

Sublexical, lexical and supralexical information in speaking:  
Current insights and directions in language production research

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## Abstract

We summarize research on language production that is based on presentations given at the Fourth International Workshop on Language Production (Münster, Germany, September 2007). The individual contributions to this special issue cover language production in its full width: from processes and information types involved in formulation (Ziegler, Cholin & Levelt; Damian & Dumay), via lexical competition and selection (Abdel Rahman & Melinger; Mahon & Caramazza) to the interplay between conceptualization and gesturing (Kita).

## Sublexical, lexical and conceptual information in speaking

This special issue of *Language and Cognitive Processes* is dedicated to language production research. It comprises a subset of papers presented at the *Fourth International Workshop on Language Production*, organised by the Psycholinguistic Research Group of the Department of Psychology at the University of Münster, Germany. It is the fourth in a series of special issues resulting from similar workshops (see Alario, Costa, Ferreira & Pickering, 2006; Goldrick, Costa & Schiller, 2008; Schiller, Ferreira & Alario, 2007). The fact that four special issues have emerged within four years time corroborates what has been evident for the last two decades: Language production is a fast-growing field of research, with researchers dedicated to experimentally fleshing out the models on the market, and to methodological innovation of the field. Clearly, the initiative taken by the organisers of the first workshop in Marseille in 2004 was timely, the turnover has been fast, and important findings have emerged.

All papers in this volume profited from the productive atmosphere at the workshop meeting, as well as at those before it. The workshop series typically brings together researchers from various disciplines within psycholinguistics, from phonetics, and from other related disciplines. Equipped and trained with their specific methodologies, techniques and research questions, participants contribute their specific perspectives and know-how such that an interdisciplinary and integrative approach to language production research emerges. The contributions to this special issue exemplify this approach. A wide range of topics is covered in this special issue, including the non-linear structure of the phonetic code, the position-nonspecific activation of segments during phonological encoding, and the existence of a mental syllabary, all at the “lower end” of language production. Further themes concern the interaction between gestures and conceptualization and - a classic and hotly debated issue - lexical selection in language production. All contributions provide interesting overviews of the issues under debate and offer novel empirical and theoretical insights. Below, we briefly introduce each contribution, keeping to their order of appearance in the special issue, which is organised from articulation to conceptualization.

The contribution by Ziegler (2009) offers interesting insights from patients with apraxia into the organization of the phonetic code. Ziegler states that current models of language production by Dell and colleagues (Dell, 1986; Dell, Schwartz, Martin, Saffran & Gagnon, 1997) or by Levelt and colleagues (Levelt, Roelofs, & Meyer, 1999) are, at best, underspecified with respect to the processes involved in the construction of phonetic or

articulatory plans. The minimal assumption shared by both models is that discrete sound units are generated, which are then processed further at phonetic and articulatory stages. Ziegler argues that these conceptions miss out on relevant properties of language production, such as coarticulatory phenomena or the generation of prosody. These shortcomings have been taken up by, for instance, Goldrick and Blumstein (2006) and Goldstein, Pouplier, Chen, Saltzman and Byrd (2007). Goldrick and Blumstein proposed that phonological planning processes and the articulatory-phonetic stage interact. Goldstein et al. suggest that invariant motor patterns (gestural scores) are stored at an abstract word-form level, such that a linear order of phonetic representations is lost. Ziegler's proposal shares with Goldstein et al. the assumption of a non-linear setup of articulatory gestures, and adds a probabilistic component to this. He tests this proposal against word-production-accuracy data from patients with apraxia of speech. The success of this approach supports his claim that phonetic plans cannot be conceived as linearly ordered sequences of discrete phonetic units. Clearly, this paper adds to the limited evidence available for the nature of late processes involved in speech production.

The role of the syllable as a unit in speech production is as interesting as it is elusive. Cholin and Levelt (2009) address the existence and the locus of syllabic units in speaking. Syllables are taken to mediate between phonological and phonetic representations, at least those syllables that are stored, because they occur frequently in the language (Levelt et al., 1999). A number of authors (e.g., Aichert & Ziegler, 2004; Carreiras & Perea, 2004; Levelt & Wheeldon, 1994) have argued for stored syllabic representations based on syllable-frequency effects in speaking (such that common syllables are produced more quickly/accurately than infrequent syllables). Levelt et al. proposed that syllables are accessed at the interface of phonological and phonetic encoding, but Cholin and Levelt argue that unequivocal evidence for this assumption is lacking. They therefore set out to test whether stored syllables are indeed relevant at a post-lexical level in speech planning. For this, they combine the implicit priming paradigm, with its proven sensitivity to post-lexical effects, with the manipulation of syllable frequency. Frequency effects, as Cholin and Levelt argue, can only come about when syllables are stored as units, because only stored units are assumed to exhibit frequency effects. So, the logic is that if frequency effects and the effects of post-lexical form similarity interact in implicit priming, this is evidence for a post-lexical locus of stored syllables. Cholin and Levelt indeed report an interaction and conclude that this implies that syllable processing is located at a post-lexical, pre-articulatory processing level. Given that languages differ with respect to the role of syllables as units of speech, it would be interesting to see whether the results for Dutch, as reported here (and elsewhere), generalise to other languages.

