How grammatical gender agreement modulates the missing V2 illusion in Hebrew

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Background: Doubly Center Embedded (DCE) sentences (1) albeit fully grammatical, are nigh-impossible to process, and are shown to evoke deteriorated acceptability scores [1,2]. In contrast, "Missing V2 (MV2) sentences" such as (2), which are derived from (1) by omitting the second verb from the structure, creating what ought to be perceived as ungrammaticality, are routinely perceived to be at least as grammatical as (1) [3,4].

(1) The result that the scientist that the virus infected found was published.
(2) *The result that the scientist that the virus infected was published.

Resource-based accounts for these facts [3] emphasize syntactic complexity, which results in the forgetting of the prediction made for the second verb. In contrast, interference-based accounts [5] emphasize the similarity between the different NP subjects, and the consequent misretrieval of first subject at the ultimate verb in MV2 sentences, as what creates the illusion.

The current study investigates whether similarity between retrieval candidates – and as a result, available retrieval cues – affects the strength of the MV2 illusion in Hebrew. After corroborating the existence of the MV2 illusion in Hebrew in a previous study (Experiment 1, [6]), we conducted three follow-up experiments, employing the grammatical gender feature. All experiments used a 1-7 acceptability rating task in which sentences were displayed fully for a limited time.

Methods and results: In **Experiment 2** (N=48, 30 sets, Table 1), we examined the possibility of a confound in the classic MV2 illusion experimental design, namely, that in the condition where the main verb is omitted (MV1), the string can be perceived as a grammatical and semantically plausible complex NP, possibly leading to elevated ratings. We manipulated STRUCTURE and EMBEDDING, to make the ungrammaticality of MV1 sentences more explicit. The results revealed that participants did not, in fact, treat these conditions as grammatical NPs (Figure 1).

Experiments 3 (N=48, 24 sets) & **4** (N=47, 24 sets) we tested whether similarity between the NPs in the sentence modulates the MV2 illusion, manipulating STRUCTURE (MV2 vs. complete DCE) and AGREEMENT (same vs. distinct, lowering the overall similarity between integration candidates compared to Experiment 1). **In Experiment 3**, the second NP and verb were morphologically feminine, such that the ultimate verb in MV2 conditions was masculine (Table 2). We found no significant difference between the two variations of MV2 conditions, suggesting a similar rate of occurrence of the illusion (Figure 2). In **Experiment 4**, the main NP subject and verb were morphologically marked as feminine (Table 3). We found significantly higher acceptability ratings in the lower-similarity, distinct MV2 conditions than the all-masculine conditions (Figure 3).

Discussion: Resource-based accounts seem to have difficulty explaining our results, as according to them, the prediction for the second verb is indeed forgotten - but this tendency is not assumed to be influenced by agreement features. However, the results align with the predictions made by interference-based accounts; under the cue based retrieval framework, the retrieval rate of a given element from memory is modulated by corresponding retrieval cues; in experiment 4, the illusion is strengthened comparatively to experiment 3 thanks to the added morphologically marked [+FEM] cue/feature that the ultimate verb and first subject share, boosting NP1's activation relatively to the masculine NP1 in experiment 3 - consequently revealing how a markedness asymmetry effect during retrieval in Hebrew helps modulate the MV2 illusion.

Table 1: Example from an experimental set (experiment 2)

DCE	(*ʃamati ʃe*) *ha-mim͡tsa ʃe-ha-mad'an ʃe-ha-virus hidbik gila pursam.* (I heard that) the result that the scientist that the virus infected discovered was published.
MV1	(*ʃamati ʃe*) *ha-mim͡tsa ʃe-ha-mad'an ʃe-ha-virus hidbik gila _____.* (I heard that) the result that the scientist that the virus infected discovered _____.
MV2	(*ʃamati ʃe*) *ha-mim͡tsa ʃe-ha-mad'an ʃe-ha-virus hidbik _____ pursam.* (I heard that) the result that the scientist that the virus infected _____ was published.

Table 2: Example from an experimental set (experiment 3)

DCE	*ha-mim͡tsa ʃe-ha-mad'an/mad'anit ʃe-ha-virus hidbik gila/gilta pursam.* The result that the scientist.M/F that the virus infected discovered.M/F was published.
MV2	*ha-mim͡tsa ʃe-ha-mad'an/mad'anit ʃe-ha-virus hidbik _____ pursam.* The result that the scientist.M/F that the virus infected _____ was published..

Table 3: Example from an experimental set (experiment 4)

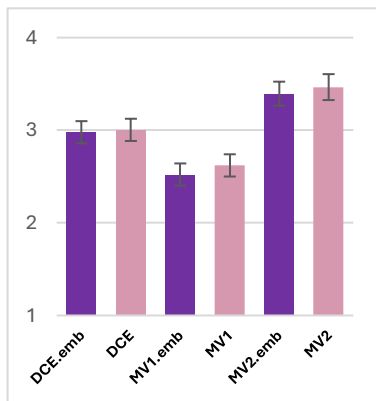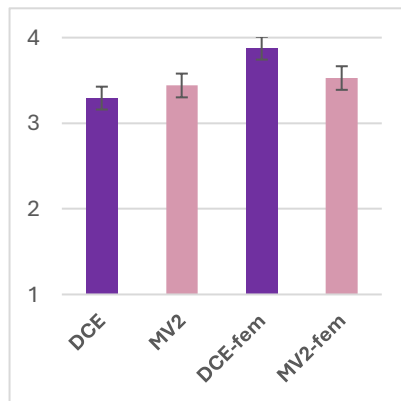| DCE	*ha-mim͡tsa/ ha-to͡tsa'a ʃe-ha-mad'an ʃe-ha-virus hidbik gila pursam/pursema* the result.M/F that the scientist that the virus infected discovered was published.M/F
MV2	*ha-mim͡tsa/ ha-to͡tsa'a ʃe-ha-mad'an ʃe-ha-virus hidbik _____ pursam/pursema* the result.M/F. that the scientist that the virus infected ____ was published.M/F

Figure 1: Experiment 2

Figure 2: Experiment 3

Figure 3: Experiment 4
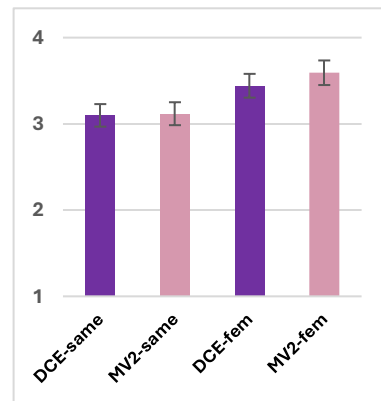
References: [1] Chomsky, Noam, et al. *"Introduction to the formal analysis of natural languages."* 1963 (1963): 269-321.**[2] Bever, Thomas G.** *"The ascent of the specious, or there'sa lot we don't know about mirrors." Explaining linguistic phenomena(1974): 173-200.* **[3] Gibson & Thomas** (1999) Memory Limitations and Structural Forgetting. LCP. [4] **Vasishth, Suckow, Lewis & Kern** (2010) Short-term forgetting in sentence comprehension, LCP **[5] Häussler & Bader** (2015) An interference account of the missing-VP effect. Front. Psychol. [6] Kishinevky & Meltzer-Asscher HSP (2023) "The status of the missing V2 illusion in Hebrew" poster presentation.