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Communicative efficiency in language production: Optional case-marking in Japanese

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ABSTRACT

Grammatical encoding is one of the earliest stages in linguistic encoding. One broadly accepted view holds that grammatical encoding is primarily or exclusively affected by production ease, rather than communicative considerations. This contrasts with proposals that speakers' preferences during grammatical encoding reflect a trade-off between production ease and communicative goals. In three recall sentence production experiments, we investigate Japanese speakers' production of optional object case-marking. Case-marking conveys information about the intended sentence interpretation, facilitating comprehension, but it also increases production effort. We find that Japanese speakers are more likely to produce case-marking when the properties of the sentence would otherwise bias comprehenders against the intended interpretation. Experiment 1 observes this effect based on the animacy of the object. Experiments 2 and 3 find the same effect based on the plausibility of the intended grammatical function assignment, even when animacy is held constant. We discuss how speakers might achieve this type of trade-off. In addition to evidencing the role of communicative pressures during even the earliest stages of language production, the results inform linguistic typology, where similar patterns have been observed in obligatory (differential) case-marking.

Introduction

One of the central questions in research on language production is the extent to which language production is affected by our communicative goals. While there is little doubt that those goals affect *what* message we wish to convey, it is less clear to what extent communicative goals affect *how* we convey that message. Specifically, the question still under debate is to what extent the linguistic encoding processes underlying language production are affected by speakers' goal to successfully convey their message.

On the one hand, it is certainly true that some aspects of the planning and decision processes involved in linguistic encoding are affected by the goal to be understood. The fact that we tend to write and speak in a language intelligible to our intended audience illustrates this quite clearly. Similarly, when conversing on a windy mountain peak, we tend to speak louder than when conversing in a quiet room. On the other hand, it is less clear to what extent communicative goals affect linguistic encoding beyond broad adjustments to language choice and speech styles. These encoding processes are generally assumed to involve several largely automatic stages (Bock & Levelt, 1994; Levelt, 1989).

Here, we focus on one of the earliest stages in linguistic encoding, *grammatical encoding*. In particular, we focus on the assembly of a sentence's morpho-syntactic structure. Grammatical encoding is of particular interest because, according to the predominant view in our field, it is primarily or exclusively affected by *production ease*

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(e.g., Arnold, 2008; Arnold, Wasow, Asudeh, & Alrenga, 2004; Ferreira, 2008; Ferreira & Dell, 2000; Lam & Watson, 2010; MacDonald, 2013). Indeed, there is now broad agreement that pressures inherent to linguistic encoding affect speakers' preferences during grammatical encoding. This includes, for example, pressures stemming from the problem of retrieving lexical information in time for its use and the linear assembly of these pieces of information (e.g., Bock & Levelt, 1994; MacDonald, 2013).

The perhaps best documented consequence of these pressures is a preference for grammatical structures that "permit quickly selected lemmas to be mentioned as soon as possible" (Ferreira & Dell, 2000, 299). Such availability-based production has received broad cross-linguistic support (reviewed in Jaeger & Norcliffe, 2009). For example, speakers prefer to order constituents referring to easily retrievable referents earlier in the sentence (e.g., Bock & Irwin, 1980; Bock & Warren, 1985; Branigan, Pickering, & Tanaka, 2008; Bresnan, Cueni, Nikitina, & Baayen, 2007; Ferreira & Yoshita, 2003; Prat-Sala, 2000; Tanaka, Branigan, McLean, & Pickering, 2011). Similarly, speakers are more likely to produce optional elements, such as disfluencies (Clark & Fox Tree, 2002; Shriberg & Stolcke, 1996) and optional function words (e.g., English complementizer *that*, Ferreira & Dell, 2000; Jaeger, 2010b; Jaeger & Wasow, 2006; Roland, Elman, & Ferreira, 2006), and to lengthen words (Fox Tree & Clark, 1997) when upcoming material is not yet available to continue production.

