Competition Model

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The competition model (CM) made its debut in Bates and MacWhinney (1982) as a mechanistic explanation of language acquisition. Since its inception, there have been a large number of studies using this framework to account for not only language acquisition but also language comprehension, language production, and impaired language processes. Because the CM distinguishes itself from many other psycholinguistic theories in its emphasis on language variation, the model has been applied to the analyses of many typologically different languages, including Chinese, English, German, Hungarian, Italian, Russian, and Spanish, to name a few. Like other scientific hypotheses, the CM has continued to evolve in order to increase its explanatory power (Bates & MacWhinney, 1987, 1989; MacWhinney, in press). Here we first provide an overview of the model and then discuss its application to the study of second language acquisition.

Cues and Cue Competition

A basic construct of the CM is the *cue*, an information source that allows the language user to successfully link linguistic form with meaning. Cues vary in their *type* (morphological, syntactic, prosodic, semantic, and pragmatic), *availability* (how often they are present), and *reliability* (how often they lead to the correct interpretation). Each cue is associated with *cue validity*, the joint product of availability and reliability, and crucially, the same cue may have different validity in different languages. For example, in English, word order (e.g., a noun before a verb) is a strong and reliable cue for identifying agent versus patient roles in an event (high validity), whereas word order is less predictive of who does what to whom in Chinese (low validity). Different languages may also utilize different cues to achieve the same goals; for example, in Hungarian, the suffix *-t* of a noun is a highly valid cue for predicting that the previous noun is a direct object, the recipient of an action, whereas in Chinese, the freestanding morpheme *ba* preceding a noun reliably indicates the direct object of a sentence.

A second key construct of the CM is that cues compete or converge in an utterance (hence the term "competition model"). That is, cues can point in the same or different directions for meaning interpretation in a sentence. In cases of competition, cue validity serves as the primary determinant of *cue strength*, that is, the weights that speakers assign to different cues during real-time sentence processing. For example, in the sentence *the elephant kicks the rock*, both word order and the animacy cue converge to point to *elephant* (preverbal, animate) as the agent of the action. By contrast, in the sentence *the rock kicks the elephant*, word order and animacy point to different nouns as the agent (word order favors *rock*, whereas animacy favors *elephant*). This divergence creates a competition between cues. In English, word order wins the competition (native English speakers reliably interpret *rock* as the agent), whereas, in Chinese, animacy wins the competition (native Chinese speakers generally interpret *elephant* as the agent; see Li, Bates, & MacWhinney, 1993). In general, sentence interpretation is facilitated when cues converge (shown in faster response time (RT) and higher accuracy) but impeded when cues compete (shown in slower RT and lower accuracy).

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Most of the empirical work within the CM framework relies on a sentence interpretation paradigm in which different sentences are created with orthogonalized cue combinations. For example, given a simple sentence of two nouns and a verb, there are three possible word order combinations: NNV, NVN, and VNN. Combined with the animacy cue (animate, A, vs. inanimate, I), these orders yield nine different conditions: AAV, AIV, IAV, AVA, AVI, IVA, VAA, VAI, and VIA. Systematic variation of the various cue types has allowed researchers to examine how cues collaborate and compete during offline and online sentence comprehension, how the same cues hold different validities in different languages, and how learners of a new language need to acquire new cue validities in sentence processing.

Second Language Learning

An important prediction of the CM with regard to learning is that cue availability and cue reliability may have different developmental trajectories. Cue availability is defined as the proportion of times a cue is available over the times it is needed, whereas cue reliability is the proportion of times the cue leads to the right answer over the total number of occurrences of the cue. In both L1 and L2 learning, cue strength is initially determined primarily by availability, because beginning learners are only familiar with cues that are relatively frequent in the language input (Taraban & Palacios, 1993; Matessa & Anderson, 2000). As learning progresses, cue reliability becomes more important than cue availability. To approach native proficiency, the learner needs to rely entirely on cue reliability for cue strength. In some cases, one can further distinguish the effects of *conflict reliability*: when two highly reliable cues compete, the one that wins the competition has a higher conflict reliability. For example, Dutch L1 learners only begin to realize after age 8 that the more reliable cue of pronoun case should dominate over the more frequent, but usually reliable, cue of word order (McDonald, 1986).

