



Incomplete Input as a Poverty of the Stimulus Argument

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Abstract

Chomsky's Poverty of the Stimulus argument provides a model of language innateness where internal factors are the main force in language development. Such an argument necessitates the examination of cases where child-learners have only incomplete language exposure, if any at all, and yet were able to produce a regularized and structured language output, presumably by compensation via an inborn mechanism. Deaf children raised in completely non-signing environments, with resultant internally developed sign systems, and a case study of a deaf boy able to improve on the sign taught to him by non-native signers, give individual examples of support for Chomsky's claim. On a larger, community-based scale, the development of Nicaraguan Sign Language by a group of deaf children, and the subsequent reforms by younger signers, demonstrate an instinctive drive towards a language system. By examining these situations of incomplete input and the following expansions by the child-signers, researchers can evaluate the validity of Chomsky's argument and come closer to understanding the issue of the innateness of language.

Introduction

Questions regarding the mechanisms by which humans, particularly children, learn spoken language have been asked since the inception of the disciplines of philosophy and linguistics. Some theorists contend that an ability to utilize language is universal and inborn in all humans, though such a "language faculty" has never been anatomically defined. Noam Chomsky's (1980, 1986) Poverty of the Stimulus argument is in favor of linguistic nativism and concludes that some aspects of grammar must be innate. It was hailed by many as proof of such an innate propensity to language and a human faculty of language. However, this model has been questioned and criticized, especially in regards to its claim that children do not receive full language exposure or input (Pullum & Scholz, 2002; Scholz & Pullum, 2002). As such, it is useful to examine cases where the child-learner definitively has only incomplete input, yet is able to produce a complete,

or at least regularized, language output. Two such situations are found in deaf children who learn American Sign Language (ASL) from imperfect nonnative speakers and the emergence of Nicaraguan Sign Language. Both instances exhibit child learners who, despite deficient input, can surpass their models and formulate a fuller language.

The Poverty of the Stimulus argument was first, and most famously, proposed by Noam Chomsky (1980) in his work *Rules and Representations*. The essential claim is that human beings must have some form of innate linguistic capacity that provides additional knowledge to language learners. The argument is twofold: Firstly, in general conversation, speakers' mistakes are generally not attended to or corrected, meaning children are continually exposed to incorrect language that is often not identified as such. Because of interference from these incorrect encounters, children should not be able to reach an understanding of the rules that govern the language system. But, obviously, normal children develop complete, correct language. Additionally, if children do not hear sufficient positive input, or correct speech, they should have difficulties acquiring and using language. However, it can be demonstrated in some cases that an incomplete or incorrect input still yields a full and rich output, suggesting an internal, innate faculty to mediate and supplement the stimuli. Analysis of the Deaf communities to be discussed provide support for this argument and supply evidence in favor of its validity.

However, many criticisms have been leveled at this argument. Firstly, the two contend that negative evidence, or direct indication of ungrammatical constructions, is clear from the absence of certain forms: if some word arrangements are never heard, they are likely to be incorrect. However, Chomsky argues that it is unlikely that such "indirect negative evidence," as he calls it, would be sufficient for language acquisition on its own. Secondly, Scholz and Pullum (2002) note that negative evidence may not be as uncommon as previously thought, and point to the reasonably high number of such constructions in child speech databases. Again, though, Chomsky's followers have maintained that such occurrences are unimportant, given children's possible lack of attention to or memory for the episodes.

Most relevant here, though, is Pullum and Scholz' (2002) argument that children are given sufficient positive input to fully learn language. Computational models have been able to learn grammar rules and acquire some words from limited sets, though some remain skeptical that such models could work on a full language (see Pinker & Skoyles, 1998). Situations where an obvious dearth of positive input is notable, though, can respond to this criticism: if there are circumstances where children have little to no positive language input and yet still produce a language output, it can be more effectively argued that an internal mechanism must be present to supplement the environmental shortage. The cases of the deaf children in hearing families, or at least non-natively signing families, and the deaf students in Nicaragua both begin in situations where there is such a poverty of relevant input stimuli, and thus provide evidence against Pullum and Scholz' (2002) contention and support for Chomsky's poverty of stimulus theory.

