INPUT, LEARNER POPULATIONS, AND THE HUMAN LANGUAGE-MAKING CAPACITY

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1 Searching for the limits of the Language-making Capacity

1.1 The LMC and the LAD

Research in generative approaches to language acquisition has demonstrated that the human Language-making Capacity (LMC) is an especially robust device, enabling learners to acquire native competences in ambient languages, even in challenging settings. This robustness is not, however, without limits. There appear to be clear cases of unsuccessful acquisition which are of particular interest because their study can shed light on the nature of the LMC. We can learn much by comparing different types of language acquisition in different populations of learners.

Language acquisition is sub-served by species-specific biological and cognitive mechanisms as well as by mechanisms shared with other species. This is what we are calling the Language-making Capacity. Following Meisel (2011), we distinguish the LMC from the Language Acquisition Device (or LAD) which, we assume, draws only on domain-specific principles and mechanisms, principles and mechanisms which are exclusively devoted to sub-serving the acquisition and processing of formal properties of human languages. We assume that the LAD becomes available to the individual as a result of neural maturation, provided it is activated during specific developmental periods by exposure to language in communicative settings. Given these assumptions, we can now ask: What are the factors that might lead to incomplete success in language acquisition?

Three candidates come to mind, based on the acquisition literature: the first is bilingualism itself. The second is the age of onset of acquisition (AOA). The third is the nature of the input to which learners are exposed. Let us look briefly at each of these.

Bilingualism can now safely be ruled out as a potential factor pushing the LAD to its limits. Over the past 30 years, research studying children exposed to more than one language from birth has demonstrated that they acquire the underlying grammatical systems of their languages successfully and within a short period of time. In other words, when compared to monolingual learners, children growing up with two or more languages do not exhibit qualitative differences in the course of acquisition of their languages or in the kind of grammatical knowledge attained. Simultaneous acquisition of languages has therefore been qualified as bilingual *first* language acquisition (2L1). For a summary of research results investigating this population of learners, see De Houwer (1995, 2009). The conclusion that bilingualism alone is not an impediment to successful acquisition is primarily based on the following observations about their acquisition profiles: (i) linguistic systems are differentiated from early on by 2L1 learners, (ii) their grammatical development proceeds through the same developmental sequences as in monolingual acquisition, (iii) 2L1ers make the same kinds of errors that monolinguals make, suggesting that their grammatical representations are similar, and (iv) the grammatical knowledge ultimately attained in each of the languages of 2L1 children is indistinguishable in kind from that of their monolingual counterparts as determined by a variety of linguistic behaviours (both spontaneous and elicited).

We attribute these properties of 2L1 to the availability of the LAD; that is to say, acquisition in both 2L1ers and 1L1ers is guided by principles of Universal Grammar (UG). Consequently, the presence of another language in the environment --- and in the minds of learners --- does not result in substantive differences between bilingual and monolingual L1 development – at least not when languages are acquired simultaneously from birth. The LAD is thus an endowment for multilingualism which does not fail when it is activated during the appropriate developmental period.

This brings us to the second of the three factors suspected to push the LAD to its limits, namely, age of onset of acquisition. AOA is of interest because successive language acquisition (2L2) is clearly *not* characterized by the properties attributed to monolingual and bilingual first language acquisition. Meisel (2011) has noted five crucial

differences in the profiles of 2L2ers: (i) when one examines particular learning problems, it becomes apparent that the kinds of errors 2L2ers make are different from those of 2L1ers; (ii) globally, rates of L2 acquisition are typically protracted; (iii) contrary to the uniformity of L1 developmental sequences across children, one finds a broad range of variation in L2 across individuals; (iv) there is also considerable variation within learners over time; (v) most importantly, it is not the case that all L2 learners are successful.

Whether it is impossible in principle to acquire native competence in a second language is a matter of controversy (compare Meisel 1991 to Schwartz 1991, 1992; also Abrahamsson & Hyltenstam 2009; Hyltenstam & Abrahamsson 2000). What is not controversial is that near-native or native-like adult L2 learners are exceptional. It is equally uncontroversial that adult second language acquisition (aL2) differs from bilingual L1 acquisition. Controversy exists, however, about the nature of these differences, more specifically whether they are of a fundamental nature, reflecting qualitative differences in the underlying grammatical knowledge, or instead superficial differences in behavioural control. In the generative paradigm, discussion has turned on whether the structural linguistic knowledge of L2 learners is fully constrained by principles of UG. We will refrain from engaging in a discussion of these controversial issues. It must suffice to acknowledge the existence of substantive differences between 2L1 and adult L2 acquisition.

Age-related changes in the LAD have been explained as being primarily caused by effects of brain maturation, this is to say, the ability to develop a full grammatical competence by mere exposure weakens or disappears in the course of development. (See Hall et al. 2012; Mayberry 2010; Mayberry & Eichen 1991.) Importantly, not all of language is affected by maturational changes, only certain *domains*. Moreover, these domains are not all affected at the same time. Phonology, morphology and syntax have been demonstrated to follow distinct developmental agendas; in addition, development is asynchronous even within these subcomponents of grammar. Consequently, maturational changes do not result in a single critical period for language acquisition. Rather, grammatical development is characterized by a number of *sensitive phases*, some of which cluster. Each of these clusters can be regarded as constituting the equivalent of one of *multiple sensitive periods*; cf. Seliger (1978), Meisel (2013). Concerning the decisive age ranges for grammatical development, linguistic as well as neuro-psychological research suggests that at around age 7 significant changes happen in linguistic development. However, recent findings suggest that changes constraining language acquisition may occur even earlier. Studies of 2L2 in early childhood have shown that acquisition still resembles L1 development in many respects, but it already exhibits distinctive properties, if AOA happens during the fourth year of life or later, in some domains of grammar. Successive acquisition during the age range of approximately 3;6 through 6 – 7 has therefore been referred to as child L2 acquisition (cL2).

In sum, there can be little doubt that AOA indeed defines the limits of the LAD. By mere exposure to their languages in communicative situations, children who are exposed to one or more languages from birth are able to develop native competence in more than one language. Learners will not be able to do so if onset of acquisition happens later in childhood, at least not in all domains of grammar. Note, however, that although exposure to the target language during sensitive phases is a necessary condition for the development of a native competence, it is not a sufficient condition. Exposure during periods of heightened sensitivity must involve the right kinds of input. In other words, quantity and quality of input too may very well set limits on what the LAD is capable of achieving. But whereas we have at least an approximate idea of the crucial developmental phases during which learners need to be exposed to input in order to develop a native grammar, we know virtually nothing about what makes input "adequate" --- that is to say, what properties of input make it crucial to successful acquisition. Adequate input is often contrasted with "impoverished" input. The issue for L1 acquisition is whether impoverished input can have similar effects on grammatical development as delayed AOA. Bilingual acquisition may provide insights into this problem.

