Acquisition of a signed phonological system by hearing adults: the role of sign structure and iconicity

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Sign language research is now a well-consolidated field of study that has produced extensive inter-disciplinary studies in linguistics, psychology and neuroscience. However, an area that has been widely neglected is the acquisition of a sign language as a second language (L2). To date, our understanding of how adults with a spoken first language (L1) go on to learn a signed L2 is limited. This shortcoming is striking given the pressing need for proficient L2 signers to narrow the gap between the hearing and the deaf community. The dramatic shortage of professional sign language interpreters has serious repercussions on how deaf signers communicate in crucial everyday situations. In the UK, for instance, the needs of 25,000 users of British Sign Language (BSL) are covered by only 800 registered interpreters (Murray 2013). This critical situation also affects the deaf children in the UK. Most of them attend mainstream schools in which Communication Support Workers with insufficient signing skills function both as linguistic models and sign language interpreters. Currently, there are efforts to create assessment tools of sign languages, but often they are adaptations of materials for spoken languages. It is crucial for the well-being of the deaf community to understand the cognitive mechanisms of sign L2 acquisition to develop efficient teaching methods and research-based teaching materials. In an effort to uncover some of the complexities of L2 acquisition across-modalities, this dissertation investigates the development of a manual phonological system by hearing adults.

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Chapter 1 gives a brief introduction on how sign structure and iconicity may influence acquisition of signed phonology. First, it provides an overview of the linguistics of sign phonology and explains that, in addition to the intrinsic complexity of each phonological parameter (handshape, location, movement, and orientation), sign structure may predict success in developing novel phonological categories. The chapter then describes that the clear direct mappings between a linguistic structure and its referent (iconicity) is a prevalent feature of all sign languages and that iconic signs may assume many forms. This chapter also points out that some of the co-speech gestures used by hearing individuals may also adopt an iconic form and that speakers' awareness of iconic gestures during communicative interactions may influence their perception of iconic signs. After drawing similarities and differences between signs and gestures, Chapter 1 gives an overview of the available literature on how sign structure and iconicity influences sign language acquisition in L1 and L2 learners. Under this theoretical background the dissertation asks: 1) How does sign structure influence the L2 acquisition of sign phonology?; 2) What is the influence of iconicity on the L2 acquisition of sign phonology?; and 3) Do hearing adults perceive iconic signs as co-speech gestures at the early stages of sign L2 acquisition?

The capacity to associate iconic signs with their referents greatly depends on a person's age, cultural background and meta-linguistic knowledge (Griffith, Robinson & Panagos 1981; Klima & Bellugi 1979; Pizzuto & Volterra 2000). Therefore, the objective of Chapter 2 was to understand experimentally the extent to which different types of iconic depictions were perceived by non-signers. To this end, iconicity ratings by hearing non-signers were collected for a set of BSL signs. These iconicity ratings were then compared with previously reported iconicity ratings by deaf signers for the same set of signs (Vinson, Cormier, Denmark, Schembri & Vigliocco 2008). Based on the iconicity ratings by hearing and deaf participants, signs on the iconic end of the scale were grouped into five categories: *action* (body movements simulating the referent), *perceptual* (representing the visual features of an object), *metaphoric* (whose meaning can be interpreted from the image produced by the manual components of a sign), *facial* (the non-manual component encoded the iconic link with the referent), and *emblematic* (they resemble conventionalised co-speech gestures). The analysis showed that overall, deaf participants regarded as iconic a larger number of items than non-signers. This was interpreted as signers having broader meta-linguistic information of the etymology of signs and that iconicity is accessible to them even when the sign-referent link may have eroded. The analysis also showed that iconicity ratings by deaf signers and hearing non-signers have a strong correlation, showing that perception of iconicity is somewhat independent of experience with a sign language. The greatest overlap in iconicity ratings was evident in action and perceptual signs