Sign Language as a True Language

Until at least the 1960s, researchers and linguists commonly felt that sign languages were merely gestural imitations of actions and only a form of mime or mimicry. As such, sign languages were thought of as linguistically deficient and not considered as full or expressive as "real" languages. Under this mentality, no argument about Poverty of the Stimulus based on research on sign language could be considered, as it would be dismissed as evidence only for the development of a simplistic gesture system and not a real linguistic system. However, experts in the field no longer hold this attitude and the current work of language researchers reflects this stance.

Petitto's work (Petitto & Marentette, 1991; Petitto, Zatorre, Gauna, Nikelski, Dostie, & Evans, 2000; Petitto, & Kovelman, 2003; Petitto, Holowka, Sergio, Levy, & Ostry, 2004) demonstrates the modality neutrality of the human language ability. Her studies of the babbling patterns in deaf children and the brain activation pattern similarities between speakers and signers during linguistic activities lead to the conclusion that sign is indeed used as a natural language and can be considered as complex, rich, and valuable as spoken language. When tracking the hand movements produced by babbling infants exposed to either speech or sign, Petitto et al. (2004) found that the kinds of babbling produced were qualitatively different between the two sets of infants. Sign-exposed babies made both slower, repeated movements directly in front of their bodies, or movements akin to meaningful sign language, and faster non-repeated movements in side spaces, while speech-exposed babies babbled with their mouths and made only the faster hand movements. Petitto et al. (2004) thus argued that the slower front-space movements corresponded to linguistic experimentation and babbling for the signing infants and were the equivalent of the oral babbling for the speech-exposed babies, demonstrating the language basis for sign.

Moreover, through neuroimaging studies, Petitto et al. (2000) have found that signers, when watching and interpreting sign or when actually signing, primarily use their left hemisphere, the side noted to be in control of language functions and specific areas known to be involved in the production of speech and hearing. Activation was not as high in the subjects' right hemispheres, which is thought to control spatial reasoning. These results would indicate that sign language is linguistic and not simply gestural or imitative, and thus is able to be used as fully and creatively as spoken language.

Additionally, Marshark and West's (1985) tests of deaf children's creative language abilities found them to be the equals of their hearing counterparts, as deaf children produced as many figurative constructions as their hearing peers, and even more types of nonliteral expression, suggesting that sign languages allow for as much expression and creativity as spoken. Such results give credence to the idea that sign language is a true language. Thus, the studies and findings to be discussed can be considered as evidence for the innateness of language in general, not just for sign.

Small-Scale: Deaf Children Learning Sign from Non-Native Speakers

The case of individual deaf children who are not exposed to a sign language or have as their source imperfect speakers is a small-scale situation where impoverished input can be seen to lead to a more comprehensive output. Unfortunately, this situation appears to be the norm for many of the deaf: it is estimated that only 10% of deaf children are born into families with at least one deaf parent (Newport, 1999). The majority of deaf children are born into, or live in, hearing families and hearing environments. This was especially true during the 1980s, when sign language was not generally considered a "real" language and deaf children were generally sent to oral-focused schools and parents were instructed to refrain from gesturing to their children. Oral education of the deaf, though, is a long and arduous process, and all too often unsuccessful, meaning children were sometimes left without a formal method of communication. Fortunately, through their own ingenuity, such children have shown the ability to generate a system of communication. For instance, deaf children of hearing parents who learned some sign, though imperfectly, were shown to be able to grasp and expand on the underlying syntactic rules though they were exposed to only impoverished sign input (Goldin-Meadow & Feldman, 1977; Goldin-Meadow & Mylander, 1983, 1998; Mylander & Goldin-Meadow, 1991; Goldin-Meadow, 2003). In addition, a case study of a deaf boy of deaf parents furthers this idea of children's ability to

surpass their input, and in some situations even use constructions and signs never used by their models (Newport, 1990, 1999; Singleton & Newport, 2004). These two examples are here examined.