2 What do studies of unbalanced exposure in bilingual acquisition show?

It has frequently been observed that 2L1 learners necessarily receive less input in each of their languages than corresponding monolinguals. This is because the relative time of exposure to each of the two languages amounts to at best 50% of the total amount of child-directed speech that an infant can attend to during the day. In fact, in most cases of 2L1, the proportions of input will be less than 50/50. Still, 2L1ers are nevertheless able to develop two native competences by mere exposure to the target languages (Meisel 2007). It follows that deficiencies are not necessarily caused by reduced exposure to the target languages. To the contrary, the LMC is robust enough to enable individuals to acquire native grammars in spite of reduced quantity of input. Yet a minimum amount of exposure is indubitably necessary for children to be able to develop a native competence, for, trivially, no input means no

acquisition. The challenge thus is to determine in what way decreasing the amount of input affects language acquisition, and whether it is possible to quantify a minimum threshold for successful acquisition of specific grammatical phenomenon. There are several ways to approach this question. One way is to experimentally present learners with controlled input and determine what they learn. Carey & Barlett (1978), and Oviatt (1980) have shown, for example, by presenting monolingual children with novel sound forms in the presence of novel objects, that the children rapidly induce novel form-meaning mappings. Thus, in the presence of two trays, one coloured red and the other one olive green, and told: "You see those two trays over there. Bring me the chromium one, not the red one"), young children learn that the novel word is a colour word on the basis of a single exposure to the stimuli, and in some cases accurately map the colour word to the correct range of the colour spectrum. This kind of learning has been called "fast mapping".[1] (Section 3 provides evidence for fast mapping L2 acquisition.) Such research sets a lower bound on induction, providing precise information on how much input is required to solve a specific learning problem, here learning both colour concepts and the sound forms of the English colour words that label them. Other research involves case studies of bilingual and monolingual development. Again consider word learning. Although it has been demonstrated that bilinguals' total vocabulary in both languages combined is virtually the same as in monolinguals, cf. Pearson et al. (1993), the vocabulary of bilinguals in each of their languages has been shown to be smaller than that of the respective monolinguals of the same age, and it also seems to develop more slowly.

Hoff et al. (2012) examined the potential effect of reduced amounts of input with respect to "grammatical complexity" and length of utterance and concluded "that grammatical development in bilingual children is also a function of language exposure" (p.23). They compared Spanish–English bilingual to monolingual English children at ages 1;10, 2;1 and 2;6 and reported that across the age groups the monolinguals in their study were more advanced in English than the bilinguals and the grammatical complexity of their English utterances increased faster. This difference in pace resulted in an increasing developmental lag between the two samples of learners. Note that the degree of developmental difference falls within the normal range of variation for monolingual children. This means that the samples should be treated as coming from the same population. However, what matters for our present concern is that the relative amount of language input in English correlated to the development of English grammar. The English-dominant bilinguals (defined as those where 70% or more of total exposure to language was to English) looked most like the monolinguals, followed by the balanced bilinguals (with a proportion of exposure between 50 – 60%) and the Spanish-dominant bilinguals (with c. 10-30% exposure to English) followed. Similarly, when looking at the acquisition of Spanish, the Spanish-dominant bilinguals achieved better results than the balanced learners, and they did better than the English-dominant ones. Some might argue that these findings support the claim that reduced input affects the acquisition of grammar. Notice, however, that the effects on grammatical development were even smaller than on vocabulary development. More importantly, Hoff et al. (2012) did not find qualitative differences between monolinguals and bilinguals, i.e. bilinguals proceeded through the same sequence of developmental milestones as monolinguals. This suggests, once again, that the simultaneous bilingual and monolingual samples are drawn from the same (L1) populations.

The discussion so far is based on the assumption that calculations of relative frequency of exposure to a language (proportions over the day) reflect more or less accurately the amount of input data available to the child. This, however, is far from obvious. Starting from the observation that the amount of speech which parents direct to children varies considerably across individuals and that bilingual children's amount of language input in each of their languages can therefore be equal to or larger than that to which monolingual children are exposed, De Houwer (to appear) examined the amount of input in Dutch received by monolingual and bilingual (Dutch-French) Belgian children at ages 1;1 and 1;8. She found no empirical support for the assumption that the amount of input is necessarily reduced for bilingual as compared to monolingual children. Her study is based on a comparison of various measures of maternal input frequency, i.e. frequency of utterances as well as of words, morphemes and syllables per utterance. This analysis revealed no group differences across these measures, and De Houwer concluded her data do not provide evidence for reduced input in the bilingual group. Her study did, however, confirm that there is extensive variation among mothers in speech rate per hour. In other words, children may hear a lower number of utterances addressed to them in the dominant language than in the one in which they receive proportionally less input. Methodologically speaking, this research clearly demonstrates that speculation about the effects of input are no substitute for focused empirical studies on input and language acquisition.

As a preliminary summary, we retain that studies examining language acquisition in settings where children have less access to the target languages than monolingual children confirm the expected relation between amount of available input and grammatical development with respect to the rate of development. But even in cases where relative frequency of contact with a language does not attain more than 30%, this did not provide evidence for qualitative deficits in the attained grammatical knowledge. Still, logically, a threshold defining the minimum amount

of input for acquisition to be at all possible must exist. In order to discover what this minimum might be, it is necessary to study cases where access to the target language is radically limited.

2.1 Heritage language speakers: Non-native grammars acquired in early childhood?

Studies of so-called "heritage language" (HL) speakers might allow us to formulate testable hypotheses about the minimum input enabling children to acquire full rather than incomplete knowledge of the target grammar. The term "heritage language speakers" most commonly refers to speakers of minority languages in bi- or multilingual communities, frequently confined in their use of this language to family-related registers. It is generally assumed that heritage language varieties are reduced or simplified in comparison to the target languages and that incomplete acquisition or structural simplification results from limited exposure to the target; cf. Montrul (2008), Polinsky (2006), Rothman (2009), Silva-Corvalán (2003), among others. Importantly, it is argued that HL learners fail to develop a native competence in the target language and that they end up speaking the language of the host society as their dominant language although they were exposed to the HL from an early age. These learners should therefore enable us to answer two questions: Under what circumstances do bilinguals fail to acquire native knowledge in spite of early exposure to the target language (early AOA)? Do HL speakers have grammatical knowledge of their languages which is different in kind to that of 2L1 or cL2 learners?

