

SECOND LANGUAGE ACQUISITION AND EXEMPLAR THEORY

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ABSTRACT

In the last decade or so, there has been a revived interest in studying the phonetic aspects of second language (L2) acquisition. In spite of increased research efforts, the representation and processing of L2 speech is still unclear. The aim of this session is to discuss the construction of a mental lexicon for L2 and the use of L1-specific speech processing strategies by L2 learners. A central issue is the extent to which words are stored as episodic traces or as abstract representations. This introductory paper summarises the two target papers by Cutler & Weber and Goldinger, and the views of the four commentators: Bradlow, Davidson, Maye and McLennan.

Keywords: Second-language speech perception, models of speech perception, lexical access.

1. INTRODUCTION

The perceptual reorganisation that occurs as a result of the learning of a second language (L2) has been a central issue in speech perception research in recent years. This process is of particular interest because it can throw light on ongoing plasticity in speech perception, long past the initial stage of attunement to the sounds of the native language (e.g., [12-13]). Many phonetic studies have investigated the identification and discrimination of L2 sound contrasts that are absent or have a different phonological status in the learner's native language (e.g., for review see [6]). Theories of L2 phonetic perception have explained difficulties in L2 phonetic perception in terms of the relations between the phonological inventories of the two languages [1,7,9]. How lexical processing in L2 may differ from lexical processing in the native language has also attracted much interest [e.g., 18,19,22], and the relation between phonetic and lexical processing in an L2 is the focus of many of the papers in this session.

The starting point of this session was the question of whether episodic or abstract

representations of lexical items could best accommodate phenomena seen in lexical and phonetic processing by L2 learners. However, as pointed out by McLennan, it is clear that the debate has moved on from this initial premise. In the two target papers by Cutler & Weber and Goldinger, the focus is on models that *combine* the contributions of episodic and abstract representations.

Why is second-language perception of particular interest in terms of this debate? In their paper, Cutler & Weber suggest that this is because the situation in which language learning occurs is very different for first and second languages. Adults learning a second language have at their disposal knowledge of language structures, of orthography and well-developed semantic and pragmatic knowledge that they can bring to bear to their interpretation of the L2, while evidence suggests that infants develop their perceptual categories primarily as a result of exposure and statistical learning [e.g., 10,14]. Cutler & Weber therefore suggest that L2 acquisition by adults provides a good test-bed for models of lexical processing because this additional language knowledge is clearly 'abstract'.

In the following sections, I will summarise the main arguments presented by Cutler & Weber and Goldinger, and the commentaries provided by Bradlow and Davidson on Cutler & Weber's paper, and by Maye, McLennan and Bradlow on Goldinger's paper.

2. Cutler & Weber paper

Cutler & Weber's paper focuses on the mismatch between phonetic and lexical processing. Even though in perceptual tasks, certain difficult non-native contrasts (e.g., /r/-/l/ for Japanese learners of English) are identified and discriminated barely above chance level, Cutler & Weber found that lexical items containing these sounds were not perceived as interchangeable homophones. They argue that 'abstract' knowledge such as knowledge of spelling, of meaning, of the existence of a particular phonetic contrast in the L2, can help

differentiate lexical items that, at the phonetic level, may be heard as variants of the same word. In recent studies [22], Cutler & Weber have used an eyetracking technique to examine the mapping of phonetic information to lexical entries in the L2. Participants are presented with a set of pictures including competitor and distractor items and have to click on the picture representing the word they hear. In this task, when instructed to click on 'rocket', for example, Japanese learners of English often looked at the picture of a 'locker' but the reverse effect happened less frequently. There were therefore asymmetries in the phonetic-to-lexical mapping that could not be explained on the basis of phonetic processing alone. Such asymmetries in phonetic-to-lexical mapping can be influenced by 'abstract' knowledge such as orthography, as shown by Escudero et al. [5]. These effects can also be modulated by previous exposure to words (word frequency of occurrence effects) thus showing the impact of episodic information. Cutler and Weber conclude that 'both abstract knowledge about the linguistic system and episodic experience from L2 input affect the construction of lexical representations of new lexical items'.

