Three Poverty of Stimulus Arguments

Cinnamon Jenson
Houston City College

I. INTRODUCTION

The Poverty of Stimulus (hereafter, "POS") argument is used in a number of fields of cognitive science, nature/nurture debates, moral psychology, developmental psychology and biology. In particular, cognitive linguists (Berwick et al.; Chomsky; Clark and Lappin; Cowie; Crain; Lightfoot; Pullum and Scholtz) use the POS argument to support "linguistic nativism," the view that humans have innate knowledge of certain linguistic features such as rules of syntax that are universal across every natural language.

The POS argument starts with an observation that children have "knowledge of language"—a host of implicit "knowledge" and automatic cognitive abilities—and an ability to understand, interpret, and produce language. If children acquired knowledge of language via a general learning mechanism (i.e., pattern recognition faculties that are not specific to language) then the environment must contain a rich source of primary linguistic data (e.g., spoken, written, or signed tokens of languages) from which to extract information about the rules of grammar. However, there is a poverty of linguistic data and children's knowledge of language far exceeds the set of stimuli the environment provides. Thus, children must be innately endowed with some linguistic knowledge that allows them to compensate for missing linguistic data from the environment (see Cowie for discussion).

The POS argument has been the strongest and most-cited argument in support of nativism for the last five decades. The aim of this paper is not to critique the controversial claims about nativism. Rather, I argue that the POS argument can be broken into three non-equivalent arguments and I compare and contrast these

arguments.

To see how the arguments can be distinguished, consider Seidenberg's summary of the POS argument:

> The input to the child is degenerate, consisting of both grammatical and ungrammatical sentences that are not labeled as such. It is also variable; children are exposed to different samples of utterances but converge on the same grammar . . . That essential aspects of grammar are innate—represented in the brain of the neonate—is said to be the only viable explanation for how languages could be learned so rapidly yet under such impoverished conditions. This hypothesis simultaneously accounts for universal properties of languages. (1601)

The overall conclusion to any POS argument is that children are supplementing their knowledge of language with innate linguistic content. However, it is one thing to conclude that essential grammar is innate because there are not enough linguistic stimuli in the environment. It is another thing to conclude that grammar is innate because children would not be able to interpret whether sentences are grammatical or not from a set of degenerate noise. These two arguments are not equivalent.

I distinguish three separate arguments that have traditionally been called the Poverty of Stimulus Argument:

> (1) The *Deficiency of Stimulus* (DOS) argument indicates the absence of linguistic stimuli in the child's environment, or absence of crucial features from which children could infer linguistic principles.
>
> (2) The *Corruption of Stimulus* (COS) argument indicates that linguistic stimuli are too degraded or poor to be used to acquire consistent linguistic principles.
>
> (3) The *Variety of Stimulus* (VOS) argument highlights the fact that children converge on the same knowledge of universal linguistic principles despite variations in individual's exposure to linguistic stimuli.

There are several reasons why these arguments are not equivalent and cannot be reduced to one single argument. First, the arguments point to diverging aspects of the environment in which they are raised. Some linguists focus on cases where there is too little linguistic information in the environment; others point to cases where the environment contains too much (of the wrong kind) of noisy stimuli. Second, each argument uses a different set of empirical observations about how language is acquired: e.g., acquisition follows universal developmental stages and

it must be acquired during a critical period of development. Finally, each argument draws a unique conclusion about *what* is innate. Some arguments conclude that *linguistic content* (e.g., rules of syntax) is innate, others conclude that a *cognitive structure* is innate (a Language Acquisition Device), and some conclude that a *process or procedure* is innate.

The following sections explain each kind of argument. I then motivate why I think these distinctions are important. Separating the various POS arguments will strengthen the overall nativist strategy and help clarify ways to break the stalemate between linguistic nativists and empiricists that has continued for decades.