The goal of the present paper is to investigate whether communicative goals can affect grammatical encoding. In particular, we ask whether a preference for robust information transmission affects grammatical encoding, beyond effects that can be attributed to production ease. A number of mutually related accounts share the idea that language or language production are affected by the goal to convey information robustly or even efficiently (e.g., Aylett & Turk, 2004; Genzel & Charniak, 2002; Gibson et al., 2013; Jaeger, 2006, 2010b; Levy & Jaeger, 2007; Lindblom, 1990a; Piantadosi, Tily, & Gibson, 2011, 2012; Zipf, 1949). One aspect that has so far been lacking is a clearer link between these approaches and more traditional psycholinguistic accounts. In an attempt to reduce this gap, we pursue our question within a framework outlined by the second author and collaborators (e.g., Buz & Jaeger, 2012; Jaeger, 2010a, 2013). The central prediction investigated below is, however, shared by most of the accounts just cited. We refer to this perspective as the *ideal speaker* framework, to highlight its relation to ideal observers (Geisler, 2003; Jacobs, 2002), which have proven insightful in understanding language comprehension (Clayards, Tanenhaus, Aslin, & Jacobs, 2008; Kleinschmidt & Jaeger, 2015; Levy, 2011; Levy, Bicknell, Slattery, & Rayner, 2009; Norris & McQueen, 2008). Since the perspective provided by the ideal speaker and similar frameworks is crucial for the experiments we present below, we briefly summarize the core assumptions of these approaches. We focus on the conceptual components and leave the formalization to another place.

The first assumption we are making is that the linguistic signal the speaker intends to produce will be at least partially degraded by noise. This noise originates from multiple sources, including noise during the planning and execution of linguistic encoding and articulation, noise in the environment, and noise in the perceptual system of the listener. This makes comprehension a problem of inference under uncertainty or inference over noisy input. Optimal solutions to this problem take advantage of predictions based on the statistics of the input. Indeed, the computational properties of actual language comprehension closely resemble those expected under such a model. This includes evidence from brain potentials (DeLong, Urbach, & Kutas, 2005; Dikker & Pylkkänen, 2013; Kutas & Hillyard, 1984; Van Berkum, Brown, Zwitserlood, Kooijman, & Hagoort, 2005; for recent reviews, see Kuperberg, 2013; Van Petten & Luka, 2012), eye-movements during reading (Boston, Hale, Kliegl, Patil, & Vasishth, 2008; Demberg & Keller, 2008; Staub & Clifton, 2006), spoken sentence comprehension (Altmann & Kamide, 1999; Kamide, Altmann, & Haywood, 2003; Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995), and self-paced reading time data (Garnsey, Pearlmutter, Myers, & Lotocky, 1997; MacDonald, Pearlmutter, & Seidenberg, 1994; Smith & Levy, 2013; Trueswell, Tanenhaus, & Kello, 1993). All these works point to a language comprehension system that heavily relies on prediction of the signal (see also Farmer, Brown, & Tanenhaus, 2013; Kuperberg, 2013; MacDonald, 2013; Pickering & Garrod, 2013).

Most relevant to the current purpose, these studies provide evidence that language comprehension becomes more difficult (e.g., less accurate and slower) when the observed signal is unexpected given prior expectations. Comprehenders are also more likely to misunderstand or misremember sentences when they have unexpected meanings (Ferreira, 2003). These costs of unexpected form and meaning are the price to pay for a comprehension system that, on average, infers intended messages robustly despite noisy input.

It is important to understand the consequences of noisy input. In the presence of noise, a rational comprehender should maintain uncertainty over the input. For example, comprehenders should not base their expectations about upcoming structure with absolute certainty on what they *believe* to have comprehended so far. This seems to be indeed observed, both during spoken and written word recognition (e.g., "right-context" effects, Dahan, 2010; also Levy et al., 2009) as well as syntactic processing (cf., "local coherence", Kukona, Fang, Aicher, Chen, & Magnuson, 2011; Kukona, Cho, Magnuson, & Tabor, 2014; Tabor, Galantucci, & Richardson, 2004). This view also correctly predicts that sentences can be misunderstood if their properties bias comprehenders towards an unintended parse, even if the grammatical properties of the sentence rule out the unintended interpretation (Christianson, Hollingworth, Halliwell, & Ferreira, 2001; Ferreira, 2003; Ferreira & Patson, 2007).

The second assumption of the ideal speaker framework is that linguistic signals differ in the degree to which they support an intended inference. In other words, some linguistic signals will make it more likely that a comprehender will infer the intended message, compared to other linguistic signals. More specifically, though, we assume