In her response to Cutler & Weber, Bradlow agrees that there is a phonetic-to-lexical 'scaling up' problem: studies that have evaluated L2 speech perception at different levels of processing have found discrepancies between patterns of phonetic perception and performance on word and sentence intelligibility tests [e.g., 15]. However, Bradlow argues that Cutler & Weber's suggestion that meta-knowledge available to L2 learners can disambiguate phonetic cues is only a partial solution. Whereas Cutler & Weber presented cases of L2 learners showing differentiation at the lexical processing level despite poor differentiation at the phonetic level, Bradlow presents the reverse case, where L2 speakers show native-like performance in terms of low-level phonetic processing but degraded performance for more complex tasks. For example, highly-competent non-native listeners show native-like perception of words and sentences in good listening conditions but a much greater fall in performance than native listeners when the same items are presented in noise [15]. This could be due to poorer phoneme level perception but in a recent study, native and non-native listeners showed parallel effects of increasing noise [2]. The picture is therefore

complex and there appears to be a 'strong effect of the accumulation of native-to-target language mismatches across levels of processing'. Bradlow presents another case of phonetic-to-lexical asymmetry with an experiment on Mandarin lexical tone discrimination by Mandarin and American English listeners. Both sets of listeners showed similar performance when tones were presented in monosyllables, showing evidence of good phonetic encoding of the stimuli. However, when the stimuli were presented within a tri-syllabic frame, non-native listeners relied more on acoustic similarity between stimuli in their judgements whereas native listeners could rely on their abstract knowledge of the categories to reinforce episodic-level encoding. Non-native listeners therefore performed worse due to their lack of abstract knowledge. Bradlow concludes that 'second language speech learning is all about gaining the knowledge structures and attentional weights that support a sufficiently native-like set of associations across the episodic-to-abstract hierarchy'.

In her commentary, Davidson argues that the use of the term 'abstract' by Cutler & Weber, in the sense of language knowledge that is brought to bear on the decoding of speech, has different connotations to the typical use of the term in the debate over episodic and abstract models. There, the term abstract refers to 'representations that are independent of the acoustic properties of specific instances that the perceiver has been exposed to'. Davidson cites further evidence to support the findings of Escudero et al. of an influence of orthography on lexical representations [21]. However she argues that orthography might not be sufficient to induce L2 learners to construct new phonetic categories and suggests that non-native listeners have a greater incentive to learn a new category when exposed to minimal pairs of lexical items containing the difficult sounds. Support for this view comes from a phonetic training study in which training with lexical items induced greater improvement in the discrimination of a non-native contrast than exposure to either unimodal or bimodal distributions of tokens without lexical evidence provided to the listeners [8]. Another training study controlling for phonotactic information also showed that the use of minimal pairs led to greater learning [3]. Davidson argues therefore that lexical evidence gives listeners more

'incentive to distinguish between acoustic differences that they might otherwise collapse'.

3. Goldinger paper

Goldinger argues that neither purely abstractionist nor purely episodic models can satisfactorily account for all perceptual phenomena. For example, abstractionist models cannot account for the fact that perception is affected by surface details such as speaker idiosyncrasies. Purely episodic models, which assume the storage of traces of spoken words, require vast memory resources and do not exploit the internal structure of these traces. Goldinger summarises the challenge succinctly by stating that 'data and logic suggest that perception entails abstract analysis, but data and common experience suggest that perception also creates individuated memories'. He describes a generic example of perceptual learning that shows the influence of both abstract and episodic knowledge sources. In a lexical decision task, listeners are exposed to items containing a consistent mispronunciation of a particular segment by a speaker (e.g., /s/ pronounced as /ʃ/). Participants soon adapt to this idiosyncrasy but only for the particular speaker producing this error. Abstract knowledge helps participants to correct the input but knowledge about the speaker extracted from episodic traces also mean that the correction is not generalised to other speakers of the language. This example very much reflects the problems that native listeners may have when listening to an L2 speaker who is substituting L1 categories for difficult non-native phonetic categories.

