Different Types and Qualities of Fillers: Maintenance and Retrieval

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Online wh-filler-gap dependency (WhFGD) resolution can be characterized as the maintenance of a wh-filler ([1,2]), an active search for the gap ([3]) and the retrieval of the wh-filler at the gap site ([4,5]). We uncover the mechanisms working behind both maintenance and retrieval components by testing what aspects of a filler are retrieved in different WhFGD constructions: "reactivated" WhFGD formation (1a) (the filler that is linked to the verb once, and is reactivated later) and "active" WhFGD formation (1b). (1a) involves a WhFGD and coordination structure where the wh-filler is linked to the verb in the first conjunct, but the wh-phrase must be "reactivated" at the coordinating connective *and* ("Reactivated Filler") ([1]). (1b) involves a wh-word directly linked to the main verb (“Active Filler”). Specifically, maintained information is easier to retrieve but unmaintained information is more difficult to retrieve when the gap is recognized ([1]). If some information from the filler is maintained and is less susceptible to decay, we expect the information to be retrieved easily. On the other hand, if some information from the filler is more susceptible to decay, we expect retrieval of decayed information to be harder. When the wh-phrase is reactivated, some of the filler's information can be reactivated (e.g., the category information) ([1]). Assuming that the filler is "released" from memory once linked to the gap ([1]), the wh-filler in (1a) might be released from memory and decayed and thus, when retrieved at the gap position, only the coarse-grained information could be retrieved (features that match the retrieval cues of the verb). If actively maintained, detailed information from the wh-filler can be retained and easier to retrieve ([1,2]). Thus, the detailed content of the whole wh-NP in (1b) could be retrieved, such as the grammatical information. We use agreement attraction as a probe to understand what information is retrieved at the gap position. Taken together, the wh-phrase in (1b) would be more likely than (1a) to trigger an illusion of grammaticality, such that the grammatically inaccessible yet feature-matching noun erroneously agrees with the verb (the agreement attraction effect) in the ungrammatical sentences [6,7,8,9].

Experiment 1: A self-paced reading experiment (SPR) (n=80) tested sentences like (1). The SPR study (Log-transformed) showed a significant interaction **local noun** x **grammaticality** at the region immediately following the verb and a three way interaction between **local noun** x **structure** x **grammaticality** where ungrammatical verbs following plural local nouns were read significantly faster than singular local nouns in both constructions with the significantly larger effect in (1b) than in (1a). The larger attraction effect in the active filler conditions suggests that the actively maintained information of the wh-fillers is indeed easier to retrieve at the gap position.

Experiment 2: We further compared wh-NP vs. Definite-NP to examine if agreement attraction occurs even when the presence of a filler-gap dependency is not signaled. A SPR experiment (n=80) tested sentences like (2). There was a significant interaction **local noun** x **grammaticality** at the verb region, yet a subset analysis revealed the effect only for the wh-filler NP, not in Definite-NP. This suggests that the reader can recognize the movement structure only when the gap in the subject position of the second conjunct is recognized. This suggests that in non-wh constructions, the filler should not be maintained, and information about the filler will be harder to retrieve, leading to less agreement attraction.

Taken together, information associated with the active wh-filler is well-preserved compared to the reactivated wh-filler that is linked to the gap once, released from memory and later reactivated, leading to the retrieval of detailed information and stronger agreement attraction. We argue for the position that posits both maintenance and retrieval playing a role in the processing of whFGD. If we posit that both retrieval and maintenance plays a role in the reactivated wh-filler cases, release from maintenance leads to the retrieval of the decayed information, where the detailed information could be lost at the second gap, leading to weaker retrieval. Conversely, active wh-filler gap dependencies involve an active filler where the wh-filler needs to be kept until the matrix verb to resolve the dependency. If the parser could avoid releasing information from maintenance and is less susceptible to decay, we expect stronger retrieval where more fine-grained information can be retrieved.

Example: Sample stimuli of Experiment 1 and 2.
(1) a. Which key to the **cells/cell** __can be used for front doors and unsurprisingly __is/are used for two doors?
b. Which key to the **cells/cell** [RC that can be used for front doors] unsurprisingly __is/are used for two doors?
: The number of the **local noun** in the wh-NP (Plural: *cells*vs. Singular: *cell*), the **grammaticality** of the second verb (Grammatical: *is* vs. Ungrammatical: *are*) and the **structure** (Coordination vs. RC) were manipulated in a 2x2x2 factorial design, where the head noun of the wh-NP was always singular.

(2) a. Which key to the **cells/cell** __can be used for front doors and unsurprisingly __is/are used for two doors?
b. The key to the **cells/cell** __can be used for front doors and unsurprisingly __is/are used for two doors?
: The number of the **local noun** in the wh-NP (Plural: *cells* vs. Singular: *cell*), the **grammaticality** of the second verb (Grammatical: *is* vs. Ungrammatical: *are*) and the **Type of the displaced element** (wh-Filler vs. The Definite-NP) manipulated in a 2x2x2 factorial design.

Structure	Local Noun x Grammaticality	Subset Analysis (Local Noun x Grammaticality)	Local Noun x Grammaticality x Structure
Reactivated Filler Vs. Active Filler	β=-0.04, **t=-3.12**	β=-0.01, t=-0.59 (Reactivated Filler); yet at the verb spillover region 2: β=-0.06, **t=-3.32** β=-0.07, **t=-3.82** (Active Filler)	β=-0.06, **t=-2.40**

Table 1: Statistics of Experiment 1 (verb spillover region 1

Structure	Local Noun x Grammaticality	Subset Analysis (Local Noun x Grammaticality)	Grammaticality
Wh-NP Definite NP	β=-0.04, **t=-2.49**	β=-0.06, **t=2.53** (Wh-NP) β=-0.05, t=-1.15 (Definite NP)	β=-0.02, **t=-2.16**

Table 2: Statistics of Experiment 2 (verb region)

References: [1] Wagers & Phillips 2014. QJEP. [2] Warren & Gibson 2002. Cognition. [3] Stowe 1986. LCN. [4] Lewis & Vasishth 2005. Cognitive Science. [5] Van Dyke & Mc Elree 2006. JML. [6] Wagers, Lau, & Phillips 2009. JML. [7] Tanner, Nicol, & Brehm 2014. JML. [78 Lago, Shalom, Lau, & Phillips 2015. JML. [9] Parker & Phillips. 2017. JML.