2. The Deficiency of Stimulus Argument

The Deficiency of Stimulus (DOS) argument focuses on the *impoverished quantity* of the linguistic stimuli in the environment. In summarizing the Poverty of Stimulus argument, Jenkins offers an argument that is more appropriately categorized as an example of the DOS argument:

> The point of the argument from poverty of the stimulus is that if it is the case that during their lifetimes neither the child nor its parents have ever been exposed to or ever uttered the crucial sentences needed to deduce some grammatical property (e.g., properties of structure-dependence, subjacency, distribution of empty categories, and the like), then no amount of intelligence or ingenuity on the child's part, nor corrections and tutoring on the parents' will yield these properties. (80)

Accordingly, if linguistic stimuli from the environment are missing, limited, not relevant, or not the right kind then knowledge of language cannot be acquired via a general learning mechanism. Thus, children possess a source of innate linguistic content in which to substitute this missing information. This line of reasoning is analogous to inferring that birdsong is innate in birds that are raised in isolation (or with very limited exposure to bird song) and yet are able to acquire their species-specific birdsong (Gould and Marler).

Empirical observations that support DOS include the following list:

> (1) *Paucity of stimuli*. Linguistic stimuli in the environment are impoverished and missing crucial elements of language from which the child could infer knowledge of language.
>
> (2) *No explicit training*: Children are not explicitly taught language, unlike other knowledge like math or penmanship that must be selectively, explicitly, and painstakingly taught.

(3) *Abundant knowledge*: Children's knowledge of language is richer than the linguistic stimuli to which they are exposed.

(4) *Productivity*: Children acquire an ability to produce or understand any of an essentially unbounded number of sentences. Language is creative and compositional.
(5) *Ease of acquisition*: Children acquire language relatively quickly and easily without explicit instruction.

The cases used to show *paucity of stimulus* and *abundant knowledge* are among the strongest evidence for linguistic nativism. For example, in the case of Nicaraguan Sign Language (Goldin-Meadow; Senghas and Coppola), deaf children are raised by caregivers who do not know sign language. When children have an opportunity to socialize with other deaf children, they spontaneously develop language with consistent structure, fully-formed syntactic rules, and rules of grammar universal to all languages. Kegl describes the case of Nicaraguan Sign Language as a language that emerges *de novo*. The environment is not only missing crucial aspects of language from which to infer principles of language, it is missing *any* linguistic input since children cannot hear spoken language. This is a striking case of "acquisition of a first language by children in the absence of even fragments of a full language or languages in their input" (Kegl 199).

Other sets of empirical observations in DOS arguments are the *Ease of Acquisition* and *No Explicit Training*. Clark and Lappin point out that children "learn their first languages without explicit instruction, and with no apparent effort" and only "hears a random subset of short sentences" (33). Babies start babbling almost immediately after birth, and by 2 years old and by the age of 5 or 6, children have expert knowledge of linguistic principles, competent in forming sentences with complex principles such as c-command, the binding conditions, subjacency, negative polarity items, that-trace deletion, etc. (MacWhinney 888). These general principles of languages are barely understood by linguists, and largely unknown by people who have never studied linguistics; from this, it follows that these complex rules could not be explicitly taught (Laurence and Margolis).

3. The Corruption of Stimulus Argument

I coin the term Corruption of Stimulus (COS) for the second form of argument. This argument focuses on the *quality* of the data, not the *quantity*. Whereas the DOS is a puzzle about how people know so *much* despite the environment that provides so *little*, COS is a puzzle about how people know so *little* despite the environment that provides so *much* data of the wrong sort. The environment does

not indicate what kind of stimuli are relevant; instead, the available stimuli are degraded and corrupt. So, children have innate means of distinguishing relevant stimuli.

The following lists several observations used to support Corruption of Stimulus arguments:

> (6) *Degeneracy*: Linguistic stimuli include ungrammatical sentences, stops, pauses, "ums" and a number of nonlinguistic noises.
>
> (7) *Selectivity*: Children are able to select from among an enormous number of seductive but incorrect alternatives to acquire just the right grammar. E.g., babies only a few days old can distinguish the phonemes of any language and are primed to attend and process linguistic sounds.
>
> (8) *Filtering*: Children are able to filter out degenerate linguistic stimuli that would lead to faulty grammar formation.