Unfortunately, the currently available results from HL studies do not present a sufficiently clear response to either of these questions. HL researchers commonly assert that HL speakers represent a distinct learner type, sharing properties with both L1 and L2 speakers in different areas of grammar; cf. Montrul (2008). But the empirical evidence on which this claim is based is drawn from simultaneous as well as early successive and late successive bilinguals. It is therefore not possible to decide whether the observed properties in the speech of HL speakers are indeed due to reduced access to the target language. We may rather be looking at a heterogeneous group of speakers who exhibit different learner profiles, e.g., successive bilinguals whose L1 proficiency has undergone attrition, balanced simultaneous bilinguals, unbalanced simultaneous bilinguals, or child L2 learners. In order to be able to disentangle the influence of the various factors shaping learners' grammars, including reduced input, it is necessary to analyze longitudinally or cross-sectionally on-going acquisition processes. The overwhelming majority of HL studies, however, investigate adult HL speakers (speakers at the end-state of learning) and therefore cannot tackle this problem. The few existing analyses of child language show, on the other hand, that although HL learners may take longer than monolinguals to acquire certain grammatical phenomena, they proceed through the same developmental stages; see Flores & Barbosa (to appear). Moreover, finding L2-like features in the behaviours of HL speakers need not be a sign of incomplete acquisition. It may result from attrition, something which occurs even in very young learners. This is evidenced by two of the children studied by Silva-Corvalán (2003); at ages 5;1 - 5;6 they failed to produce some Spanish tense forms which they had used earlier, at ages 3;0 – 3;3. Silva-Corvalán analyzed the acquisition of the Spanish tense-modality-aspect (TMA) system by seven children. Importantly, she could rely on longitudinal data from two of them. One of them was raised bilingually up to age 3; after that, the home language was English. From then on until age 5, his exposure to Spanish was limited to approximately 3-4 hours per week. The other child's exposure to Spanish amounted to less than two hours per week during the entire period studied. By ages 5;1 – 5;6, each child had acquired a system of Spanish TMA morphology, but crucially, it was a simplified one when compared to that of monolinguals and to HL children who received more Spanish input. It thus seems that these two learners not only acquired incompletely the Spanish TMA system but their system was subject to attrition during the last two years. In other words, the children's linguistic competence was diminishing due to a shift in the input in the home from both Spanish and English to mostly English.

These findings strongly suggest that incomplete acquisition of grammars is likely to happen only when access to the target language is dramatically reduced. It is, however, not possible to give a more precise estimate of the quantity of input necessary for the development of a native competence. In order for HL studies to shed light on these matters, researchers need to gather detailed information about quantity and quality of input during sensitive phases for language development (recall that this includes the period between ages 3 and 7), specifically, to determine that a feature allegedly indicating incomplete acquisition was part of the language used by their caretakers. In addition, it must be shown that this feature was (or was not) part of the child's grammar at a specific point in developmental time. Unless both of these requirements are met, claims to the effect that incomplete acquisition is caused by insufficient exposure to the target language are speculations and not findings.

3 Input is a difficult topic to study

As these limited observations should make clear, serious consideration of the topic "input" reveals that true explanation of a failure to learn is hard won. It is worth reminding ourselves of what Steven Pinker told us over 30 years ago about how difficult it is to make explanatory claims about input as a causal factor in language acquisition (Pinker 1979). In order to argue that input explains acquisition, several conditions must be met (see also Echols 2001):

(1) Pinker's input criteria
   a. Some distinction must be critical to the solution of a precise learning problem.
      (Accompanied by an unpacking of the learning problem to make clear what forms or form-meaning mappings must be present in the input, *or* what abstract formal distinctions must be inferred from the input.)
   b. The distinction must be present in stimuli to which the learner is exposed.
      (This might mean a token in a single stimulus or multiple tokens in different contexts, depending on the logical nature of the learning problem.)
   c. The distinction must be processed by the learner.
      (In second language acquisition this is known as the "input becomes intake" distinction; others refer to the learner's "sensitivity" to the distinction.)
   d. The distinction must be causally related to change in the learner's behaviours.
      (At the very least, we must be able to show that the distinction is present in input to the learner in a temporal period that *precedes* the emergence of the sensitivity to the distinction in receptive tasks or to the emergence of the phenomenon in production.)

In explaining the failure to learn some target phenomenon, we might want to re-word Criterion (1b) as in (1b'), with everything else staying the same.

(1) b'. The distinction is absent in stimuli to which the learner is exposed.

In other words, in claiming that there are environmental accounts of failure to learn, criterion (1b') would have to be shown to be what matters: The learner fails to learn phenomenon P because necessary input is absent. It is a standard argument in approaches that claim that UG is the foundation of language acquisition to claim that learners cognize some distinction which is, in fact, *not* present in the input. This amounts to making simple correlations between input and knowledge. Notice, however, that in claiming that the absence of the distinction in the input is what causes the learner to lack the distinction in their grammar, we need to do more than find such simple correlations between the learner's own production and frequencies of the distinction in the input. If it turns out to be true instead that certain types of learners do not process a particular distinction (our criterion "c"), but the distinction is present in the input, or, conversely, that learners' are sensitive to a distinction even if it shows up infrequently, then this says something about the internal workings of the human mind. It is *not* the input that matters.

There are lots of reasons to think that assumptions about inadequate input may actually reflect whether learners of a given type or learners at a given stage are insensitive to a particular distinction. In other words, the information might be potentially available in the input, but it is not processed at all or it is not processed in a native-like fashion. In discussing this, let us now shift our focus of attention from 2L1 acquisition and cL2 acquisition to research on adult L2 acquisition, where the evidence for failure to learn is much clearer.

Consider in this regard a study that tested intermediate and advanced Korean learners of English on sentences containing nouns that were either bare nouns or plural-marked. See the examples in (2) and (3) (MacDonald 2010; MacDonald & Carroll 2013):

(2) a. Who has more caterpillars?
    b. Who has more clothing?
    c. Who has more ketchup?

(3) a. Who has more rocks?
     b. Who has more rock?