In this paper, Goldinger describes a 'complementary learning systems' (CLS) approach [17] to word perception, which solves the 'plasticity-stability' dilemma. This approach involves a combination of hippocampal and cortical networks: the hippocampus is fast learning and memorises specific events whereas the more stable cortical network is able to learn statistical regularities and therefore construct more abstract representations. The systems are interdependent so traces in the hippocampus are not purely episodic but include input streams from the cortex. Also, more abstract cortical representations can be shaped by episodic information (e.g., extensive exposure to regional accent). To evaluate the CLS model, Goldinger conducted a simulation of an

experiment of voice-specific priming that is reported in detail in the paper.

Maye picks up Goldinger's point that 'each stored exemplar is actually a product of perceptual input combined with prior knowledge'. Exemplar representations are therefore biased to some extent by the attentional weights that listeners give to different acoustic/phonetic aspects of the item and these weights will be affected by knowledge of L1 phonology, especially in weaker bilinguals. This view ties in with Cutler & Weber's view of a greater weight of abstract knowledge for L2 than for L1 processing. Maye, like Bradlow, refers to the particular issue of L2 processing in difficult situations (e.g., speech in noise). She argues that L2 learners may rely more on episodic representations in ideal conditions, and that the relative breakdown in processing when listening in noise may be due to the greater reliance in such conditions on more abstract information from phonological memory, which will be biased towards L1 phonology. Maye stresses that further understanding of L2 processing may come from elucidating causes of individual differences in L1 biases in L2 processing. In first language acquisition, Tsao et al. found a relation between age of attunement to L1-specific cues and later language development [20]. Maye suggests that there might also be longer-term individual differences in degree of attentional weighting, with some people having weaker cortical filters leading to encoding more episodic representations whilst others being more efficient 'processors'. Those listeners with greater access to veridical exemplars may acquire a more native-like accent in an L2. Both Maye and Bradlow point out that a problem that remains to be explained by models is that phonology appears to affect even low-level auditory perception. As a result, the filtering process that results from abstract phonological knowledge reduces L2-relevant phonetic information being available for episodic encoding.

In his response to Goldinger, M^cLennan focuses on the circumstances that might affect the balance between the contributions of abstract and episodic information in lexical access and on the challenges that models such as CLS need to address. The first challenge is to determine whether one type of representation is dominant. M^cLennan argues that abstract representations are more likely to be the default representation (if there is one) as 'few studies offer support for the involvement of

episodic representations during the immediate online perception of spoken language'. Theoretical frameworks also need to account for fine-grained temporal effects. Recent work by McLennan et al. supports the view that more abstract representations affect processing early and episodic presentations later but McLennan stresses that further investigations are needed for a more complete picture of time-course effects [16]. A further challenge for hybrid models such as CLS is to explain how the weight of abstract and episodic representations in processing might vary across populations. Finally, a specific challenge for the model is to provide a more detailed account of the way in which abstract cortical representations can be affected by extensive episodic exposure.

4. Conclusion

In summary, this session is particularly exciting because it represents a new phase in the development of models of lexical access, with the debate having clearly moved on to frameworks that accommodate the contribution of both abstract and episodic types of representation. Further, it is increasingly recognised that the relative weight of abstract and episodic representations is likely to vary across populations (e.g., L1 vs L2 speakers, children vs adults) as suggested by Cutler & Weber and others, and even possibly across individuals, as suggested by Maye. The issue of mapping between phonetic information and lexical access in L2 learners provides an ideal test-bed for evaluating the weights of episodic and abstract information in lexical processing. This should ensure that investigations into L2 perception remain a focus of attention in the next decade.

5. REFERENCES

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