These observations focus on the degraded nature of linguistic stimuli and the ability of children to reliably acquire correct knowledge of linguistic principles from such stimuli. *Degenerate* stimuli include nonlinguistic noises such as dog barks, traffic noise, or coughs. Some linguistic expressions are irrelevant, such as interrupted fragments, false starts, lapses, slurring, slips of the tongue, pauses, run on sentences, foreign words and phrases, or incomplete sentences. These data cannot be used as inputs for grammar formation. Even variables such as speaking fast, slow, or loud pose problems for language acquisition as "none of these variations matters to language per se" (Laurence and Margolis 227).

The corruption of stimuli shows that children must *select* what features of noises in the environment are relevant for language formation. As Laurence and Margolis put it, "speech doesn't come pre-sorted into the categories of reliable data and noise" (230). Lightfoot (60) notes that if only 5% of the expressions in the environment are ungrammatical, the child would have problems developing grammar if using a general learning theory. Nativists argue, then, that the mind must at least contain innate concepts such as *phonemes*, *sentences*, *nouns*, *verbs*, or questions. It is the mind that carves indistinguishable noise at its linguistic joints.

The strongest cases of COS are those of Creolization (see Bickerton, Pinker). In early colonial America, children of slave communities were exposed to linguistic data from their parents, who spoke pidgin, a make-shift combination of words used to communicate with others who spoke different languages. Pidgins have "no consistent word order, no prefixes or suffixes, no tense or other temporal and logical markers, no structure more complex than a simple clause, and no consistent way to indicate who did what to whom" (Pinker 34). Yet children

exposed to pidgin create their own language (i.e., Creole) that contain linguistic universals, systematic structure, and syntactic properties such as auxiliaries, prepositions, case markers, and relative pronouns. Pinker infers that children cannot help but add these innate rules, thus "re-invent the language" (35).

Although scholars use the case of Creoles to support POS arguments, it is more appropriate as an example of COS. It is not that there is a *poverty* of information in the environment; children are exposed to pidgin. The problem is that pidgin is degraded and does not provide stimuli from which children can extract consistent rules of syntax.

The DOS and COS arguments draw upon a different set of empirical observations. In cases relevant to DOS such as Nicaraguan Sign Language, there is no information in the environment from which children can infer any rules of grammar. A theory that would explain these empirical observations may propose some set of innate linguistic *content* such as knowledge of syntactic rules that may be triggered by minimal cues. This would explain how children could compensate for the absence of input of that content. The COS argument, in contrast, assumes a rich set of stimuli in the environment, but which is degraded or unusable for the purpose of inferring principles of grammar. A more appropriate explanation for COS is that children implicitly *sort* through information in the linguistic stimuli, *ignore* faulty or ungrammatical data, or are *primed* to focus on only relevant linguistic stimuli. These solutions suggest innate *processes* or cognitive *mechanisms*, not innate *linguistic content*. So, the kinds of theories required to explain evidence used in COS arguments are of a very different sort than those to explain DOS arguments.

4. The Variety of Stimulus Argument

I coin the term Variety of Stimulus (VOS) arguments to refer to acquisition of the same set of linguistic knowledge across individuals despite variable linguistic stimuli between each individual's environment. Few scholars mention this particular argument, though there are a number of instances where the argument is alluded to and treated as a basic POS argument.

The VOS argument presents a puzzle about how individuals who are exposed to a wide variety of linguistic stimuli converge on the same knowledge of language. As an analogy, birds raised with exposure to other species of birdsong still acquire their own species-specific birdsong (Gould and Marler). Consider that any child may be exposed to tokens of any possible natural language such as English, Mandarin, pidgin, ASL, or a multi-linguistic environment. If children acquire language via general learning mechanisms then each individual would learn a different set of knowledge contingent on the environment. Yet, children acquire the same set of knowledge such as rules of syntax universal to all

languages. As Crain puts it, the problem is "to explain how different learners converge on similar mental representations on the basis of dissimilar environments" (365). The following several empirical observations used to support VOS arguments:

> (9) *Ubiquity*: All normally developed children acquire language. Every society develops language, even in isolation from other societies.
>
> (10) *Linguistic Universals*: Certain linguistic principles are universal to every natural language.
>
> (11) *Convergence*: Children acquire the same set of knowledge of language of linguistic universals.
>
> (12) *Fixed Ontogeny*: Language acquisition develops in ordered stages, and in relatively the same pace and order regardless of chronological age, with predictable errors.
>
> (13) *Insensitivity to Variation:* Children acquire knowledge of language despite wide variation in linguistic stimuli, and regardless of their education or upbringing.

