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Context updating during sentence comprehension: The effect of aboutness topic

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ABSTRACT

To communicate efficiently, speakers typically link their utterances to the discourse environment and adapt their utterances to the listener's discourse representation. Information structure describes how linguistic information is packaged within a discourse to optimize information transfer. The present study investigates the nature and time course of context integration (i.e., aboutness topic vs. neutral context) on the comprehension of German declarative sentences with either subject-before-object (SO) or object-before-subject (OS) word order using offline comprehensibility judgments and online event-related potentials (ERPs). Comprehensibility judgments revealed that the topic context selectively facilitated comprehension of stories containing OS (i.e., non-canonical) sentences. In the ERPs, the topic context effect was reflected in a less pronounced late positivity at the sentence-initial object. In line with the Syntax-Discourse Model, we argue that these context-induced effects are attributable to reduced processing costs for updating the current discourse model. The results support recent approaches of neurocognitive models of discourse processing.

1. Introduction

In everyday communication, we typically link our utterances to the discourse environment of the interlocutor in order to efficiently achieve our communicative objectives. Besides other factors, the speaker considers background information and feedback of the listener. Linguistic (e.g., information structure, stress) as well as extra-linguistic features (e.g., gestures, eye-gaze) are dynamically used to clarify what the utterance is about and ultimately guide the cooperative listener to the communicative intention of the speaker. It has been proposed that the listener structurally represents all relevant aspects of information (e.g., participants, events) delivered via language and perception within a mental model in which further incoming discourse information is integrated (e.g., Cowles, 2003; Johnson-Laird, 1980).

Information structure (cf. *information packaging*) is concerned with how information is packaged within a discourse to optimize information transfer (Chafe, 1976). In this regard the idea of efficient communication was defined by Clark and Haviland (1977) as: "The speaker tries, to the best of his ability, to make the structure of his utterances congruent with his knowledge of the listener's mental world" (p. 4). Ordering of information at the sentence-level is thought to be influenced by information structural concepts, such as topic-comment, given-new, or focus-background (e.g., Büring, 2007; Halliday, 1967; Krifka, 2008; Lenerz, 1977). However, these information structural concepts lack a uniform definition and depend on the field of research and respective theoretical framework. For the purposes of our study, we use the following definitions: The TOPIC of a sentence is typically understood as the information that the speaker intends to increase the listener's knowledge (Gundel, 1985). Hence, topic is defined as what the sentence is about; COMMENT is what is said about the topic (Gundel, 1988; Reinhart, 1981; see Section 1.4 for a more detailed definition of topic). GIVEN INFORMATION constitutes information the speaker expects to be already known by the listener (e.g., Haviland & Clark, 1974); that is, information explicitly mentioned in the previous discourse or information that can be entailed by the context (e.g., Chafe, 1976; Schwarzschild, 1999). In contrast, NEW INFORMATION describes information the speaker expects to introduce to the listener in the sense of "newly activating" it in the listener's consciousness (Chafe, 1976). FOCUS refers to the new/informative or contrastive part of an utterance. Whereas, BACKGROUND denotes less relevant information (e.g., Vallduvi & Engdahl, 1996). Experimentally, focus is often induced as contrastive focus, where the newness of the information is emphasized by its contrast to

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previously focused information (e.g., Jacobs, 1988). A special type of contrastive focus is corrective focus, where an assumption is explicitly corrected. These information structural concepts are thought to be realized by distinct prosodic (i.e., accenting) and/or syntactic (e.g., sentence position) phenomena (see e.g., Chafe, 1976; Féry & Krifka, 2008; Skopeteas & Fanselow, 2010; Steedman, 2000).

In the present study, we aim to investigate how a previously presented context, in particular a context introducing all characters of a fictitious scene with emphasis on one of them as the *aboutness topic*, affects the comprehension of a subsequent canonical (subject-before-object) or non-canonical (object-before-subject) declarative sentence in German. Before we present the two experiments (Experiment 1: offline comprehensibility judgments, Experiment 2: Event-related potentials (ERPs) during online sentence processing) we first give a brief overview of German word order, the underlying neurocognitive mechanisms of sentence and discourse processing, as well as previous findings concerning information structural concepts and sentence processing relevant to understanding the motivation and predictions of the present study design.

1.1. Word order in German

Word order in German is relatively flexible. Reordering of constituents within a sentence can be used to highlight the communicatively relevant part of the utterance. German has a strong subject-first preference (e.g., Gorrell, 2000), but reordering of constituents within a sentence is possible, because syntactic roles can still be assigned correctly due to morphological case marking at the respective determiner or determiner and noun. Case marking of the subject by nominative (NOM) and object by accusative (ACC) case is ambiguous for feminine, neuter, and plural noun phrases, but unambiguous for masculine singular noun phrases. The example sentences (1a, b) illustrate case marking for masculine subjects and objects in German with the finite, transitive verb in the second sentence position. (1a) depicts a canonical declarative sentence with typical subject-before-object (SO) word order. (1b) depicts a non-canonical sentence with object-before-subject (OS) word order.

