# Processing modes and Representation of CVCVC words in Hebrew: Insights from an auditory rhyming task

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The Hebrew template morphology triggers multiple debates regarding the root and template autonomous representation and non-linear processing in the mental lexicon [1,2,3]. Growing research in neuro- and psycholinguistics supports the root and template representation in the mental lexicon and their role in lexical access and, therefore, non-linear processing [4,5]. Using visual and auditory priming experiments with varied stimuli of templatic words (in a sentence or real vs. non-real words with legal and illegal roots), these studies found the root and template morphemes to facilitate reading with different magnitude of semantic involvement [6]. Here, we explore the impact of the language-specific root and template on processing using a rhyme recognition task provided with auditory Hebrew templatic words.

Rhyme recognition tasks are often used to measure phonological awareness—the ability to understand that words are a series of sounds (phonemes) apart of their meanings. As a validated universal phonological awareness test, it assesses phoneme discrimination and linear processing by the grain size: whole word, syllables, sub-syllabic units, and phonemes. Overlooking the root and template in such a test might result in errors that may be wrongly interpreted.

We conducted three studies to examine: 1. if native-Hebrew speakers (Heb1) process templatic words differently from non-Hebrew speakers (Heb0). 2. if different templatic stimuli trigger different processing and the variation in processing among native-Hebrew speakers. 3. L1-L2 interaction concerning processing templatic words among L2-Hebrew speakers (Heb2) by comparing results of Heb1 with Heb2.

We designed rhyme recognition tasks comprising 178 contextless auditory templatic stimuli of rhyming (R) and non-rhyming (NR) pairs. Most stimuli were CVCVC pairs divided into three subgroups: Baseline (0-2 similar root phonemes in a pair), Transposed-CRs (same root phonemes in different positions in a pair), Highlighted-VM (identical roots with different vocalic template). Additional templates were added to studies 2 and 3 (e.g., non-stressed-matched pairs). To ensure the ability to discriminate phonemes and recognize rhymes, we added 62 CVC pairs of all identical and contrasting phoneme possibilities. To ensure prominence of morphology, we controlled codas' phonological proximity for rhyme perception. We hypothesized that prominence of non-linear processing would yield a high error rate. Significant differences between language groups and stimulus subgroups were expected to varying extents. The experiment was distributed online worldwide. Participants filled in a questionnaire regarding their linguistic background and then were asked to answer, "Does it rhyme?" according to their intuition. Response time was limited to 2 sec to avoid a "calculated" decision. Rhyme considered pairs whose both words have stress-matched identical final syllable's vowel and coda (-VC). 144 participants (58Heb1, 54Heb2, 32Heb0) completed the entire experiment. Answers were recorded and analyzed.

**Table 1: Examples of the Stimuli** (*Stressed syllables in **Bold***)

| | Baseline | Transposed-CRs | Highlighted-VM | non-Stress-matched |
|---|---|---|---|---|
| **NR** | *ba**xaʃ**-ba**las**,* | *ra**vac**-ca**var*** | *xo**lem**-xa**lam*** | ***ge**reʃ-ge**reʃ*** |
| **R** | *ʃi**men**-co**fen*** | *la**taʃ**-ta**laʃ*** | *sa**xak**-su**xak*** | - |

The main results show that all groups scored well in CVC pairs (Fig.1). However, in CVCVC pairs, although trends may resemble, an internal examination revealed significant differences. While non-Hebrew speakers show linear processing pronounced by the sub-syllabic division of the Baseline pairs, native-Hebrew speakers showed a ceiling effect in non-rhyming pairs and a high error rate in rhyming pairs (Fig2.) Interestingly, native-Hebrew speakers showed variations in processing modes used with different stimulus groups. L2-Hebrew speakers' results were between non- and native- speakers, suggesting L2 influence concerning processing. Further analyses are yet to be conducted, including correlations with the speakers' linguistic backgrounds.

**Figure 1. NR vs. R in CVC and CVCVC by Language Groups**

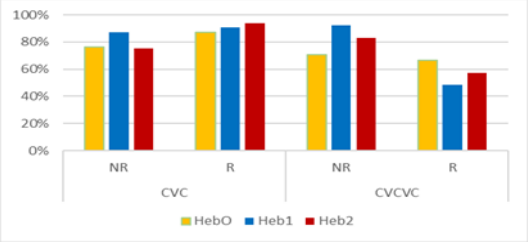


**Table 2: Subgroups by NR vs. R by Language Groups**

| | NR | | | R | | |
|---|---|---|---|---|---|---|
| | **Heb1** | **Heb2** | **Heb0** | **Heb1** | **Heb2** | **Heb0** |
| **Baseline** | 93% | 84% | 78% | 68% | 71% | 71% |
| **Transposed-CRs** | 93% | 86% | 77% | 44% | 61% | 61% |
| **Highlighted-VM** | 95% | 84% | 64% | 31% | 45% | 64% |
| **Non-Stress-Matched** | 79% | 59% | 23% | - | - | - |

The results in CVC suggest that speakers can recognize rhymes and discriminate phonemes. Errors in the NR are explained by phoneme or rhyme perception. The shift to CVCVC impacts greatly the Heb1 with poor results in R, suggesting a certain influence of template morphology and non-linear processing, especially in pairs with passive templates. This suggests that the syntactic-lexical information expressed in the template, but not the meaning encompassed in the Root, plays a great role in the speakers' lexicon, raising the possibility of inhibition of linear processing. The low results in the transposed-CR stimuli for all language groups suggest sensitivity to co-occurrence phoneme restrictions, however, to a different extent.

To sum up, this research supports the functional existence of template morphology and non-linear processing among Hebrew speakers and that some of the linguistics knowledge (not meaning) associated with the Root and Template develops while learning Hebrew. The differences within native Hebrew speakers (not shown here) may suggest that linear and non-linear processing modes compete. Further analyses of these data would shed more light on the subject.

**Reference**

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