In VOS arguments, it is noted that each individual only has access to a small and unique subset of linguistic stimuli, and yet acquire the same set of knowledge. The puzzle applies to children raised in similar environments as well. Ariew calls this an *insensitivity to variation* and explains:

> Despite exposure to significantly different samples of data, different children in the same linguistic community end up adopting essentially the same linguistic intuitions, and thus, it is plausible to suppose along with Chomsky that they innately possess essentially the same grammar. (8)

At the very least, people acquire the same linguistic knowledge in order to converse with others in their own language.

More strikingly, children acquire the same set of knowledge of *linguistic universals,* aspects of language that are universal to every fully developed language, such as the Verb-Object constraint, principles of c-command, and morphological and phonological rules (Baker; Chomsky; Pullum and Schultz; see, Evans and Levinson for discussion).

The VOS argument also draws on observations that children's internal constitution varies, such as differences in "IQ, responsiveness to environmental

cues, eagerness to learn, attention span, and memory" (Laurence and Margolis 231). Nevertheless, children undergo predictable stages of language acquisition (Brown and Hanlon; Radford), thus demonstrating a *fixed ontogeny of development*. These developmental stages are found in deaf children who learn sign language (Goldin-Meadow; Kegl, et al.; Klima and Bellugi), and blind children (Gleitman and Newport). Children also make predictable errors during those stages, and these errors are universal even among cases of Creoles (Bickerton). Given the variety of linguistic stimuli in each child's environment, an empiricist would predict more haphazard development.

Whereas the DOS and COS arguments emphasize the quality or quantity of environmental stimuli, the VOS arguments appeal to similar end-states over a wide range of different environments. Appropriate theories that may explain cases of VOS may propose processes of canalization, where the end-state is determined despite variable early stages of development.

5. Cutting the Gordian Knot

Scholars have traditionally conflated the DOS, COS, and VOS arguments into one heading. This has led to a divide between linguistic nativists and empiricists for decades. It has, so to speak, created a Gordian Knot, a predicament that is seemingly impossible to entangle.

One problem with conflating POS arguments is that scholars lump together a host of empirical observations about children's abilities and the environment. However, we can now see that theories that explain acquisition in one kind of environment (e.g., an *impoverished* environment noted in DOS cases) may be inadequate to explain acquisition in another (e.g., a *corrupt and degraded* environment noted in COS cases). And, it is not clear how either kind of theory would explain a convergence of the same universal knowledge despite a *variety* of environmental stimuli among individuals (VOS cases). By separating these arguments, scholars can avoid lumping together empirical observations and will aid in creating more effective theories of language acquisition.

Another problem is that when linguistic empiricists criticize some POS arguments, they conclude that nativism fails altogether, when in fact their arguments only target some aspect of the argument. For example, Prinz argues that humans need only be equipped with a domain general mechanism used to "notice patterns, recognize familiar objects and make decisions based on prior decisions" (Prinz, 168). He points to a rich source of indirect linguistic data from which children can infer rules of grammar. Given that the environment is not as impoverished as nativists claim, the POS arguments fail to support nativism.

However, once we separate the three arguments, we can see that empiricist arguments are better suited to target some POS arguments than others. Empiricist

theories may be better suited to explain acquisition in the face of corrupt or degraded stimuli. In other words, they address COS cases: Despite noisy and corrupt inputs, a general learning mechanism can pick up on relevant patterns when they are present. However, empiricist theories are less suited to explain DOS cases. After all, a general learning mechanism must receive some input (and input of the right kind) for pattern-recognition to work. Thus, separating the POS arguments can help nativists and empiricists target theories to explain various empirical data. Given that language acquisition involves innate cognitive mechanisms as well as features of learning, nativists and empiricists must work together. It is my hope that by clarifying the explanatory scope, empiricists and nativists can move forward in a debate that has stalled for decades.