(1a) Der Uhu malt den Igel.
[the$_{[NOM]}$ owl$_{[NOM]}$]$_{subject}$ [paints]$_{verb}$ [the$_{[ACC]}$ hedgehog$_{[ACC]}$]$_{object}$.
'*The owl paints the hedgehog.*'

(1b) Den Igel malt der Uhu.
[the$_{[ACC]}$ hedgehog$_{[ACC]}$]$_{object}$ [paints]$_{verb}$ [the$_{[NOM]}$ owl$_{[NOM]}$]$_{subject}$.
'*The hedgehog, the owl paints.*'

Sentences (1a) and (1b) differ in the manner of information packaging (SO vs. OS order). However, both sentences induce the same propositional representation. In isolation, the OS order (cf. example 1b) is assumed to be harder to process compared to SO (e.g., Schlesewsky, Fanselow, Kliegl, & Krems, 2000), but interestingly, context information (e.g., a preceding sentence or question) has been found to ease the processing of OS sentences (e.g., Meng, Bader, & Bayer, 1999) (see Section 1.3 for the effect of information structure on the processing of word order variation in German).

Thus, in German main clauses, subjects as well as objects can appear in the sentence-initial position before the finite verb (so called *prefield*). Similarly, if the verb is not in the second but in final sentence position, either the subject or object can follow the complementizer (so called *middlefield*)[1] (see e.g., Pittner & Berman, 2008, for an overview of the topological classification of German sentences). As commonly assumed, the OS order is derived from the basic order of SO; but, depending on the theoretical framework, different movement operations are assumed to underlie word order variation in the German pre- and middlefield (e.g., Haider & Rosengren, 1998; Lenerz, 2000; Müller, 1999; see Diedrichsen, 2008, for an alternative, movement-independent account of the German sentence topology). Bornkessel-Schlesewsky and colleagues substantiate the distinction of word order variation in the pre- and middlefield from the neuroanatomical perspective (Bornkessel-Schlesewsky, Grewe, & Schlesewsky, 2012): Whereas numerous studies reported an increased activation for OS opposed to SO within the left inferior frontal gyrus (lIFG), aboutness-based sequencing (prefield) activated anterior subregions of the lIFG, but prominence-based sequencing (middlefield) activated superior subregions of the lIFG (for a review, see Bornkessel-Schlesewsky & Schlesewsky, 2012).

Several semantic and discourse-related factors have been proposed to affect the linear order of sentential constituents (e.g., concerning the thematic role, actors should precede non-actors; for a review about incremental argument interpretation during processing of transitive sentences, see Bornkessel-Schlesewsky & Schlesewsky, 2009a). Numerous studies proposed factors that crucially affect word order in the German middlefield (e.g., Bornkessel-Schlesewsky & Schlesewsky, 2009b; Choi, 1996; Lenerz, 1977; Müller, 1999; Siewierska, 1993). For the purposes of our study, the most important are findings concerning the German prefield: As attested in written corpora, SO and OS sentences predominately occur with an accusative object (Bader & Häussler, 2010). SO sentences tend to contain active verbs, whereas OS order frequently occurs with verbs lacking an agent argument (i.e., passivized ditransitive and unaccusative verbs). Further, OS is more frequent if the object is animate and the subject inanimate (Bader & Häussler, 2010), which fits the previously proposed animacy-based ordering preferences of sentential constituents (Tomlin, 1986). In the present study, we aimed to exclude confounding effects of the listed linearization preferences in order to examine the effect of aboutness topic in the prefield of SO and OS sentences. Thus, we held the following factors constant: case of the object (accusative), verb type (active, transitive), thematic roles of subject (agent) and object (patient) as well as their animacy status (animate). Persisting differences between OS and SO word order we further considered by focusing on comparing contextual effects *within* the respective word order.

1.2. Neurocognitive models of sentence and discourse processing

Different neurocognitive models of sentence comprehension have been formulated to better understand the nature and time course of online sentence processing (e.g., the *extended Augmented Dependency Model* (*eADM*) by Bornkessel & Schlesewsky, 2006a; the *auditory sentence processing model* by Friederici, 2002). Basically, the architecture of these models is assumed to be hierarchically organized in phases that specify the steps of incremental sentence comprehension and correspond with functionally separable networks at the brain level. These processing steps have been linked to specific language-related ERP components. After the prosodic analysis, indexed by a negativity peaking around 100 ms (N100), the model of Friederici (2002) proposes three phases: Phase 1 is an initial phrase-structure-building process of the sentential constituents. In phase 2, morphosyntactic as well as semantic information is integrated (i.e., thematic role assignment), indexed for instance by the left anterior negativity (LAN) and the negativity around 400 ms (N400). Phase 3 is characterized by reanalysis and repair mechanisms as indexed by the positivity around 600 ms (P600) (Friederici, 2002). Similarly, the eADM proposes three phases

[1] The deviation of SO order in the German middlefield is termed *scrambling* (i.e., OS: ..., dass den Igel der Uhu malt. (..., [that]$_{[complementizer]}$ [the$_{[ACC]}$ hedgehog$_{[ACC]}$]$_{[object]}$ [the$_{[NOM]}$ owl$_{[NOM]}$]$_{[subject]}$ [paints]$_{[verb]}$.)).