(4) (Picture accompanying *Who has more rocks? Or Who has more rock?*)

Participants had to imagine that there were two individuals, one who owned the two big rocks on the left of (4) and the other who owned the six little rocks on the right of (4). Their job was to decide "Who has more?" Barner & Snedeker (2005), who developed the task, have shown that native English-speakers are biased to respond to the question containing plural-marked nouns like (2a) by counting the number of entities depicted. Thus, six little caterpillars count as "more caterpillars" than two big caterpillars. In addition, English-speakers count objects when responding to questions containing bare nouns that express semantic aggregates, like (2b). In contrast, they respond to bare nouns that express substances (2c) (also with bare noun syntax) by estimating the relative volume or size of the depicted material. In that case, two big blobs of ketchup is "more ketchup" than six little blobs. Finally, English-speakers are acutely sensitive to the presence or absence of the plural-marker with "flexible" nouns that can denote either individuals or substances. When presented with cases like (3a), English-speakers determine magnitude by counting the number of entities depicted, so six little rocks are "more rocks" than two big rocks. In contrast, when presented with a bare noun, they determine magnitude on the basis of volume, so two big rocks are "more rock" than six little rocks.

MacDonald's interest in studying Korean learners of English turned on two issues. First of all, Korean is a generalized classifier language in which distinct free morphemes (classifiers) may be used to individuate and/or massify nouns (Unterbeck 1995). This use is optional; a speaker may also use bare nouns to refer to either a single or multiple individuals. Thus, both English and Koreans make use of bare nouns, but while both Korean and English may use bare nouns to refer to individuals, in English reference to a single individual requires a determiner like *the* or *a,* or a number like *one,* and reference to multiple individuals of the same kind requires plural-marking.[2] Bare nouns not marked with plural are only used to refer to substances or multiple individuals of different kinds (the aggregates). The grammatical cues to both the mass/count distinction and number are thus different in the two languages. Secondly, plural-marking is obligatory in English in the functions just described, meaning that its occurrence in the input will be frequent, and it is acquired early by young children (Brown 1973: 274). By hypothesis, Koreans who have been exposed to enough English to have attained intermediate or advanced competence, as determined by standardized tests, will have received lots of exposure to the English plural marker. The question was: Will intermediate and advanced Korean learners of English show the same mappings as native speakers, thereby showing sensitivity to plural-marking as an asymmetric cue to individuals, while recognizing that aggregates and substances are both cued by bare nouns?

When given the "Who has more?" test, the Koreans performed in a native-like way in judging sentences (2a-c) against the visual stimuli. They performed at chance levels on (3), the "flexible" noun cases that denote individuals when marked by the plural and substances when present in the bare noun context. Flexible nouns presented in the visual context of the experiment thus had to be interpreted solely by relying on a correct parsing of the morpho-

syntax since both sides of the picture could, in principle, have been chosen. MacDonald's Korean subjects could not select the picture appropriate to the linguistic input, suggesting that they had not, in fact, acquired the count/mass grammatical contrast and were not sensitive to English plural-marking. Given that the participants were relatively proficient (intermediate to advanced learners), that the plural-marker is obligatory when reference to multiple individuals of the same sort is intended, and the plural marker is frequent in the target language, it seems reasonable to exclude an input story for this apparent failure to learn the English plural-marker. In other words, we do not want to say that Koreans failed to deal correctly with the flexible nouns because of insufficient exposure to the English plural-marker. We should seek a solution elsewhere.

One possibility is that with experience, our language processors attune to the properties of the L1 and process input based on the distinctions encoded in the L1 grammar. On this story, Korean learners of English are simply not processing as distinct morpho-syntactic units the relevant sound cues, viz. the /s/, /z/ and /əz/ that occur at the right edge of English nouns. One account for this parsing failure (p.c. Annie Tremblay 2013) is that syllable codas are not permissible in this position in Korean words and therefore Koreans are not sensitive to the relevant input. But a knowledge transfer story in speech and language processing is not enough on its own to explain the persistence of the problem over developmental time. Why does the LAD not engage in grammar-restructuring based on, say, a "bootstrapping" from number concepts to the morpho-syntactic functional category of Number. For those of us who believe that maturation of the brain changes the way the LAD works and, in addition, that there are distinct and autonomous linguistic representational systems, an appeal to "representational deficits" in structural domains is possible (see Hawkins & Chan 1997), possibly related to the inaccessibility of "uninterpretable" morpho-syntactic features (on a minimalist account) or to the absence of mappings from conceptual structures to the relevant functional category (on an Autonomous Induction Theory story, cf. Carroll 2001). Recall that the Koreans can cognize, apparently, that individuals should be quantified by counting (2a,b) and that substances should be quantified by volume (2c). The Autonomous Induction Theory claims that ontological categories in conceptual structures (individual, substance, aggregate) can map to Noun Phrases in morpho-syntactic structures. This explains why the Koreans were native-like on cases (2a-c), which include both Plural-marked and bare noun syntax. We claim, nonetheless, that what is missing is precisely the morpho-syntax of Number needed to correctly deal with the sentences in (3). This is explained by the fact that there is no possible mapping from conceptual structures to the Plural morpheme itself. This is because the functional category Number has very little to do with numerical concepts (Emonds 2000), thereby precluding a mapping from numerical concepts to the Plural-morpheme in the syntax.[3] The Autonomous Induction Theory thus claims that learners must induce the Plural morpheme as a category of the morpho-syntax, but cannot do so, perhaps because they are not accurately representing the prosodic cues to the Plural morpheme and there is no conceptual structure-syntax mapping from numerical concepts to Plural.

This example shows that to make precise claims about input, we need to differentiate input-to-speech-processors from input-to-the-LAD (see Carroll 2001 for extended discussion of this distinction). Moreover, we need a clear theoretical understanding of the logical and empirical relation between processing and acquisition (see Fodor 1998 a,b). For many of the distinctions that we want to study, e.g. Number, it is clear that they are not present in the speech that learners hear, but they might very well be present in a learner's internalized mental representations (via L1 transfer), to which we have no direct access. Accordingly, we need to investigate what learners already know that they make use of in learning novel linguistic features, contrasts, constituents or constructions in order to understand how the organization and structure of existing mental representations of language could lead to the creation of *novel* mental representations. To do that, we need to carry out studies in which the input is strictly controlled. This idea motivates the decision to investigate adult L2 in the initial stage through what we call "first exposure studies".

4 Processing L2 speech to acquire word forms: the segmentation problem

Although it is possible to investigate the learning of grammatical distinctions in first exposure populations (Carroll & Widjaja 2013; Rast et al. 2014), in fact, most work has examined segmentation and/or the mapping of sound forms to referents inferred from visual processing of videos, or pictures. In keeping with the claims of (1), we start with a discussion of the learning problem behind the ability to segment sound forms from continuous speech.