WORKS CITED

Ariew, A. "Innateness is canalization: A defense of a developmental account of innateness." *Where Biology Meets Psychology: Philosophical Essays*, edited by V. Hardcastle, MIT Press, 1999. 117–139.

Baker, C. L. *The Logical Problem of Language Acquisition.* MIT Press, 1981.

Berwick, R. C., Chomsky, N., and M. Piattelli-Palmarini. "Poverty of the stimulus stands: Why recent challenges fail." *Rich Languages from Poor Inputs*, edited by M. Piattelli-Palmarini and R. C. Berwick, Oxford University Press, 2012. 19-42

Bickerton, D. *Roots of Language*. Karoma, 1981.

Chomsky, Noam. *Knowledge of Language: Its Nature, Origin, and Use*. Praeger, 1986.

Clark, A., and S. Lappin. *Linguistic Nativism and the Poverty of the stimulus.* Wiley-Blackwell, 2011.

Crain, S. "Language acquisition in the absence of experience." *Language acquisition: Core Readings,* edited by P. Bloom, MIT Press, 1994. 364–409.

Cowie, Fiona. *What's Within: Nativism Reconsidered.* Oxford U. Press, 1996.

Crago, M. "Communicative interaction and second language acquisition: An Inuit example." *Tesol Quarterly* 26.3 (1992): 487–505.

Elman, J., Bates, E. A., Johnson, M., Karmiloff-Smith, A., Parisi, D., and Plunkett, K. *Rethinking Innateness*. 4th ed., MIT Press, 1999.

Evans, N. and S. Levinson. "The myth of language universals: Language diversity and its importance for cognitive science." *Behavioral and Brain Sciences* 32 (2009): 429-448.

Gleitman, L. R. and E. L. Newport. "The invention of language by children: Environmental and biological influences on the acquisition of language." *An Invitation to Cognitive Science,* edited by Gleitman and Liberman, MIT Press,

1995. 1–24.
Goldin-Meadow, S. *The Resilience of Language: What Gesture Creation in Deaf Children Can Tell Us About How All Children Learn Language.* Psychology Press, 2003.
Gould, J. L. and P. Marler. "Learning by instinct." *Behavior and Evolution of Birds,* edited by W. Mock, 1999, W. H. Freeman and Co. 4–19.
Jenkins, L. *Biolinguistics: Exploring the Biology of Language.* Elsevier Science and Technology, 2000.
Karmiloff-Smith, A. "Nativism versus neuroconstructivism: Rethinking the study of developmental disorders." *Developmental Psychology* 45.1 (2009). 56–63.
Kegl, J. "Language emergence in a language-ready brain: Acquisition." *Variation and Universals in Biolinguistics*, edited by L. Jenkins, Elsevier, 2004. 195–236.
Klima, E., Bellugi, U. *The Signs of Language*. Harvard U. Press, 1979.
Laurence, S. and E. Margolis. "The poverty of the stimulus argument." *British Journal of Philosophy of Science* 52 (2001): 217-276.
Lightfoot, D. *The Language Lottery: Toward a Biology of Grammars*. MIT Press, 1982.
MacWhinney, B. "A multiple process solution to the logical problem of language acquisition." *Journal of Child Language* 31.4 (2004): 883–914.
Pinker, S. *The Language Instinct*. Morrow and Co., 1994.
Prinz, J. *Beyond Human Nature: How Culture and Experience Shape the Human Mind.* W. W. Norton and Co., 2012.
Pullum, G. K. and B. Scholz. "Empirical assessment of stimulus poverty arguments." *The Linguistic Review* 18 (2002): 9–50.
Radford, A. *Syntactic Theory and the Acquisition of English Syntax: The Nature of Early Child Grammars of English.* Basil Blackwell, 1990.
Seidenberg, M. S. Language acquisition and use: Learning and applying probabilistic constraints. *Science* 275.5306 (1997): 1599–1603.
Senghas, A. and M. Coppola. "Children creating language: How Nicaraguan Sign Language acquired a spatial grammar." *Psychological Science* 12.4 (2001): 323–328.