A second important prediction of the CM is that learners need to acquire new cue-strength patterns when learning a second language, and that depending on the language-specific properties of the speaker's L1 and L2, this acquisition may show different patterns. In a study of Chinese–English bilinguals who acquired their L2 at different ages, Liu, Bates, and Li (1992) examined how bilinguals assign thematic roles during online interpretation of sentences in L1 and L2. They identified four logical possible outcomes for adult bilingual learners: (a) differentiation: a clear separation in the use of cues for each language; (b) forward transfer: use of L1 cue patterns in the interpretation of L2 sentences; (c) backward transfer: use of L2 cue patterns in the interpretation of L1 sentences; and (d) amalgamation: an integrated pattern of cue use for both L1 and L2. The results of Liu et al.'s study were that late bilinguals showed clear forward transfer, in that they used their L1 cue strengths to interpret L2 sentences (e.g., relying more on semantics than word order in cases of cue competition). By contrast, early bilinguals, depending on the age of L2 acquisition, showed either differentiation or backward transfer. More importantly, there was no monotonic effect of age of acquisition, in that the teenager group exhibited stronger differentiation patterns than the early childhood group.

A given cue type may play different roles in different languages, leading to important implications for second language learning. Tokowicz and MacWhinney (2005) examined the ERP (event-related potential) responses of English–Spanish bilinguals who read sentences containing subject–verb agreement (similar in L1 and L2), determiner number agreement (different in L1 and L2), and determiner gender agreement (unique in L2). In both English and Spanish, subject–verb agreement is required, whereas determiner number marking differs in the two languages: English marks number only on the noun (*houses*) while Spanish marks number on both the noun and the determiner (*la casa* vs. *las casas*). ERP patterns showed that the English–Spanish bilinguals were highly sensitive to grammatical violations

in L2 for constructions that are formed similarly in L1 and L2 (subject–verb agreement), but were not sensitive to those that are formed differently in the two languages (determiner number agreement). In a similar ERP study, Chen, Shu, Liu, Zhao, and Li (2007) found that Chinese–English bilinguals showed high levels of accuracy in detecting subject–verb agreement violations in the L2 even though their L1 does not use any morphological agreement; however, their ERP response patterns differed from those of native English speakers in that no LAN (left anterior negativity) or P600 waveforms were present. These findings suggest that the particular cue strength from L1 may be ingrained in the late bilingual speakers, and that the L1 cue patterns negatively impact their processing in the L2, sometimes reflected not in behavioral but only in neural responses.

The Unified Competition Model

The CM is a model that highlights the dynamic interaction of cues in response to the processing environment, in which the statistical characteristics of the input and the learning characteristics of the language user jointly determine the processing outcome. The model has stimulated much crosslinguistic research, in both the monolingual and the bilingual context. Interestingly, while the model emphasizes that cue validities are highly variable and are different for users of different languages, it stresses that the underlying learning mechanisms are similar across L1 and L2 language acquisition. MacWhinney (in press) recently articulated this idea in the unified competition model (UCM), according to which the following constructs should be invoked to account for similarities and differences between L1 and L2 acquisition: maps, chunking, transfer, resonance, connectivity, codes, and mental models. Each of these constructs relies on additional tracks and traditions of research. For example, the account of lexical and grammatical maps is based on the DevLex model, a type of self-organizing neural network model of learning (Li, Farkas, & MacWhinney, 2004; Li, Zhao, & MacWhinney, 2007), as well as evidence from this work regarding the processes of entrenchment in neural networks (Zhao & Li, 2007, 2010). The account of chunking derives from the theory of item-based learning (MacWhinney, 1975, 1982). The model of connectivity derives from recent work in neuroimaging (Zhao et al., 2008; Friederici, 2009). The role assigned to codes and social participation comes from studies of social bases of learning (Firth & Wagner, 1998), and the role of mental models comes from recent work in cognitive linguistics (MacWhinney, 2008).

The UCM addresses the issue of similarities between L1 and L2 acquisition by emphasizing the extent to which second language learners must deal with the risk factors of entrenchment, negative transfer, social isolation, parasitism (dependency of L2 on L1), and mismatched connectivity (incorrect connections between processing areas). These risk factors arise from neurological, cognitive, and social configurations that change with development. The model also suggests how learners can make use of preventive factors to overcome these risks. The preventive factors include positive transfer, social participation or immersion, active thinking in the L2, reorganization through resonance (interactive activation from corresponding sites), and internalization (using L2 for inner speech). In order to achieve successful L2 acquisition using the same core mechanisms available to the child, the older learner must maximize the use of each of these protective factors. How these risk factors unfold in development and how learners can actively use the protective factors remain as the major challenges to theories of second language acquisition.

SEE ALSO: Bilingualism and Cognition; Bilingual and Multilingual Education: Overview; Connectionism; Emergentism; Second Language Speech Perception and the Brain; Sentence and Discourse Processing in Second Language Comprehension

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Suggested Readings

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