suggesting that for both groups, signs with links to the physical features of an event or an object are the easiest to interpret regardless of linguistic background. For the other categories, however, deaf signers' experience processing a visual language led to differences in the perception of iconicity. Deaf participants rated metaphoric signs lower than non-signers. Perhaps, this is because signers see such signs as frozen entries in their mental lexicon, and unlike non-signers, their meaning is not accessed through the interpretation of each element of the sign. Also, the higher iconicity ratings for facial signs by deaf participants may reflect the relevance of the non-manual component to extract grammatical and lexical information during signing. The highly disparate ratings for emblematic signs between groups (the lowest rating for deaf participants) suggest that while emblems are a rare cohort of manual forms with a well-established meaning, for deaf signers they are just another set of lexical signs. Chapter 2 concludes by arguing that experience with the real world allows for deaf participants and non-signers to perceive iconicity in some signs to the same extent and that experience in a visual language skews perception of iconicity for other iconic categories.

Crucial for the development of new phonological categories in a second language is a learner's ability to differentiate the contrastive and non-contrastive features of a target word. Thus, Chapter 3 explores the ability of non-signers to discriminate and articulate the phonological parameters of a sign (handshape, location, movement, and orientation) and how sign phonological complexity may influence the process. To this end, a sign repetition task was administered to a group on hearing non-signers. The intrinsic nature of each parameter suggested that some would be more difficult to perceive and articulate than others. Also, it was anticipated that signs with multiple features would pose greater cognitive demands than those with fewer features. Phonological complexity was operationalised through the Dominance and Symmetry Constraints, which establish the symmetry of movements and the markedness of handshapes, depending on whether they are one- or two-handed signs (Battison 1978). The analysis of the articulation errors revealed that all of the parameters were articulated significantly different from each other. Location was followed by orientation, then movement and finally handshape. This pattern of errors is the same as has been reported for deaf children acquiring a sign language as first language (Conlin, Mirus, Mauk & Meier 2000; Marentette & Mayberry 2000; Morgan, Barrett-Jones & Stoneham 2007). This chapter argues that in addition to motor dexterity, the perceptual ability to distinguish the boundaries of the contrastive features of signs plays a significant role in phonological development and that deaf children and hearing adults may need to overcome similar hurdles to discriminate manual phonological categories. The results also revealed that articulation accuracy is highest in one-handed signs, and that accuracy gradually decreases as the phonological features

of signs decrease, until reaching the lowest point in two-handed signs with different handshapes and asymmetric movements. This pattern of errors indicates that as the phonological components of a sign increase, so does its structural complexity, putting more cognitive pressure on learners to identify and articulate the components of a sign.

Chapter 4 incorporates iconicity as a variable that may influence the acquisition of a manual phonology. Studies have consistently reported that non-signers are more accurate and faster at recalling, naming and translating iconic than arbitrary signs (Baus, Carreiras & Emmorey 2012; Campbell, Martin & White 1992; Lieberth & Gamble 1991). However, the tasks implemented in those studies reveal little information about the effect of iconicity during sign phonological development. In order to determine how iconicity affects the ability to discriminate and articulate the parameters of a sign, hearing adults enrolled in the first level of a BSL course took part in a sign repetition task. The stimuli consisted of a set of iconic and arbitrary signs balanced for phonological complexity. Participants were tested before they started the BSL course and then 11 weeks after (22 hours of instruction). The results revealed that articulation accuracy improved significantly in the second testing session and that participants displayed the same pattern of errors as the one reported in Chapter 3 (location the most accurate, followed by orientation, then movement, and then handshape). Articulation accuracy was highest in one-handed signs and gradually decreased as the number of features in a sign increased. Interestingly, iconicity had a negative effect because arbitrary signs were articulated significantly more accurate than iconic signs. The differences in articulation accuracy between iconic and arbitrary signs were more evident in signs including more phonological features (higher phonological complexity). These results were interpreted as participants being unable to map arbitrary signs onto a referent thus having to pay closer attention to their components to imitate them accurately. In contrast, participants were able to associate iconic signs with their referents, and during articulation participants retained the iconic elements of signs but dismissed their exact phonological structure. Perhaps participants did not discriminate the phonological structure of iconic signs because they recognised their meanings due to their clear mappings with their referents. These results suggest that iconicity plays an important role during phonological development and would predict that learners will be more accurate at identifying the phonological features of arbitrary than iconic signs. Contrary to the facilitation effect found in sign learning, results from Chapter 4 indicate that iconicity may have a negative effect in sign L2 phonological development. Non-signers may be less capable of recognising the phonological constituents of iconic signs because the resemblance to a referent allows comprehending their meaning without phonological mediation. This type of superficial processing is similar to the processing of

iconic co-speech gestures in that speakers' attention does not centre on the specific handshape, location, movement or orientation with which gestures are executed but only on their overall similarities with a referent.