When listening to continuous speech, an experienced, knowledgeable listener uses a variety of cues in the signal to represent speech as discrete representations of sound units. For example, a listener may make use of pre-lexical cues to word boundaries. It has been shown in a number of word-learning studies using artificial languages that inserting a brief pause between the syllables fundamentally alters the way in which the input is processed (Endress & Bonatti 2007, inter alia). Thus, pause seems like a good candidate to be a universal cue to a prosodic word boundary (Morgan & Demuth 1996). Finn & Hudson Kam (2008), however, have shown that in the absence of

pauses, the mechanism that putatively tracks statistical probabilities between syllables as they are being processed is constrained by the phonotactics of the listener's first language. This is just one instance of what Cutler (2012) calls "language-specific listening". Language-specific listening emerges as learners acquire their L1s, and as the processors of their language faculty attune to properties of the input. Language-specific listening makes for very efficient L1 speech and language processing but it can get in the way of second language acquisition. This is because word units in fluent speech are only partially detectable based on properties of the signal ("pre-lexical" cues to word boundaries). L1 segmentation in practised listening arises from detecting the sound patterns of familiar words (Fisher & Church 2001: 52; Tyler & Cutler 2009). It also draws on grammatical knowledge (Mattys et al. 2005; Mattys & Melhorn 2007). Obviously, one major problem for individuals learning their first words in an L2, is that they do not have "familiar" words yet. In other words, they have not constructed phonetic or phonological representations of words that would support word recognition during listening. They also lack sound-meaning mappings for words. And, of course, at the initial stage of L2 exposure, they also lack knowledge of the L2 grammar, knowledge of the L2 phonology, and mappings between meaning and L2-specific grammatical constructions or meanings and L2 phonology. Listeners must nonetheless carve out word-length sound forms from the signal, encode the segmented sound forms in long term memory, and, in addition, come to encode distinct variants in separate acoustic contexts as instances of "the same word". Moreover, information about the contexts in which forms appear must also be represented if the learner is to induce how variation in forms is contextually conditioned. Finally, learners must induce senses of words from contexts of use because it is the sense (not reference) of a word which permits it to combine with other words to form phrases and sentences.

How do these things actually happen? Given the evidence for "language-specific listening" (Cutler 2012), and the important role that lexical transfer plays in L2 word learning (de Groot & Keijzer 2000; de Groot & van Hell 2005), such questions are difficult to answer. Still, Finn & Hudson Kam's (2008) research suggests that the LMC is plastic and is able to deal with novel distinctions. One research strategy is therefore to document the ways in which language-specific listening might affect how adult L2ers acquire new words forms and the conditions under which they can go beyond what exists in the L1. This motivates doing studies using controlled input with learners who have had no prior exposure to the L2.

We can now ask the following questions:

> (5) a. Just how fast do these segmentation processes operate?
>   b. How much/how little input is actually needed to segment sound forms?
>   c. Is there a connection between the outcomes of in-real-time segmentation processes and what gets stored in long-term memory?
>   d. Is there evidence for L1 lexical effects in the initial learning of L2 word forms?
>   e. Is there evidence for other kinds of "language-specific" (L1-based) listening during segmentation?
>   f. Are there other independent factors at work?

These are the kinds of questions that have been addressed in first exposure L2 research.

4.1 The U Calgary first exposure studies

The first author has carried out a number of first exposure studies involving adult Anglophones. Our subjects were exposed to German. The main reason for choosing German as the target language was that it is known to be acoustically and syntactically different from English in many respects but phonologically very similar. Lexemes in each language exhibit stress, and stress is needed to distinguish specific words (Berg 1997). The two languages have consonants and vowels that are phonetically similar (Chomsky & Halle 1968; Wiese 2000; Eisenberg 2004). As well, because the two languages come from a common ancestor and there are important shared cultural traits (such as Christian naming practices), it is possible to find cognate words, defined here as words that are phonologically similar because they share segments organised in comparable linear sequences, e.g., *Martina* [ma:'tina] vs. [mar'tinə]. Similarity is, of course, a matter of degree. Compare: *Johann* ['johan] and *John* [dʒɑn]*, or *Sybille* [zy'bɪlə] and *Sybil* ['sɪbəl]. One goal of our research has been to see just how much transfer one could observe on first exposure and whether transfer facilitated learning by reducing the amount of input required to learn individual words.

A second question was how much difference prior exposure to German might make. In one study we compared first exposure learners to learners who had had two or three semesters of university German-language instruction. The differences between the first exposure learners and our "beginners" were not large, confirming that Anglophones are well-equipped right from the start, given their L1 phonological and lexical knowledge, to rapidly solve the segmentation problem in German. These results should therefore shape our approach to the question of learning typologically more distant languages. Even in such cases, first exposure learners will bring tools to the task of learning the L2, and we need to identify what they are. Moreover, even when prior knowledge does not always lead to *early* resolution of a learning problem, we must still ask: What L1-based processing procedures are put to use on first exposure? What has to change in the learner's mental representations for them to process targeted distinctions? What environmental manipulations, if any, could cause such changes?

Across our various studies, target items were nouns. This is not unusual; the study of noun learning has a long history in developmental psycholinguistics.[4] In addition, studies of untutored learner production (Clahsen, Meisel & Pienemann 1983; Klein & Perdue 1992) suggest that, as in L1 acquisition, nouns are among the first words acquired. Indeed, Gleitman and Gleitman (2001) have demonstrated that when Anglophone adults were shown short video clips of an English-speaking mother interacting with her child, with a target word "beeped" out of the audio, and were required to guess what the word was, they successfully guessed 45% of the nouns targeted but only 15% of the verbs. Gleitman and Gleitman conclude that real world observation of a noun's contingencies of use is sufficient to identify nouns (but not verbs) under these minimal conditions and would also support a "noun bias" in language acquisition in all populations. Such a bias seemed like a good reason to focus initially on nouns in a first exposure context. Target words were different kinds of proper names: simple first names, or first names + compound last names.[5] As it turned out, both types of stimuli could be rapidly segmented from the speech signal and retained over a two-week period.

In conducting our experiments, we looked at various properties of the input: position of the target name in questions, cognate versus non-cognate status of the target word, word length (as measured in number of syllables), and whether the word was simple or compound.[6] We used a paradigm in which participants, seated at a computer station, listened to standardized input in the form of a sequence of 20 randomized presentational sentences while looking at coloured line drawings of people. Each sentence introduced the individual in the picture in an appropriate syntactic context (4 different constructions were used). At no point did participants see anything in writing and there were no translations provided. They were told simply to learn the names of the people depicted. Immediately following the 20th declarative sentence, participants heard 20 randomized questions that corresponded to each declarative sentence.[7] The target names were embedded in a conjunction giving them an option: Name *oder* Name 'Name or Name'.