The paper by Damian and Dumay (2009) addresses a level above phonological-phonetic encoding. They investigate the activation of phonemes during multiple-word productions. It is well known that phonologically related distractors facilitate word production (Damian & Dumay, 2007; Meyer & Schriefers, 1991). A shared onset can, however, result in inhibition in certain paradigms (O'Seaghdha, Dell, Peterson & Juliano, 1992). To further explore the discrepancy in results, Damian and used adjective-noun phrases (e.g., *green goblin*) to realize phoneme repetition. Would shared segments result in facilitation, as the picture-word interference data suggest, or in inhibition, as, for example, the paired-syllable paradigm would suggest? In an earlier study, Damian and Dumay (2007) had shown that word-initial overlap in adjective-noun phrases resulted in a facilitated production. In their current work, they replicate and extend this result, by comparing within- and between-utterance repetition effects. Shared segments produced facilitation within an utterance, but inhibition between utterances. Given that the position in the word of the repeated segment did not affect the strength of facilitation, Damian and Dumay suggest that the effect arises at a phoneme processing level, at which phonemes are activated in a position-unspecific manner.

Moving beyond sound-based representations in speech production, the contribution by Abdel Rahman and Melinger (2009a) addresses a core issue of lexical processing in language production: lexical competition and selection. Spoken word production research, particularly within the chronometric tradition, has focused mainly on interference effects with categorically related stimuli (e.g., the increased latency for naming the picture of a CAT when DOG is present as distractor word). This interference effect was taken to indicate competition between coactivated lexical entries (e.g., <CAT> and <DOG>). However, recent studies have challenged this view, either by reporting the absence of interference effects or, even more convincing, the presence of facilitatory effects. For instance, Mahon, Costa, Peterson, Vargas & Caramazza (2007) observed facilitation when distractor words are from a different grammatical class. They suggested that facilitation results from lexical priming whereas interference is a consequence of a bottleneck in a post-lexical articulatory buffer. In contrast, Kuipers, La Heij and Costa (2006) assume that a response-congruency checking mechanism, located at the preverbal level, is at play. It generates both facilitatory and inhibitory effects, depending on the task. In their contribution to this volume, Abdel Rahman and Melinger (2009a) propose a lexical-network account for semantic context effects that rests on two assumptions. (1) The context provided by the distractor modulates the generation of a lexical competitor cohort. The target response enters into a competition with the cohort competitors and must exceed the cohort-competitors' summed activation in order to be selected for

production. (2) Whether facilitation or interference will be observed depends on a trade-off between semantic/conceptual priming, and lexical competition. Interference will be observed only when both a competitor cohort is sufficiently activated and conceptual facilitation is slight or absent; facilitation is observed in all other cases. Abdel Rahman and Melinger sketch how their proposal could be applied to picture-word interference and semantic blocking paradigms (noting, however, that the precise computational dynamics are still to be determined) In their rejoinder, Mahon and Caramazza (2009) criticize elements of this proposal. Abdel Rahman and Melinger (2009b) respond to this rejoinder and clarify their arguments. These debates - concerning the nature and locus of lexical selection in speaking, the diverse interpretations of available results and their model implementation - are still far from resolved. The presentation of different viewpoints within one issue certainly is a valuable contribution to this ongoing discussion.

The final contribution to this special issue by Kita (2009) moves beyond lexical processing to investigate what determines the frequency of representational gestures during speaking. Kita proposes that representational gestures (including iconic gestures, such as the hands moving in a circle when describing a circle, and deictic gestures, for example, indicating a location) are coordinated with message generation. Kita (2000) has shown that more difficult speaking tasks result in more gestures. This finding suggests that representational gestures facilitate conceptualization for speaking. In his contribution to this special issue, he tests his prediction that the frequency of representational gestures depends on the presence of competing representations in the conceptualisation process. His participants had to describe diagrams that differed only in the way certain lines were highlighted. In the easy diagrams, the highlighted lines were congruent with the target conceptualisation. In the hard condition, they elicited a competing conceptualisation. His participants indeed showed more representational gestures when the diagrams elicited competing conceptualisations than when not. These data add to a growing body of evidence on the way speech and speech-accompanying gestures are interleaved at various stages of (conceptualisation for) speech production.

The research as presented here in this special issue nicely illustrates how the field of language production research has expanded over the last two decades. This holds with respect to the overall number of studies, but, more importantly, to the range of phenomena and processes that have been subjected to rigorous experimental scrutiny. We are certain that the research presented in this issue will advance language production research and, more generally, research into the cognitive processes underlying language.

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