

Do you see what I see?: A first look at the implications of language deprivation syndrome for comprehension of texts in sign languages

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Abstract: The comprehension of a text is key to its efficacy. For this reason, comprehension tests with selected members of the target audience is a key quality control step before the publication of texts, including the translation of texts from the Bible. While lack of comprehension can be due to a number of factors, when translating sign language texts many difficulties can arise because of language deprivation syndrome (LDS). Language deprivation syndrome occurs when a child is not exposed to language in early childhood. This is rare in children with normal hearing but, unfortunately, is quite common in children who are deaf. Not being exposed to language in early childhood has some effects which can be lifelong. These effects can include a less developed theory of mind, inability to use and understand more complex linguistic structures, decreased ability to learn other languages, difficulty with types of scalar implicatures and neurological changes. Experienced Bible translation teams have responded to lack of comprehension of texts among Deaf who are exposed to language later in life primarily by adjusting texts through trial and error. However, a study of the effects of the syndrome may point to changes in texts which would make them more comprehensible. This paper proposes further studies which should indicate what changes would mitigate these effects and lead to increased comprehension.

1. Introduction

When a Bible translation project in a southeast Asian sign language began in 2015, the Deaf team discussed that their target audience would be high school graduates. This specific requirement was put into place because many Deaf people in this country do not acquire a first language (L1) until adolescence or adulthood. Those individuals who have completed high school are the most likely to have had enough language exposure before adolescence to be able to understand the translation. Those who do not have access to a language at infancy, struggle academically and often do not complete high school.

Those who have worked only with spoken language communities are not aware of the consequences language deprived individuals encounter because it is extremely rare for hearing children to have had a language deprived environment. Language transmission is assumed to occur intergenerationally when adults speak and children learn language through exposure. However, for Deaf people, language transmission rarely occurs within the familial unit because only four percent of Deaf children have even one Deaf parent (Mitchell and Karchmer 2004). The majority of Deaf children are born to hearing, non-signing parents. For these children, their first exposure to sign language is often in a school setting rather than at home, thus beginning first language acquisition around the ages of 5-7 or even later. Further complicating the transmission process, many Deaf people are not sent to Deaf schools and do not interact with the Deaf community on a regular basis as children. In these cases, individuals often complete childhood and have entered adolescence or adulthood before encountering the Deaf community and finally having meaningful exposure to a language. There are also many instances when Deaf adults never meet another person that knows a sign language and therefore do not have access to learn a language. When a Deaf person is linguistically isolated from the Deaf community, they rely on gestures for communication, this is commonly called homesign.

Language acquisition has been shown to have a critical or sensitive period for development (Lenneberg 1967, Mayberry and Kluender 2018). Critical or sensitive periods are specific time periods when the brain is uniquely able to acquire a skill. In animals, common examples are bird learning birdsong. For humans, when there is no exposure to natural language during the critical period for language acquisition, it has multiple interrelating effects that are known as language deprivation syndrome (LDS) (Glickman and Hall 2019). While we describe a variety of effects of LDS, it is important to note that this should be considered as a spectrum. Adults who rely on homesign to communicate with family members, never having access to an L1, would be the most severe on this spectrum, while those

who were exposed to a natural sign language as young children (but not from infancy) would show the least effects and be the least severe. Unfortunately, LDS affects a wide number of deaf individuals both in developing and developed nations. Around 80% of deaf children in developing countries do not receive any education (WHO 2013) and those who do may not complete high school due to lack of effective educational support as well as various societal, practical, and financial factors. This aforementioned SE Asian sign language Translation team is a developing country where it is likely that the majority of deaf individuals in the country have severe enough LDS that a translation in their sign language does not grant them effective access to scripture. Due to these factors, the translation team decided that a sign language translation would not effectively communicate to those with severe LDS, and limited their target audience to Deaf who have completed a high school degree - a fraction of the total Deaf population, some of whom still likely have mild LDS.

Section 2 will provide an overview of the effects of LDS that are known so far. Section 3 will then describe the ways in which the effects of LDS are being addressed in current translation work. Section 4 will provide a brief, and far from exhaustive, list of future studies needed to fully understand and address the issues introduced throughout the paper.