(6) Types of questions in the input (across different experiments)
    a.   Steht da Bernd oder Benno?
        Stands there Bernd or Benno
        'Is that Bernd or Benno standing there?'
    b.   Sehen Sie hier Frank oder Franz?
        See you here Frank or Franz
        'Do you see here Frank or Franz?'
    c.   Ist das Ortrud Dahlhoff-Benke oder Gabrielle Blauhemd?
        Is that Ortrud Dahlhoff-Benke or Gabrielle Blue-shirt
        'Is that Ortrud Dahlhoff-Benke or Gabrielle Blauhemd/Blueshirt?'[8]
    d.   Ist hier Niko Reppert-Hein oder Leo Kleinberger?
        Is here Niko Reppert-Hein or Leo little-mountain-LOC
        'Is this Niko Reppert-Hein or Leo Kleinberger/from the little mountain'

Participants pressed a key on the left side of the computer keyboard if they thought the first name was the target name. They pressed a key on the right side of the computer keyboard if they thought the target name was the second name they heard. Responses were automatically recorded for accuracy and latencies were recorded at the same time.

Our studies have a "longitudinal" dimension to them that other first exposure studies do not have. This is because we controlled the presentation of training items in terms of the participants own success. If a participant succeeded on the first training trial to match all names to their pictures, s/he passed to a test phase. If participants were only partially correct in segmenting all 20 items and mapping them to the picture, they did the training trial

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again until they succeeded or had completed 10 training trials (= "learning to criterion").[9] As it turned out, participants were extremely good at segmenting words on the first training trial (and indeed, the first items of the first training trial).

Successful participants returned two weeks later and heard only the questions. If they made a mistake, they got feedback. They then did the re-test again. Our paradigm is the only one in the existing literature so far that also tests "long-term" retention. This is important because we want to know if the words that learners are segmenting are actually stored in long-term memory. Results show that participants were very good at retaining representations of the words in memory over a 2 week period with no additional input.

We have accuracy scores and response latencies on all of our measures (training trials, test, re-tests). We also measured the number of training trials needed to learn to criterion. Given what we know about the ease with which intermediate and advanced L2ers grasp the meanings of cognate words and readily learn their forms (Costa, Caramazza, & Sebastián-Gallés 2000; de Groot & Keijzer 2000; Pál 2000), we expected that cognate names (those that have a similar abstract phonological form to L1 names) would be easier to segment. We therefore used them as a baseline in three separate studies.[10] Data are presented in Table 1.

Table 1: Accuracy rates on single-word cognate names across 3 studies (N)

Study	Training Trial 1	Test	Re-test 1	Re-test 2	Mean # Training trials to criterion
1	85.6% (25)	96% (23)	87.9% (22)	93.6% (22)	3.2
2	82.7% (33)	95% (23)	85.9% (21)	93% (21)	3
3	78.3% (26)	95.7% (26)	87.7% (22)	96.3% (22)	3.9
Mean	**82.2%**	**95.6%**	**87.1%**	**94.3%**	**3.4**

Table 1 shows that responses to the cognate items were, in fact, consistently accurate, even on the first training trial. Accuracy was good from the very first stimulus, as shown by split half reliabilities. It took participants approximately three training trials to map all 20 names to the pictures and some learners obtained perfect scores even on Training Trial 1. These findings are robust.

In our second study (Study 2), we compared first exposure participants learning German cognate names to their learning of non-cognate names. Participants were not quite so good on the non-cognates on the first training trial (cognates = 82.7% vs. non-cognates = 70.6%) and the difference between the cognates and non-cognates was highly significant (paired t-test: t(55) = –4.09, p = 0.0001). It also took participants much longer to match the target names to the pictures (mean of 5.56 trials on the non-cognates vs. a mean of 3.04 trials on the cognates) and this difference was also significant (paired t-test: t(22) = –5.61, p = 0.000). This suggests a strong lexical effect during segmentation, which was confirmed by the response latency data. Learners responded much more quickly to the cognate items (681.7 ms) than to the non-cognate words (818.33 ms). This difference was significant (t(186) = –2.94, p = 0.003). See Carroll (2012) for more details. Finally, production data was more accurate on the non-cognate items than on the cognate items because some learners just used the English pronunciation of the names (although there was a considerable amount of variability in participants' productions). Thus, although first exposure learners do not have representations of the L2 sound forms, they use phonetic cues in the signal to activate L1 word representations (Carroll 2010).

These findings are consistent with findings of Park & Han (2008), Rast & Dommergues (2003), and Rast (2008) who have also found evidence of L1 lexical activation in the earliest stages of acquisition. The high performance of the participants on the cognate words is not surprising given the sensitivity to cognates exhibited by learners at much more advanced stages of L2 acquisition. While at later stages of learning, cognate words are known to present learners with problems (they lead to persistent errors of pronunciation and interpretation), it is clear that they present first exposure learners with a handy tool for parsing the signal. However, L2ers are also readily able to segment and learn the non-cognate words, which are lexically novel. Notice that performance on Training Trial 1, at 70.6%, although lower than on the cognate items is significantly above chance. Moreover, the fact that participants get the

same high score on both cognates and non-cognates on Test (95%) and perform equally well on Re-test 2 (cognate = 93%; non-cognates = 90%) show that once the learners have acquired the forms they retain them over the two-week interval and their linguistic properties have no effect. In short, contrasts like cognate status appear to play a role in the speed of lexical activation and in the shape of the sound forms activated, but do not play a significant role in segmentation or in recall, at least not given the way our stimuli are presented. Thus, both cognate and non-cognate forms can serve as the basis for building an initial lexicon. Moreover, since lexical transfer is not at issue in the case of the non-cognate words, the ease the learners demonstrate with them probably relates to the "phonological transparency" of the L2 consonants and vowels in comparison to L1 consonants and vowel, in other words to sound system-similarities. By this, we mean that, e.g., English and German /t/ or English and German /u/ share enough phonetic features to be treated as classification equivalents. See Rast & Dommergues (2003) on phonological transparency and Flege (1987) on equivalence classification.[11]

In Study 3, we presented participants with first + last names that were compounds. Despite the fact the names averaged 5 syllables in length and the utterances averaged 10 syllables in length, participants were still able to segment the nouns and retain them over two weeks. See Table 2.

