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Language production in a shared task: Cumulative Semantic Interference from self- and other-produced context words☆

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ABSTRACT

This study assessed the effects of semantic context in the form of self-produced and other-produced words on subsequent language production. Pairs of participants performed a joint picture naming task, taking turns while naming a continuous series of pictures. In the single-speaker version of this paradigm, naming latencies have been found to increase for successive presentations of exemplars from the same category, a phenomenon known as Cumulative Semantic Interference (CSI). As expected, the joint-naming task showed a within-speaker CSI effect, such that naming latencies increased as a function of the number of category exemplars named previously by the participant (self-produced items). Crucially, we also observed an across-speaker CSI effect, such that naming latencies slowed as a function of the number of category members named by the participant's task partner (other-produced items). The magnitude of the across-speaker CSI effect did not vary as a function of whether or not the listening participant could see the pictures their partner was naming. The observation of across-speaker CSI suggests that the effect originates at the conceptual level of the language system, as proposed by Belke's (2013) Conceptual Accumulation account. Whereas self-produced and other-produced words both resulted in a CSI effect on naming latencies, post-experiment free recall rates were higher for self-produced than other-produced items. Together, these results suggest that both speaking and listening result in implicit learning at the conceptual level of the language system but that these effects are independent of explicit learning as indicated by item recall.

Conversations typically center on a specific topic. As a result, speakers may repeatedly refer to different exemplars of a semantic category. For example, a conversation about a past vacation may include mentions of multiple types of vehicles, buildings or geographical features. Even though the repeated retrieval of same-category exemplars is likely to occur regularly during normal language use, it appears to be quite challenging from a procedural point of view. When speakers are asked to name a series of pictures containing multiple items from the same category, naming latencies slow down for each additional item that belongs to the same category as a previously named item, a phenomenon known as the Cumulative Semantic Interference effect (CSI; Brown, 1981; Howard, Nickels, Coltheart, & Cole-Virtue, 2006; see also Alario & del Prado Martín, 2010; Navarrete, Mahon, & Caramazza, 2010; Oppenheim, Dell, & Schwartz, 2010).

In the typical continuous CSI paradigm (Howard et al., 2006), participants name a series of pictures containing five items each from 24 different semantic categories plus a number of fillers. In this paradigm the CSI effect manifests as a 20 to 30 ms increase in naming latency for each additional member of a category that is named (Alario & del Prado Martín, 2010; Belke, 2013; Howard et al., 2006; Oppenheim et al., 2010; Navarrete et al., 2010; see also Rose & Abdel Rahman, 2016). Thus far the CSI effect has been found to emerge only in the context of word production tasks requiring name retrieval. When speakers name written words instead of pictures, the effect is absent (Navarrete et al., 2010; Belke, 2013). Moreover, when pictures are semantically categorized (e.g., as natural or man-made), repeated access to a semantic category results in cumulative *facilitation*, such that categorization times decrease each time an additional exemplar from the same category is presented (Belke, 2013; Riley, McMahon, & de Zubicaray, 2015).

The CSI effect demonstrates that language production is sensitive to linguistic context in the form of previously produced words. More specifically, the effect suggests that name retrieval for the purpose of language production leads to implicit learning within the language system, which affects subsequent retrieval operations (Belke, 2013; Howard et al., 2006; Oppenheim et al., 2010). Models developed to account for the CSI effect differ with regards to the level of language processing at which this retrieval-based implicit learning is proposed to

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occur. In the influential models by Howard et al. (2006) and Oppenheim et al. (2010), CSI emerges as a result of incremental changes in the connections between the conceptual and lexical levels of representation. In both models, target processing during picture naming results in conceptual activation of the target as well as semantically related items (Collins & Loftus, 1975; Levelt, Roelofs, & Meyer, 1999; McClelland & Rogers, 2003). In the model by Howard et al., naming a picture strengthens the conceptual-to-lexical connections for that item. As a result, previously named category coordinates compete more strongly for selection with a subsequent target name than non-previously named category coordinates, slowing down lexical selection. In the Oppenheim et al. model, naming a picture does not only strengthen the conceptual-to-lexical connections for that item but also weakens these connections for its (co-activated) category coordinates, which results in slower naming of these items on subsequent trials.