2. Language Deprivation Syndrome

2.1 Neurological effects

Possibly underpinning all other effects are the neurological changes that have been documented in individuals with LDS. Current research has documented both functional changes in how the brain processes language and structural changes to the brain as a result of LDS. It is widely accepted that the brain has more plasticity at birth and through conditioning and maturation, that plasticity is lessened with age. Individuals with LDS are lacking critical input of language during the time when the brain still has high levels of plasticity. Therefore, their brains mature without the input of linguistic structure or information. When performing linguistics tasks, Deaf individuals with exposure to their first language later in life (those who experience LDS) showed activation in more posterior areas of the brain used for visual processing rather than in the classic linguistic areas of the brain (Mayberry, Chen, Witcher and Klen 2011). This is not because sign language is a visual language. Deaf individuals who began signing at birth did not show this pattern, but had neural activation in the typical areas of the brain for language processing. Because there was no exposure to language during the critical period of language acquisition, individuals with LDS cannot process language in the same way as people without LDS. Not only do the brains of people with LDS process language differently, they are actually structurally different from those who had access to language since birth. In structural scans of the brain, “The results show that delayed acquisition of a first language is associated with changes in tissue concentration in the occipital cortex close to the area that has been found to show functional recruitment during language processing in these deaf individuals with a late age of acquisition.” (Pénicaud et al 2013). Without input of language during the critical period, the brain is forever changed and continues to show differences in its structure and language processing after language is introduced.

2.2 Linguistics effects

These neurological changes are related to linguistic disfluencies in all areas of language. Starting with the smallest unit of language, an initial case study of two individuals with LDS showed that they mastered 80% and 67% respectively of handshapes in ASL once they were fully exposed to language (Morford 2000). Despite linguistic production of phonologically acceptable forms being quite high, multiple studies have found that both rate and accuracy of phonological processing in individuals with LDS is an area of concern. Experiments have shown that even given extended processing time, those with LDS perform lower than other signers on phonological processing tasks even at the single word level (Mayberry 2007).

Every study that we have found that examines production or comprehension of morphological information encoded in language has found significant negative effects for individuals with LDS. In production, these signers tend to strip the morphology from words, producing only the “frozen” lexical items or apply morphological rules inconsistently (Newport 1990). In comprehension, individuals with LDS have shown a lack of sensitivity to verb agreement (Emmorey et al 1995).

Even those adults with LDS who are considered functional in ASL show consistent grammatical (syntactic) errors that lead to misunderstandings. These individuals fail to use grammatical features such as topic comment structure. Also, failure to use proper morphology on verbs lead to confusion of subject and object which, as can be imagined, causes major misunderstandings in communication. In studies of individuals with LDS who have learned ASL later in life, they have been shown to produce sentences with basic word order, but not with more complex word orders (Newport 1990). However, there is growing evidence that they do not rely on basic word order in comprehending linguistic information, but instead rely on probable event bias (Cheng 2019 forthcoming). When given improbable nonsense sentences, signers with LDS consistently reversed subject and object in their comprehension in order to make a sentence that matched their bias of how the world works. In contrast, individuals who learned language from infancy, regardless of their experience of signing ASL, consistently relied on basic word order even if the sentence meaning was improbable. Without the syntactic building block of basic word order, more complex syntactic constructions are incomprehensible. Experiments examining grammaticality judgments for various syntactic structures found that individuals with LDS differed from those who were exposed to sign language from birth in accuracy in all areas studied, but not in latency of responses (Boudreault and Mayberry 2006). Various syntactic structures from simple sentences to relative clauses were examined. In all of them late learners showed deficits that support the findings of others, namely, individuals with LDS never gain native syntactic skills even at the basic sentence level despite exposure to sign language later in life. It is fairly common during comprehension checks of a Bible translation with community members, to have one or more of the participants confusing who the subject of an action is with the object, or other grammatical features. Often, when there is confusion, a smaller segment of the passage is shown a few more times to see if it is understood accurately or if the translation is in error. When reviewing the passage multiple times, the community members are often able to see what they originally misunderstood. If the majority of those present understood it correctly we assume that the translation is correct and move on in the process. This anecdotal experience is consistent with findings by researchers that LDS affected Deaf often need more time to process a sentence or phrase than those without LDS. Interestingly, in studies which provided picture support to basic sentence tasks, individuals with LDS could perform at near native levels, although they still struggled with complex sentences (Boudreault and Mayberry 2006). A SE Asian sign language translation team have in their most recent distribution produced videos both with and without pictorial support so that the Deaf had the ability to choose whatever was more beneficial to them. Those with native-like language abilities felt that pictures detracted from their ability to focus on the signer and understand what was being signed, while those with LDS struggled to understand the story without the pictorial support.