Table 2: Accuracy rates (%) among first exposure and beginner L2 learners in Study 3

	Cognates					First + Compound Names				
	Trial 1	Test	Re-test 1	Re-test 2	M	Trial 1	Test	Re-test 1	Re-test 2	M
FExp	78	95.6	87.7	96.4	89.3	77.8	87.7	82.7	86.8	83.6
Beg	88.8	95	93.9	93.9	91.4	90.6	93.9	88.9	91.9	91.3
Mean	83.4	95.3	87.8	95.2	90.4	83.9	90.7	85.9	89.3	87.4
	Mean # Training Trials to Criterion									
FExp	3.9					3.7				
Beg	2.8					2.6				

FExp = first exposure learners
Beg = beginners

On the longer and more complex compound names, first exposure learners were significantly above chance with an accuracy rate of 77.8% on the first training trial, virtually identical to their performance on the cognate names. On the same complex items, they performed very well on Test and Re-tests, although somewhat less well than on the cognate items. Beginners, defined as students who had had two to three semesters of university German, performed much better on the task on the more complex names, basically at ceiling. As the experiment proceeded their performance remained constant. Importantly, their performance on the more complex names was virtually indistinguishable from their performance on the simpler cognate items. The difference between the accuracy scores of the Beginners and those of the First Exposure group was significant ($F(1, 180) = 28.93$, $MS_{BetGroups} = .269$, $\eta^2 = .139$, $p = 0.011$.). Moreover, the Beginners were faster in learning to criterion; on average 2.6 training trials to the First Exposure average of 3.7 trials. Performance of both groups on the cognate names was similar on this measure to their performance on the more complex names.

Examination of individual responses showed that five Beginner participants (25% of the group) scored 100% on the first training trial. Only one First Exposure learner was able to do this. Eight Beginners had scored 100% by the end of Training Trial2, versus only four First Exposure learners. One First Exposure learner failed to learn to criterion while all of the Beginners succeeded. Thus, while results of the First Exposure group show that they too were able to rapidly segment the names and matched them to the pictures there was considerable variability in the group. The advantage of having been previously exposed to German is that even the slowest learner got the job done faster.

What is striking here is that the greater structural complexity and length of the compound names had little effect on performance. And, once again, once the learners had segmented out the names, they performed very well on Test and on the Re-tests. Our study thus replicates findings of Rast (2008, 2010) that word length does not play a role in segmentation of early words among adult learners. This makes for a stark contrast with first language learning where

early words are short and may be truncated or lengthened to fit a two-syllable pattern (so English *banana* goes to *nana* while French *l'eau* goes to *lolo*). See Echols (1993, 1996), Pater & Paradis (1996), Demuth & Johnson (2003). It also provides an empirical foundation for studies which have emphasized the role of "formulaic" speech or "prefabricated routines" in aL2 acquisition (Hakuta 1974; Wray 2002) since the definition of such productions is that they are syntactically unanalysed sound forms of some length.[12]

5. Discussion and Conclusions

Let us now return to our research questions in (5). How fast do segmentation processes operate? Based on our data showing that first exposure learners are as accurate on the first questions they hear on the first training trial as they are on the last questions, it looks as if segmentation takes place basically as learners listen. How much input does this population of learners need to segment sound forms? Apparently, they require very little exposure. When responding to individual questions during Training Trial1 our participants had had two exposures in distinct acoustic, phonological and syntactic contexts. That was all they needed. Given that our results are consistent with studies involving learners exposed for the first time to typologically distinct languages, it is clear that the emphasis of certain emergentists on the slow and incremental nature of learning (Mellow 2008) is exaggerated. Not all aspects of language learning are slow; not all aspects of language learning require repeated exposure to input. If segmentation and referential mapping is fast not only in experienced listeners of a language but in first exposure learners, then one can ask why this should be so when other learning problems demand much more exposure. We believe that the logical nature of the learning problem and the relationship of speech to abstract mental representations of words play a role.

Is there a connection between the fast processes of segmentation and what gets stored in long term memory? Our data clearly show that minimal exposure can result in retention over a two-week period during which participants had no further contact with German stimuli. Is there evidence for L1-lexical effects in the initial learning of L2 word forms? Yes, there is: L2 words that are phonologically like L1 words activate L1 lexical entries. Thus, well-established cognate effects found in advanced learners show up right from the start. Is there other evidence for L1-based listening? Does greater proficiency help? Yes, but our first exposure learners are so good at this task that two to three semesters of German instruction cannot increase their accuracy a great deal.

To sum up, Cutler and Shanley (2010: 1844) have stated that listening to an L2 is "inordinately hard" and may require targeted training. Inordinately hard tasks might be ones where adult L2 learners fail. The results from our studies, as well as those carried out by Gullberg et al. (2010, 2012) and Rast (2008, 2010) and Rast and Dommergues (2003), show that segmentation even at the initial stage is rapid. Our research shows moreover that an initial vocabulary can be carved out of the signal and retained for two weeks with no further exposure. No targeted training for segmentation appears to be required (although list learning benefits from repeated exposure) and, when we consider the full range of studies, it does not appear to matter how typologically close the L1 and L2 are. This observation relates to current debates in language learning theories. Emergentist and usage-based approaches to language acquisition define frequency of exposure to input as a critical explanatory factor (Barlow & Kemmer 2000; Abbot-Smith et al. 2001; Bybee 1995, 2007). Such approaches claim that that language learning involves, first of all, encoding "instances" of forms. These signal-specific representations incrementally "schematize" through repeated exposure to the forms in different contexts (Dąbrowska 2004; Lieven & Tomasello 2008). However, we see effects of repeated exposure in our data only in deciding the accuracy of a list of mappings of forms to pictures. On individual items, the learners are very accurate on the basis of limited exposure to differing phonetic forms. This suggests that learners are cognizing abstract representations during listening. Focus experimentation is required to shed light on the exact nature of those abstract representations. As for list learning, it is well known that it taxes our memory. Fortunately, outside of foreign language classrooms, very little word learning involves list learning. Note that the Gullberg et al. and Rast studies also found limited effects of frequency of input in the realm of segmentation. As well, Nakamura (2012) found limited effects of frequency of input in an L2 study of several syntactic constructions. Thus, while repeated exposure may be required for the representation of abstract categories, relabeling this as "schematization" does nothing to explain the learning problem. We need to bring acumen and nuance to discussions of frequency in the input, and the best way we know to do this is to be guided in our assumptions by the best formal models of language at our disposal.