Homesign: A Lack of Input Results in a Limited but Regular Code

Goldin-Meadow and her colleagues (Goldin-Meadow & Feldman, 1977; Goldin-Meadow & Mylander, 1983, 1998; Mylander & Goldin-Meadow, 1991; Goldin-Meadow, 2003) have studied children in linguistically impoverished situations and have found that the children, though they have access to little or no linguistic input, are able to develop a way to communicate and express their wants, needs, and thoughts. A system of gestures and signs called “homesign” is often developed in such situations (Mylander & Goldin-Meadow, 1991). Homesigns are basic signs and phrases unique to each isolated child but which comprise more than primitive nonlinguistic gestures. Such systems, though simpler than full languages, are still noted to have consistent sign-meaning mappings, morphological features, and a structured gesture-order. In this, homesigns appear to parallel some features of normal language acquisition (Mylander & Goldin-Meadow, 1991).

The development of homesign in the cases Goldin-Meadow has studied can be directly traced to an innovation of the child. The majority of the parents in the cases studied were instructed by their child’s teachers to refrain from gesturing to their children, making it unlikely that much input could come from a parental model; the experimental evidence from Goldin-Meadow and Feldman (1977) appears to support this premise. The researchers have demonstrated quantitatively and qualitatively the differences between parents’ habitual gestures and the child’s signs through analysis of elicited videotaped interactions in which researchers visited each family at home and presented toys. The videos were intercoded by multiple research assistants to note communicative gestures within motoric movement streams (Goldin-Meadow & Feldman, 1977).

After recoding and analysis, mother and child were reliably found to show gesture-order differences in their signings, with parent-gesture more closely corresponding to the English word-order system than the child’s, meaning that the child could not have simply learned a word- or morpheme-order pattern from her parents. It also implies that the English order, as taught in school, would not have had a strong influence (Goldin-Meadow, Mylander, deVilliers, Bates, & Volterra, 1984), suggesting that the sign system is internally developed. Further, even if the school imposed a variant of sign known as “signed-out English” or “manually coded English,” a form shown to be incongruous with real natural languages, deaf children were observed to “self-correct” and revert to more ASL-like, and thus more natural-language-like, constructions, decidedly separate from their input (Gee & Mounty, 1991).

Additionally, Goldin-Meadow and Feldman (1977) found that the children studied began to use longer, multi-sign phrases conveying semantic relations earlier than their parents, again suggesting that the children could not simply be imitating or copying their sources, and often were the inventors of new signs later imitated by their parents (Goldin-Meadow & Feldman, 1977). These longer phrases were also noted to be recursive, or self-referencing and repeating, a particularly important and unique element in human language and, given the reduced input, a characteristic that must have arisen internally and thus be innate (Goldin-Meadow, 1982). Mother and child also only used the same sign for an object about a quarter of the time, again demonstrating that the child was not simply ‘copying’ her parents’ gestures; the child-learner is thus shown to be the creative force behind the gestural system. Such a schism in usage and

development is notable, for it allows a researcher to strongly theorize that, if there is no other or fuller input, some internal mechanism must be in place to automatically supplement it.

Interestingly, a sign-resemblance could be found across the children studied, though not always between mother and child. Goldin-Meadow and Mylander's (1983) subjects all had in common a usage of basic handshapes: "Point and Thumb handshapes referred to manipulation of very narrow objects, Fist and O referred to wider objects, and C and Palm were used for the widest objects... All of the children used Point for straight thin objects..." (Slobin, 2004, p. 12). This cross-child similarity also held cross-culturally, specifically in comparisons of Chinese and American deaf children of hearing parents. Even here, the children's signs were more similar to each others' than to their mothers' (Goldin-Meadow & Mylander, 1998). Similar shape-class relationships and forms are found between ASL and other sign languages, suggesting a kind of innate, internally-driven convergence despite radically different starting points.