There has been less study of comprehension of semantic relationships for individuals with LDS. One study showed that individuals with LDS were not able to master lexicalized scalar implicatures despite exposure to ASL even though they were able to respond appropriately to implicatures using quantity or spatial relations (Davidson and Mayberry 2014). A scalar implicature is the understanding that when a statement uses a scale there is an implication that other items on that scale are not true. The specific lexicalized scale in this study was some/all. The participants were tested on whether they would infer that some meant “not all.” For at least this limited area, lack of linguistic input in childhood resulted in individuals not making connections of implied meaning. Further studies into the effects of LDS on semantics are necessary.

Effects in every area of language have been shown for individuals with LDS even after they are exposed to a natural sign language. For example, Teri Miles was involved in a community comprehension check on a New Testament passage which was fairly long, around 30 verses or so. One of the Deaf women who attended the session was able to digest and repeat the entire story after watching the video

twice. Her recall and handling of the text revealed that she not only understood the passage, but was able to help the translation team come up with even better ways of rendering sections or phrases. However, the other Deaf people present were unable to recall more than just the basic tenants of the passage and needed to slowly walk through the passage to make sure they understood the translation and that it was accurate. When trying to determine the reason for the discrepancy between how the different participants were able to understand the passage it became clear that the woman who was able to understand the passage so well had access to language as an infant because her parents are Deaf. The other participants did not receive any language access until they were school age.

Two notable commonalities in various linguistic errors are response time and production versus comprehension effects. First of all, those with LDS have been shown in multiple studies to process grammar more slowly and with more errors than their peers (Skotora 2012). However, adults with LDS create meaning out of linguistic input at normal speeds (Skotora 2012). Similarly, multiple studies found that signers with LDS formed grammatical judgements at the same rate as native signers, but their accuracy was much lower (Bourdreault and Mayberry 2006). This could explain why clinicians working with individuals with LDS have reported that they often “too easily jump to conclusions, miss subtleties, and feel an unsupported certainty in their beliefs” (Gulati 2019, 39). This would logically lead to many errors in the comprehension of texts. Secondly, there are often gaps between what an individual with LDS is able to produce linguistically and what they are able to comprehend. Individuals with LDS actually perform better in producing language than they do in comprehending it. This is important to note so that teams and others don’t assume that because a person can relay information they will be able to access a text. It is often the case during comprehension checks, where one or two individuals misunderstand the translation not because of any error on the part of the translation but due to the effects of LDS on their comprehension abilities. A decision has to be made at that point to move on in the comprehension check, determining that there is nothing wrong with the translation, but only the ability of certain individuals to comprehend it due to LDS. Sometimes, when most or all of the participants struggle with LDS, a comprehension check has to be scrapped and redone at a later date. While it is stressed that qualified community members should be invited to participate in comprehension checks, it is hard to determine who suffers from LDS just from normal conversations among peers. Many of the underlying effects of LDS may not be realized until a non-typical story or situation is related to them. For example, when a long pre-recorded passage is presented in which they are needing to process, it can become overwhelming. In conversations between peers, often breakdowns of communication can be clarified and dealt with in real time, where during the viewing of a translation there is no way to request more information or clarification from the signer.

2.3 Conceptual Gaps

In addition, the lack of linguistic input during early development has been shown to result in difficulties with both temporal and abstract concepts. People with LDS struggle with chronology to the point that even sequencing basic children's stories can be an insurmountable task (Gulati 2019). This is an essential finding when considering Bible translation. Many of the passages that are chosen for translation are narratives. Such concepts as flashback or prophecy would be utterly incomprehensible to an individual that struggles with basic sequencing. In addition, LDS prevents people from grasping many abstract concepts. While concrete entities can be seen and touched and experienced without any language, language is necessary to understand such concepts as grace, love, and forgiveness. For example, Gulati says “It is not unusual in a single hour-long meeting for a person with LDS to soak up a dozen new simple signs for objects and to recall and use them easily at the next meeting. It is far more challenging to convey a single abstract noun such as ‘parenting’ or side effect’.” (Gulati 2019, 35).