Building upon this interpretation, Chapter 5 explores the speculation that at the onset of sign language learning, non-signers process iconic signs through the same mechanism as they process iconic co-speech gestures. Iconic gestures have been reported to facilitate lexical retrieval because of their shared links to the conceptual system (Krauss, Chen & Chawla 1996; Krauss 1998; McNeill 1992). Based on the finding that iconic gestures prime semantically related words (Yap, So, Yap, Tan & Teoh 2011), Chapter 5 asks whether the iconic signs of a conventionalised sign language cause the same behavioural response in the lexicon of non-signers and whether sign language proficiency alters this effect. To that end, a cross-modal lexical decision task was administered to a group of non-signers and proficient signers. Participants were asked to look at a set of iconic signs (primes) and determine whether semantically related and unrelated target words were real or not. Sign primes depicted actions (action signs) or the perceptual features of an object (perceptual signs). If iconic signs are processed as iconic gestures by non-signers, it would be expected that signs would prime semantically related words only. In addition, given that action signs have more transparent sign-referent correspondences (higher iconicity ratings as reported in Chapter 2), it was expected that action signs would yield faster response times than perceptual signs for semantically related words. It was also anticipated that the pattern of lexical activation would be different in participants who had gained proficiency in BSL. Results showed that iconic signs activated semantically related words in the same way as gestures, confirming that non-signers process both iconic manual forms through the same mechanism (i.e., without phonological mediation). Activation occurred regardless of the type of referent because signs depicting actions and perceptual features of an object yielded the same response times. The pattern of activation was different in proficient signers because only action signs led to cross-modal activation. These results suggest that non-signers process sign iconicity in the same way as they do with gestures. After gaining proficiency in a sign language there is a shift in the mechanisms used to process iconic manual structures with factors like polysemy, phonological processing and neighbour density playing a more important role than sign-referent similarities.

Chapter 6 presents a comprehensive discussion of the results of the experimental chapters and concludes that sign phonological complexity and iconicity are two factors that determine phonological development in sign L2 learners. The results from Chapter 3 and 4 suggest that the intrinsic nature of each phonological parameter makes some of them easier to discriminate and articulate than others; and importantly, that perception in conjunction with motor dexterity can explain

the errors produced by non-signers. The ability to discriminate the phonological constituents of a sign will greatly depend on its overall complexity. Discrimination is easiest in simple signs but will be more difficult when signs include multiple phonological features. Iconicity was also found to have a negative effect in sign phonological discrimination. Learners are consistently less capable of discriminating the phonological constituents of iconic signs arguably because they can map them onto their referent in the same way as they do with iconic gestures. This suggests that at the early stages of sign acquisition, non-signers exploit their gestural system to scaffold their new manual linguistic system and as they gain proficiency they move away from articulating and processing iconic signs as gestures. Chapter 6 concludes that iconic gestures act as 'cognates' during the acquisition of a sign language as L2 because of their overlapping similarities with iconic signs. The data presented in this dissertation argues that sign L2 acquisition draws parallels with some aspects of L2 acquisition in spoken languages but also exhibits aspects exclusive to the visual modality. Chapter 6 suggests that future lines of enquiry should adhere to a specific phonological model like the Dependency Model (van der Kooij 2002) or the Prosodic Model (Brentari 1999) under paradigms including both perceptual and production tasks. It also suggests that future research in sign L2 acquisition should be well-informed of the wealth of knowledge gathered in gesture studies, another field investigating manual communication but with which sign language researchers have had limited interaction.

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