The development of a regularized, structured homesign system in the face of little to no linguistic input, including parental input, gives credence to those arguing for innate language via Poverty of the Stimulus. The fact that the deaf children were found to form recursive, creative, and meaningful signs and systems similar to the natural and more developed languages of the world by their own invention would indicate an innate drive to linguistic communication (Goldin-Meadow et al., 1984). As Feldman, Goldin-Meadow, and Gleitman (1978, p. 408) stated,

We have studied the communicative system developed by young children who are as radically deprived of language input as can be imagined. We have found that these linguistically isolated individuals display communicative skills that are language-like, despite their deprivations. We conclude that there are significant internal dispositions in humans that guide the language acquisition process.

Such expressive output from such impoverished, and indeed almost nonexistent, input supports the Poverty of the Stimulus argument and indicates an internal system for language.

ASL and Impoverished Input: The Case of Simon

A more specific situation can be seen in the case of Simon, a profoundly deaf boy who is the son of deaf parents who learned ASL as teenagers. In this way, he is at an advantage for learning language, though his situation is still imperfect. Most likely due to the age at which they learned sign, Simon's parents are not completely fluent signers; though they use the basic components fluidly and consistently, they are noted to have certain flaws among the more complicated elements. Simon's performance in ASL, though, has been noted to surpass that of his parents. However, this occurrence is not due to a supplemental source of input: Simon's school uses a form of signed English, which has been noted to have an unnatural structure, and has no friends who know ASL (Newport, 1999).

Singleton and Newport (2004) studied Simon and his signing from ages 2 to 9, again via elicited video interactions and conversations, comparing Simon to both his parents and deaf children of native-signing deaf parents on certain elements of sign. One component examined was morphology, or the use of ASL's smallest meaningful signs, as Simon's parents here demonstrated inconsistencies, a deficit that is perhaps not surprising, given ASL's highly complex morphological system. For example, Simon's parents tend to use the "movement" morpheme correctly in 65-70% of cases, with the mistakes in the remaining 30% having no pattern or correlation either individually or between parents. Simon's usage, though, is decidedly improved from his parents'; he uses the correct movement morpheme about 90% of the time, a substantial

improvement, given that his input included unpatterned, unpredictable mistakes for a third of the entries (Newport, 1999). Additionally, Simon's performance on the use of movement morphemes was on par with that of the compared deaf children from native-input backgrounds (Newport, 1999). As there is no outside influence to support this compensation, such an improvement points towards an internal correction mechanism and drive towards convergence upon the standard form.

This impressive rate can be contrasted with Simon's input and performance on the "classifier" morpheme, employed correctly by his parents only 40% of the time (Alexiadou & Roberts, 2000). Though his performance was more consistent with the regular ASL form than that of his parents, Simon was not able to reach the same level as the native-input deaf, as even by age nine his usage was not as complex as that of a native signer (Alexiadou & Roberts, 2000). Finally, Simon's parents did not use certain highly complex types of morphemes and thus Simon was never exposed to them; subsequently, he failed to develop such classes or categories completely (Newport, 1990; Ross & Newport, 1996). In contrast, though Simon's parents did not use some universal features of natural languages, such as topicalized structures, Simon could and did use them (Newport, 1999). These last two observations imply that when a feature is simply an element of one specific language some initial input is needed, but when it is universal it can be internally realized. The evidence for an ability to create universals without input suggests an internal, innate language faculty and supports Poverty of the Stimulus-type arguments.

Though Simon's linguistic competence cannot be said to represent perfect acquisition of sign, it converges more towards the accepted form of ASL than the performance of his parents. He was able to overcome some degree of uncertainty on certain elements of the language, changing his input's probabilistic and inconsistent content to the more regularized, structured system found in ASL and other natural languages. As Newport (1999, p. 168) stated, "Where his input was adequate, Simon's resulting morphology matched that of native ASL; where his input was less adequate, Simon nevertheless moved toward native ASL and stopped short of a full native system only as the disorder of the data he received...intervened." Simon's ability is not cited here as a unique case, but as a representation of the human ability to overcome incomplete input, as also demonstrated by the earlier-discussed deaf children in situations of greatly impoverished language input.