Throughout we have emphasized that input is not just what is "out there", in fact input cannot be sensibly discussed in the absence of an analysis of the knowledge the learner brings to the task of analysing it. We mentioned briefly one example where learners appear to be insensitive to a morpho-syntactic distinction (namely Plural-marking) despite lots of evidence for it in the input for any learner who is sensitive to the distinction. Our

segmentation data show that learners who are sensitive to relevant cues in the input do not need much input at all. Discussions of what a minimal threshold for bilingual first language acquisition should be couched with these ideas in mind. Even at 9-months of age, young children are already acquiring language-specific constraints on the distribution of sound units based on minimal exposure to input (Gerken & Bollt 2008). They are learning to be language-specific listeners. This means that if exposure to one language dramatically diminishes during a sensitive period, the child's ability to attend to a novel property of that particular language will likely change as well. This means that discussions of the role of input in first language acquisition (in particular, whether heritage language learners constitute a distinct population of learner) must be based on studies of what children in changing input circumstances are sensitive to and can process. We recognise that planning a study in which the linguistic living conditions of learners change suddenly and dramatically may well be impossible, but, in principle, this is what is required. For input to the Language-making Capacity (and the LAD) is not so much "out there" in the objective physical world as in the subjective mind of the learner.

Acknowledgements

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[1] Swingley (2010) correctly notes that the claim that 3- and 4-year-olds fast-map is controversial and many reject the idea that young children can rapidly make a correct semantic inference on the basis of this kind of input. Swingley points out that the original study, which showed that the children never chose the red tray on hearing the instructions (meaning that they knew how to map the word *red* onto the colour spectrum) and months later mapped *chromium* only onto colours that were not already semantically stable in their lexicons (for example, green, brown, or grey), focused on the fact that children created a new lexical entry (they recognised the word *chromium* much later), attributed it to the correct semantic field (colour-words), and changed the interpretation of existing words (the familiar but unstable words *green, brown, grey*) on the basis of this single exposure.

[2] The situation is actually more complex in that Korean has a morpheme *–tul* that may be shifting from a focus marker to other functions, frequently described as plural marking. Whether it is accurate to view *–tul* as like the English plural-marker is far from clear. See Kim (1994), Kim (2005), and Kwon & Zribi-Hertz (2004). See Doetjes (2012) for cross-linguistic comparisons of the count/mass distinction and number.

[3] Thus, notice that all of the pictures required a choice between multiple objects (two objects versus six objects). More generally observe that Number categories are not only finite, there are very few of them, and they do not map in any simple way to numerical concepts. See Dehaene (1997) on numerical cognition, and Corbett (2000) on grammatical number.

[4] Unlike many other researchers, however, we do *not* assume that one can generalize from word learning studies that examine nouns only to the learning of other word classes. After all, one thing that distinguishes English and German nouns from some other word classes in these languages is that most nouns constitute prosodic words and therefore can be pronounced in isolation. Nouns (or at least those that denote concrete objects) can also be referential without any supporting syntactic context. (See the discussion immediately following.) This makes these words "listable" in ways that words of other word classes are not. Thus, the decision to choose to study noun learning is not merely a matter of convenience to the researcher; studies of the learning of other word classes are independently required.

[5] Some have been surprised by this choice; we have been surprised by this reaction. It suggests a failure to grasp that the study of word learning need not coincide with concept learning (which is definitely *not* the focus of our research). It also suggests a failure to grasp that proper names have referential uses in some syntactic contexts only, while in others, the meaning shades off into categorization. Thus, the difference between a naming function and a classification function is not based in an inherent lexical distinction (proper name vs. common noun) as traditional grammars have claimed. Rather, the distinction is rooted in the syntactic context that a noun occurs in on a given instance of language use. Jonasson (1994) presents a great deal of empirical evidence of this from French. Comparable examples can be found in many other languages.

[6] This is a subset of the phenomena investigated across the various studies. We also examined two kinds of semantic properties: whether the compound last name was referentially transparent or referentially opaque, or whether the name was a referentially transparent description. In addition, we carried out calculations of transitional probabilities, and we analyzed our input both phonologically (syllable counts, prosodic word structures, intonational phrases) and acoustically (pitch, intensity, pause and duration were measured). See Carroll (2012, 2014).

[7] Analysis of responses revealed no differences in accuracy rates based on the presentational frame.

[8] This is an example of a compound last name that could have been analysed simply as a sound form or as a semantically transparent compound word (and yes, Gabi was wearing a blue shirt in the picture).

[9] Learners who failed to learn to criterion were then released from the experiment. Their results were included in the analysis of accuracy rates on the Training Trial1. Analysis revealed that these participants were no worse in segmenting words on this training trial than other participants; their problems arose simply in learning to map all 20 names to the correct picture.

[10] In each study we conducted two experiments. In Study 1, one experiment involved English data (so drawing on knowledge of L1 words, grammar, and sounds) and one experiment involved German stimuli using cognate words. In Study 2, one experiment used the same cognate stimuli as in Study 1 and one experiment used non-cognate names. In Study 3, one experiment used the same stimuli from the previous two cognate experiments, while the other experiment involved first + last names, both of which included some cognate words.

[11] No one should assume, however, that there is a simple relationship between phoneme similarity and the ease of acquisition of L2 phonological contrasts. Flege (1995) has shown that L1-L2 phones that are similar present L2ers with problems; Young-Scholten (2004) points out that it is difficult to predict which phones learners will treat as equivalent, as more is involved than just phonetic similarity (including phonotactic constraints).

[12] A reviewer observes that our definition of "formulae" is clear, but not necessarily consistent with the definitions used in the L2 literature on formulaic speech., in particular, Wray's work. The early literature on formulaic speech or prefabricated routines focused on two distinct issues: memorization of items versus rule-learning, and knowledge of sequences of speech versus knowledge of syntax. There is a certain degree of vagueness in formulations in the research we have consulted, since such research was rarely linked to formal theories of language. This vagueness permits various (and not necessarily consistent) interpretations of what formulae are supposed to be. Hakuta (1974: 287), for example, states: "Evidence will be presented here that suggests a strategy of learning on the surface structure level: learning through rote memorization of speech segments without knowledge of the internal structure of those speech segments". Talk of "surface structure" places us in the realm of

syntax, not phonology. Accordingly, if learners have not represented the "internal structure" of the sequences, the author must mean that the sequences are syntactically unanalysed. This is the interpretation we present in the text. Of course, segmentation of "speech" does not require analysis of the internal phonological structure of the sequences, but given that Hakuta's work predates most of the work in metrical and autosegmental phonology, we assume that such structure was not the focus of his claims.