When at a meeting with a group of Deaf individuals in the Philippines, I (Teri) was introduced to a young man who was really excited to see that the Bible was being translated into Filipino Sign Language. He had biked over 4 hours one way during monsoon rains just to get more information. However, during my conversation with him, it was clear that he could not hold a conversation for very long. He was able to tell me about his bike trip to the meeting and briefly why he was excited, but when

asking any questions about his life other than that topic he was unable to understand how that related to the story. I tried several attempts to talk about simple basic concepts about his family, but I was unable to have a conversation about anything besides what he wanted to share with me. This is an example of how LDS prevented the man from discussing any issues that were not present and concrete.

2.4 Theory of Mind

Theory of Mind (ToM) is an important skill which children start acquiring at a young age (beginning as early as age 3). ToM is the ability to be conscious of one's own beliefs, knowledge and experiences and to know that others may not have the same beliefs, knowledge and experiences. Different aspects of ToM are -

1. Diverse Desires (DD)
2. Diverse Beliefs (DB)
3. Knowledge Access (KA)
4. (Content) False Beliefs (FB)
5. Hidden Emotions (HE)

Children acquire ToM from interactions and conversations with others and from having people's actions explained. Deaf children often do not have these interactions and conversations. At home there may be no one to explain things to them, to help them understand why someone acted in a certain way. Some studies show that by later ages Deaf children often reach parity with their hearing peers. However, most of these studies have been in a school setting and in many parts of the world the majority of Deaf children do not get to attend school and if they do, they attend for fewer years.

Until Deaf children learn a language they are left with observation alone. They cannot learn what others are thinking or saying. They can only guess the reasons behind people's actions. So far, we have found no studies indicating that a deficit in theory of mind continues into adulthood. However, it is logical to assume that Deaf adults with LDS would also have a less well developed theory of mind.

Around 2008 or 2009, I (Harry) was working with the (first) Filipino Sign Language translation team. I had just started reading about ToM so I decided to share with them what I had found. They caught the idea quickly and indicated that they had a challenge with passage of the Bible that they were translating and that it may have been due to ToM. In 2 Samuel 11 is the story of David and Bathsheba. After her husband was killed the leader of the army, Joab, sent a messenger to David. This is a complicated ToM in that the message carried by the messenger had two meanings. Only Joab and David were supposed to understand the true meaning of "Uriah the Hittite is dead". The servant did not know that Joab was following David's orders. However, the translators translated in such a way that the messenger knew the true meaning of the message. Their translation advisor explained the situation to them. When they understood the situation they revised their translation.

We predict that a less well developed ToM will have led other translators to misunderstand the source text and to translate incorrectly. Sometimes the consultant will pick up on this but not always. In other situations the translators will have translated a passage correctly but it may be misunderstood. Sometimes this is discovered during comprehension testing. When it is, then the translation can be modified in order to make the situation more clear.

Further research is needed into whether Deaf adults with LDS have a less well developed theory of mind. If the research shows that this is the case then passages with complex ToM situations can be made more clear. It would also help to make a list of passages with complex ToM and to make sure that translation resources provide help to translators.

2.5 Effects on L2 acquisition

Without a fully internalized first language, individuals with LDS never attain high levels of competence in subsequent languages. For translators with any degree of LDS this can lead to great misunderstandings and difficulty with a source text. It also could affect their ability to access resources such as commentaries on a passage. Several experiments have shown that individuals with LDS perform

worse in English tasks than Deaf native signers and hearing L2 learners (It is noteworthy that these two groups of L2 learners performed at similar levels). (Mayberry 2007). In fact, on complex syntactic structures (such as relative clauses), individuals with LDS performed at chance levels in the experiments.

“Specifically, the mean English reading grade achievement of the group with high ASL grammatical skill was at the post high school level. By contrast, the mean English reading achievement of the group with low ASL grammatical skill group was between Grades 3 and 4 (Chamberlain, 2002; Chamberlain & Mayberry, 2007).” Mayberry 2007

It has been commonly explained that Deaf people struggle to learn written language because of the correlation between sounds and orthography; however this is clearly not true in the above experiment for Deaf native signers. The inability to reach high levels of proficiency in written language is due to LDS not to deafness. However, it also needs to be noted that for some Deaf who have a strong L1, they may not have a strong L2 due to lack of education access. However, if those who have a strong L1 foundation, learning an L2 is a reasonable expectation that is within their neurological and linguistic capabilities with access to quality education (Gulati, 2014).