Large-Scale: Nicaraguan Sign Language as a Situation of Incomplete Input

In contrast to the individual, small-scale language developments discussed above, the invention of Nicaraguan Sign Language is a large-scale, community-based phenomenon and demonstrates another instance of impoverished input begetting a complete, rich language. Prior to 1979, there was no Deaf community in Nicaragua. Deaf citizens were thinly scattered through the country, with little to no intra-Deaf contact and with marriage and inheritance patterns tending not to lead to deafness running in families. While each individual most likely created a homesign system for reasons earlier discussed, such systems were still limited and individualistic. Although they may have approximated some elements of a natural language, they were lacking in many others and not immediately sufficient for communication outside of the family (Senghas, 1995a). Additionally, while the previously discussed homesigning children had parents who learned at least some elements of sign language, the Deaf in Nicaragua lacked even imperfect signing models, meaning the task of generating any kind of communication system was entirely laid upon the child's creative capacities.

However, the education system imposed after the Sandinista revolution of 1979 saw the creation of new special-education schools where deaf Nicaraguans were brought together in close

contact for the first time. Though the schools stressed an oral method of teaching, the students were able to communicate via sign and gesture outside the classroom; this situation resulted in the melding and formalization of the individual homesign systems into a greater composite, producing the first large-scale language of sign in the community. With successive generations of signers, garnered from new students each year entering the schools, sign flourished and continued to develop, adding more features and converging on elements found in other mature sign languages (Kegl, Senghas, & Coppola, 1999).

As such, Nicaraguan Sign Language demonstrates two levels of children's compensation for impoverished input, and thus two examples of support for the Poverty of the Stimulus argument. The initial meeting and combination of the narrower, shallow homesign systems produced a more complex sign language shown to be more than simple mimicry and independent of both the syntax of the spoken Spanish of the country and common Nicaraguan gestures. However, another level of development was added as new young deaf children entered the signing community: though these students learned the sign developed by the older children at the school, the system handed to them was at times itself impoverished, irregular, or idiosyncratic. This second generation parallels Simon's creativity in their reformation and shaping of the language into a more complete, regular system. The substantial differences between the older and newer versions of the sign language are reflected in the two different names for the systems: LSN, or "Lenguaje de Signos Nicaraguense," is the older version, while ISN, "Idioma de Signos Nicaraguense" refers to the newer form. "Lenguaje" means any kind of communication system, while "idioma" translates as a formal, national language; thus the level of complexity and use is reflected by the nominal distinction (Senghas, 1995a, 1995b; Kegl, Senghas, & Coppola, 1999).

Cohort Comparisons: Demonstrations of Change From the Bottom

The differences between the older, original Nicaraguan signers, defined as those entering the community before 1983, and the younger newer signers, or those entering after 1983, has been elucidated by Senghas (1995a, 1995b, 2003; Senghas & Coppola, 2001; Kegl et al., 1999; Senghas, Kita, & Ozyurek, 2004) in her studies on the groups' comparative grammars, morphologies, and general signing speed and fluency. Such work demonstrates that the regularizing developments arise from the bottom, or from the newer signers, rather than reinvention imposed from the older signers and adopted by the younger due to a "prestige" status.

In one such study, experimenters compared signers' fluency, via rates of morphemes per minute and morphemes per sign, and number of mimetic signs in narratives elicited after subjects viewed a short nonverbal cartoon. Though the presence of mimetic, or imitative, gesture does not mean a sign language should automatically be deemed undeveloped, more mature versions tend to have other arbitrary and non-mimetic signs or inflections available. The team found that ISN signers had higher morpheme rates than signers of LSN, meaning "ISN signers convey more information per unit of time than LSN signers do. In other words, their signing is more fluent" (Kegl et al., 1999, pp. 196-197). Additionally, there were significantly fewer mimetic gesture signs in ISN than in LSN (Kegl et al., 1999). These results reveal Nicaraguan Sign Language's continued development over time, with the younger signers serving as the force behind the changes. With each movement towards fluency and away from mimicry, the ISN signers built upon their impoverished input, surpassing it and giving weight to the Poverty of the Stimulus case.