In contrast, Belke's (2013) Conceptual Accumulation account does not identify the CSI effect as originating in the conceptual-to-lexical connections. Instead, the account proposes that the incremental changes that give rise to the CSI effect are contained within the conceptual level of representation. The Conceptual Accumulation account is based on the Featural and Unitary Semantic Space (FUSS) model of lexical-semantic memory (Vigliocco, Vinson, Lewis, & Garret, 2004). The FUSS model consists of two distinct layers: a layer of conceptual features (e.g., has wings, can swim) and a layer of amodal, unitary "lexico-semantic representations" (e.g., duck; see Vigliocco et al., p. 433). The conceptual features are connected to the lexico-semantic representations in a many-to-one fashion, such that semantically similar concepts (such as items from the same category) share more features than semantically dissimilar concepts. The lexico-semantic representations are akin to the lexical concepts implemented in non-decompositional models of lexical-semantic encoding, such as WEAVER++ (Levelt et al., 1999; Roelofs, 1998; Roelofs, 2014). Belke (2013) drew upon the FUSS model and the WEAVER++ model in order to establish a working model of lexical-semantic encoding, including a fully specified level of conceptual representations and a mechanism for lexical selection. This model includes a layer of conceptual features, a layer of lexical concepts and a layer of lexical representations (Belke, 2013). Picture naming results in the co-activation of the target lexical concept and the lexical concepts of related items by virtue of their shared conceptual features (consistent with the characterization of shared activation in Oppenheim et al., 2010). According to the Conceptual Accumulation account (Belke, 2013), repeated access to a semantic category strengthens the connections between the lexical concepts that are being retrieved and their shared conceptual features, which results in the durable accumulation of activation within the conceptual level (Kroll & Stewart, 1994; Belke, Meyer, & Damian, 2005). For instance, when naming a duck, the links between its conceptual features and its lexical concept are strengthened. As a result, the lexical concept of duck and its associated lexical representation will be co-activated more easily when another item from the same semantic category is retrieved shortly afterwards. The same holds for other exemplars from the same category, so retrieving several items from the same semantic category results in high levels of activation within that category's section of the conceptual network. The observed effect of this increased conceptual activation varies depending on the task. During semantic categorization, increased activation in the appropriate section of the conceptual network will facilitate categorical (e.g., natural or man-made) responses, resulting in a cumulative facilitation effect as observed by Belke (2013) and Riley et al. (2015). By contrast, item naming requires the selection of a single entry at the level of lexical representations. Increased conceptual activation among a target and its category coordinates spreads down to the lexical level where it results in increased competition, causing the observed cumulative slowing of naming latencies.

Thus far, most semantic context effects including CSI have been studied within the domain of either comprehension or production, assessing the effects of prior production on subsequent production, or of prior comprehension on subsequent comprehension. However, a sizeable portion of everyday language use occurs in the context of conversation, which involves interlocutors rapidly alternating between the production and comprehension of utterances (Pickering & Garrod, 2004). Consequently, the linguistic context preceding many spontaneous utterances comprises a mixture of self-produced and other-produced (i.e. perceived) speech. A small number of studies have investigated the possible transfer of CSI between comprehension and production tasks using printed word naming as the comprehension task. This approach has yielded mixed results. Vitkovitch and colleagues found that word naming interfered with subsequent naming of semantically related pictures (Vitkovitch & Cooper, 2012; Vitkovitch, Cooper-Pye, & Ali, 2010). In contrast, Navarrete and colleagues found that picture naming interfered with subsequent printed word naming, but not vice versa (Navarrete et al., 2010; Navarrete, Mahon, Lorenzoni, & Peressotti, 2016; see also Belke, 2013). Studying the role of the presence of a partner in a shared naming task, Kuhlen and Abdel Rahman (subm.) presented evidence demonstrating that CSI can operate across speakers. Specifically, they showed that the CSI effect was greater when task partners alternated naming category exemplars compared to when a single participant named every other exemplar in a category and the remaining exemplars were shown but not named. These findings suggest that listening to a partner naming objects affects language production in a similar fashion as naming the objects oneself. However, in Kuhlen's and Abdel Rahmans' study, all pictures were shown to both participants, who may have covertly named all objects. Thus, there are remaining questions regarding when and how implicit learning in the language system may occur across domains.

Although neither the models by Howard et al. (2006) or Oppenheim et al. (2010) nor the Conceptual Accumulation account (Belke, 2013) were developed to consider potential cross-domain CSI effects of prior comprehension on subsequent production, predictions can be derived from each model. According to the models by Howard et al. (2006) and Oppenheim et al. (2010), the CSI effect originates in the semantic-to-lexical connections. Specifically, the effect is modelled to arise as a consequence of the process of selecting a specific lexical representation among all the lexical entries co-activated by shared conceptual activation. Thus, the incremental changes in the production system that give rise to the CSI effect are a direct consequence of the challenges posed by the conceptual-to-lexical mapping requirement of language production. As a result, the effect is considered to arise only following a process of conceptual-to-lexical mapping, as is required for picture naming but not passive listening (Oppenheim et al., 2010). In contrast, the Conceptual Accumulation account proposes that the CSI effect results from changes in the connections within the conceptual level. As it is typically assumed that conceptual representations are shared between the production and comprehension systems (Levelt et al., 1999; Roelofs, 1992), this account predicts that prior comprehension and production of a picture name will result in a similar buildup of activation among the conceptual features and lexical concepts of the appropriate sections of the conceptual network, as also suggested by the cumulative facilitation observed for semantic categorization tasks (Belke, 2013). As a result, both comprehension and production are predicted to result in CSI during production of subsequent exemplars from the same category.

The current study investigated the effects of self- and other-produced semantic context words on subsequent picture naming using a joint (two-person) version of the continuous CSI paradigm. Pairs of participants named a series of pictures while seated side by side, alternating naming and listening turns within each category (see Fig. 1). We assessed the cumulative effects of self-produced context words (within-speaker interference) and other-produced context words (across-speaker interference). According to the model of CSI by Howard et al. (2006) and Oppenheim et al. (2010), other-produced exemplars do not involve semantic-to-lexical mapping for selection and therefore should not interfere with a speaker's subsequent naming of items from the same category,