3. Current response

While there is no way to change the neurological effects of language deprivation once it has occurred, there are various linguistic remediation strategies being attempted. One example of these efforts is occurring in Nicaragua where there are programs for adults with LDS to learn Idioma de Señas de Nicaragua (ISN). This program has serviced and collected data from over 400 adults with LDS in their language acquisition process. Among the strategies they have found successful in teaching communication are explicit teaching of grammatical concepts, using shared stories to improve narration, and providing language examples that are closest to the individual’s current ability with gradual increases in complexity over time (Spitz and Kegl 2019). However, even with intensive intervention, most individuals only attain to an “expanded gesture” level of communication. For most individuals with LDS who have their first exposure to sign language as adolescence or adults, they never use any form of grammar. They can expand their vocabulary and communicate in 3-4 word utterances, but never go on to use grammatical forms (Spitz and Kegl 2019). Interestingly, there is no mention whether these strategies have any effect on the comprehension of language by individuals with LDS.

Translation teams have attempted to address these issues through various methods and ways. Some teams travel to meet with deaf people and their families to try to encourage them to be sent to Deaf schools, Deaf churches, or establish relationships with deaf to be able to teach them the local sign language. A translation team in SE Asia uses shared stories, acting, etc. to teach sign language while travelling and produced language primers to be left with individuals with LDS in rural areas. Other teams have less formal engagement with language deprived individuals and often Deaf churches engage in reaching out to the Deaf in their surrounding area.

These above examples attempt to increase the language ability of individuals with LDS, but with the lack of research targeting effective strategies no one knows their efficacy and how they can improve strategies. Also, these strategies do not directly address how translations should be modified to enhance comprehension. Often translations are adapted and simplified through comprehension checks with the Deaf community in order to meet their needs, some of whom are affected by LDS. However, teams and consultants are unequipped to understand the effects of LDS on language use and comprehension. Currently, the main issue is that there are no consistent guidelines for such changes.

We propose that in addition to supporting remediation efforts, translation teams should consider the following:

- Decide if and how their project aims to reach those with LDS with the Word of God, whether through their current project translation goals or a different project.
- Strive to use simple short sentences
- Provide accurate pictorial supports when possible

- Publish simplified stories that would target Deaf affected by LDS. While this would be considered more along the lines of children's stories, then translation - it would be helpful to introduce the gospel to those who are strongly affected by LDS.
- Visual storyboards: Produce drawn storyboards of selected passages for those who could not understand the sign language translation.

4. Suggested future study

Linguistic Deficits

- Early research has shown that language deficits cannot be corrected by training. Is that true? Is this true of all deficits?
- For those well past the normal age of learning L1 are differing teaching methods needed?
- A more detailed analysis of how LDS affects eventual linguistic outcome is still needed
- Studies into semantic effects of LDS
- Studies showing how much various factors affect comprehension. For example, how much does picture support help? Is there any effect of priming?

Modifying Sign Language Texts

- What changes can be made to sign language texts in order to compensate for a less than fluent audience?
- Would such changes be acceptable to those who are more fluent?
- Would such changes be acceptable to other constituencies, e.g., funders and "outside" authorities?

Translation Personnel

- What type of training is needed for translators so that they can avoid translating in such a way that makes texts harder to comprehend for those with LDS?
- Translators need training so that they can properly interpret the results of comprehension testing. Why are segments of the audience not understanding the text but others are? Is LDS a likely cause and, if so, what part of LDS is responsible?
- What resources need to be provided to translators so that they can understand the source text so that it can be translated clearly?

Theory of Mind (ToM)

- Most studies of ToM have been of children and most of those have been of school children. Studies need to be produced of Deaf adults with various levels of schooling and with LDS. These studies need to be of all five aspects of ToM and not just one.
- Can deficits in theory of mind be overcome with training? If so, what kind of training is most effective?
- What changes in texts can compensate for ToM deficits? Would such changes be acceptable to all constituencies?
- For translators what sorts of study materials are needed so they can understand complex ToM situations in the source text?

Pictorial Supports

- How do pictures affect "readability" of translated texts?
- What standards of practice need to be adopted for inclusion of pictures in a translated text?
- What rate of introducing new pictures is most effective? Are other factors more important?

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