Similar patterns of results were found on tests of spatial morphology. Compared with older signers, younger signers who had more recently entered the signing community used more spatial modulations, a common feature of sign languages, especially in shared-reference indication. As

such, the younger signers can be seen as the innovators and developers of the modulation: “Drawn together, these results show that the youngest members of the second cohort [the ISN signers], as children, surpassed their input, taking a partially developed language and systematizing it in a specific way” (Senghas & Coppola, 2001, p. 327). Likewise, the younger signers began to break motion down into path and manner, instead of incorporating both parts into one sign, a discreteness that more resembles other natural languages. Older signers, in contrast, used one combined iconic sign, which is more similar to the gesture of the hearing, speaking population (Senghas et al., 2004). Such improvements and regularizations over impoverished stimuli brought the signs to the level of a full language.

Given little to no input, the first generation of contact deaf, or deaf children who had contact with each other, were able to generate a new and unique, though imperfect, communication language. Given relatively impoverished and incomplete input, the successive waves of Nicaraguan deaf students were still able to develop a regular, linguistically full, expressive language. ISN seems to have arisen “abruptly when very young children radically restructured a highly variable, less than optimal signed input by bringing their innate language capacities to bear in acquiring it” (Kegl et al., 1999, p. 201). The most apparent force able to fill in the gaps and allow for each leap forward is an innate faculty of language.

It should be noted, though, that the Nicaraguan deaf children’s corrections alone do not necessarily demonstrate a linguistically creative force. Child learners in any language regularly overgeneralize, overextend rules, and make mistakes allowable perhaps by underlying universals but not by their own language. This can be seen in English-speaking children’s extension of the plural marker “-s” to irregular words, making the plural of “foot” become “foots.” However, this regularization does not last, as the much more common input “feet” eventually overrides “foots.” The reason the changes developed in the versions of Nicaraguan Sign Language did not fade out is firstly due to the relatively small population of speakers, and thus less overriding input, but secondly to the fact that these children were not only regularizing but expanding the language and syntax, making it more descriptive and exact. This enhancement, without adult help, is what makes the changes from children so impressive.

Conclusion

These studies of deaf children’s creation and acquisition of language reflect the crux of the Poverty of the Stimulus argument and show another set of languages to which it is also applicable, widening the base of supporting evidence. Goldin-Meadow’s and Singleton and Newport’s studies of individual deaf children offer a qualitative view of how each child was able to improve on deficient or virtually nonexistent input, while Senghas et al.’s work with the Nicaraguan sign languages demonstrates a quantitative overview of the evolution of a complex language and change from the bottom through younger speakers.

The examples outlined in this paper serve as strong proof of an innate language faculty in support of Chomsky’s Poverty of Stimulus theory. However, others may take a less heavy-handed approach and label these children’s creations a demonstration of a bias, or possibly a propensity, of humans for language, but not go so far as to call them “proof.” While the Poverty of the Stimulus argument clearly applies directly to cases of impoverished input in sign language, it must be shown that typically developing children also encounter incomplete language exposure, whether through a lack of negative input and corrections or simply insufficient positive input; thus, a mechanism or explanation for this poverty of stimuli is not completely evident yet.

More research in the field is necessary before Chomsky’s theory can be definitively validated and, more generally, the field can come to a conclusion regarding the innateness of language in

humans. Perhaps with careful analysis of typical children's language input and more studies of signers' communication interactions, a large enough data corpus can be built to be fully analyzed for these assertions. Either way, the abilities demonstrated by the deaf children in hearing families, by Simon, and by the Nicaraguan Deaf at least show the remarkable human capacity for some form of creativity, communication, and connection.

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