces a full sentence describing the action. The target sentences require the use of agreement-verbs.

Results

Just like speaking POB patients, the LOOPS made more *phonological* errors than the controls in morphologically simple signs and in bases of morphologically complex signs, but made *whole-unit* errors in number-signs, function signs, and morphological-affixes (see Table 1). In contrast to the performance in the abovementioned structures, the LOOPS did not make more errors involving agreement verbs than the controls, which may suggest that verb agreement is not stored as pre-assembled units in the signing POB, or that intact morphosyntax is able to support these structures in the production of LOOPS. Unlike the controls, the LOOPS did not show a recency effect when repeating lists of signs, mirroring the pattern reported by Vallar & Papagno (1986) for a hearing pWM-impaired patient (Figure 1).

Conclusions

The error pattern of the POB-impaired signers was similar to the pattern reported for spoken-language users. These findings show that similar impairments to pWM mechanisms can be found in sign-language users and in speakers of spoken-languages, and suggest that similar pWM mechanisms are responsible for both sign-language and spoken-language processing.

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Table 1. Types of errors the LOOPS produced in the sentence repetition test.

Participant	All Errors	Classifiers	FE	NI	Morpho	Function	Phono
SMA	46	3	5	5	3	7	12
JDQO	64	4	11	3	5	9	4
JRI	35	0	1	4	0	7	0
ORA	51	4	3	2	1	4	7
ARA	58	0	2	7	1	15	11
Mean LOOPS (SD)	50.8 (11.2)	2.2 (2.1)	4.4 (4.0)	4.2 (1.9)	2.0 (2.0)	8.4 (4.1)	6.8 (5.0)
Mean Control (SD)	16.3 (8.2)	0.6 (0.9)	0.7 (1.0)	0.7 (0.7)	0.1 (0.3)	3.0 (2.4)	0.6 (0.7)
t(18)	**7.48**	**2.47**	**3.46**	**6.28**	**3.85**	**3.68**	**4.94**
p-value	**<.0001**	**.02**	**.003**	**.0001**	**.001**	**.002**	**.0001**

Cells highlighted in **peach** indicate significantly more errors than the controls (Crawford & Howell's, 1998, t-test). Cells highlighted in blue indicate significantly more errors of the LOOPS group compared to the control group (t-test for independent samples).
FE – morphological facial-expressions, NI – numeral incorporation, Morpho – morphological error (substitution or omission), Phono – phonological error.

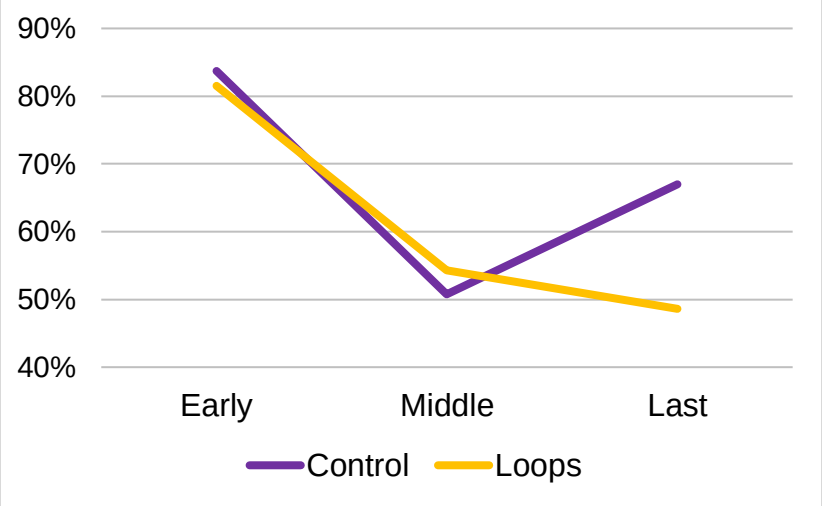

Figure 1. Serial position curves of the LOOPS (**orange**) and the controls (**purple**). Whereas the serial position curve of the controls was best described by a quadratic effect ($F(1) = 10.25$, $p = .006$), the serial position curve of the LOOPS was best described as a linear effect ($F(1) = 14.32$, $p = .02$), showing primacy but no recency effect.