Following the conversation: Topic shifts elicit switch costs in naturalistic discourse

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How do listeners follow a conversation through frequent changes in topic? Shifting within discourse structures (e.g., to a new event) can affect the efficiency and difficulty of language production (e.g., increased planning time, disfluency) and comprehension (e.g., increased reading time) (Gernsbacher, 1997; Lorch et al., 1985; Swerts, 1998). This suggests that moving between structural elements involves some time- or resource-consuming cognitive processes. Some theories suggest that these processes are domain-general (Gernsbacher, 1997), but they have not yet been precisely defined. Therefore, we aim to understand how the demands of topic shifting during conversation might be served by cognitive processes that support complex, coordinated behavior across domains. We focus on set shifting, which invovles the activation of task-relevant sets and inhibition of task-irrelevant sets to guide responses to upcoming stimuli. In conversation, topics are posited to be hierarchical sets of relevant information, similar to rule sets, action plans, and categories studied in relation to non-linguistic set shifting (Hobbs, 1985). We hypothesize that encountering a topic shift engages the same kind of set shifting mechanisms as in non-linguistic tasks, which leads to shift costs. In addition to studying neurotypical conversation, we also study individuals with traumatic brain injury (TBI). Given topic-related difficulties in conversation alongside deficits in set shifting (Coelho et al., 2002; Hill et al., 2018), the TBI population serves as a useful test case for what happens to conversation abilities in the face of non-linguistic deficits. We expect larger topic shifting costs for TBI patients given this profile. As a first step to addressing these hypotheses, our preliminary study tests whether topic shifts affect language processing and assesses which linguistic processes are sensitive to shifts.

We analyzed 15-minute samples of unstructured English conversation from healthy adults and adolescents as well as TBI patients from TBIBank (N=20 per group) (Coelho et al., 2002; Elbourn et al., 2019). Each recorded sample was transcribed and coded according to conventions for Computerized Language ANalysis (CLAN) (Coelho et al., 2002; MacWhinney, 1992, 2018). We divided each sample into topics by identifying topic initiating (e.g., discontinuity – “anyway…”) and ending (e.g., wrap-up statements) markers (Leaman & Edmonds, 2020). We categorized participant utterances within a turn as new topic introductions, responses to investigator-initiated topics, responses to continuing topics, off-topic, or backchannels. We analyzed the participant responses directly following investigator-initiated new topics (“shift”) and participant responses to continuing topics (“no shift”), focusing on measures of productivity (words per utterance), syntactic complexity (verbs per utterance), semantic complexity (idea density), fluency (filled or unfilled pauses per syllable) and revision (repetitions, rephrasings per utterance). We tested the effect of topic status (shift, no shift) across groups (healthy, TBI), controlling for age and education.

When the topic shifted, participants’ responses had fewer verbs ($\beta = -0.30$, $p = 0.003$), words ($\beta = -0.19$, $p < 0.001$) and repetitions and rephrasings ($\beta = -0.40$, $p < 0.001$) per utterance relative to when there was no shift. Despite being shorter, less syntactically complex, and requiring less revision, responses had a higher frequency of filled pauses ($\beta = 0.37$, $p < 0.001$), reflecting planning difficulty. There were no differences between healthy and TBI groups (Figure 1). In the TBI group, higher TBI severity was associated with fewer verbs, words, and filled pauses per utterance (p’s < 0.05). This may make group differences more difficult to detect (i.e., mild TBI might not induce large topic-shift effects, but more severe TBI might). Given deficits in producing on-topic responses in this sample (Coelho et al., 2002), the lack of group effects in following topic shifts may suggest different mechanisms for discourse structure comprehension and production.

The combination of increased planning difficulty and shorter, less complex utterances demonstrates a pattern of costs in response to encountering a topic shift. This result is consistent with shift costs to response efficiency in non-linguistic tasks (Monsell, 2003). These results also provide groundwork to examine whether behavioral shift costs are associated with the same neural mechanisms involved in non-linguistic shift costs (McKewen et al., 2020). Ultimately, this work can provide insight into how humans contend with complex, dynamic linguistic information.

Figure

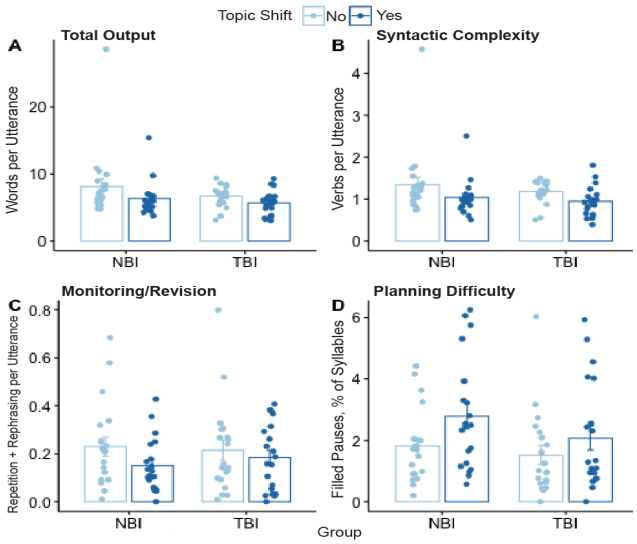

Figure 1. Words per utterance (A), verbs per utterance (B), repetitions plus rephrasing per utterance (C) and filled pauses as a percent of syllables (D) measured for utterances in turns following a topic shift initiated by the investigator (yes shift) versus in turns remaining on a current topic (no shift) for each group. NBI=non-brain injured healthy adults; TBI=patients with traumatic brain injury. Bars represent mean values. Error bars represent standard error. Individual points represent individual subjects' data.

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