

THE COMPREHENSION HYPOTHESIS AND ANIMAL LANGUAGE

Stephen Krashen

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INTRODUCTION

In this paper I discuss the possibility that the Comprehension Hypothesis provides a plausible explanation for animal language, both communication systems that animals develop in interaction with others of their own species (but not always their own subspecies), as well as cases of animals acquiring human language. Specifically, I attempt to determine to what extent animal language acquisition fits the Comprehension Hypothesis.

THE COMPREHENSION HYPOTHESIS

The Comprehension Hypothesis states that we acquire language and develop literacy when we understand messages, that is, when we understand what we hear and what we read, when we receive “comprehensible input” (Krashen, 2003). Language acquisition is a subconscious process; while it is happening we are not aware that it is happening, and the competence developed this way is stored in the brain subconsciously.

The Comprehension Hypothesis has had several inventors and has been known by several different names. I have referred to it as the Input Hypothesis in previous publications. Well before my work began, Frank Smith and Kenneth Goodman hypothesized that “we learn to read by reading,” by understanding what is on the page (e.g Smith, 2004; Goodman and Goodman, 1979). James Asher (Asher, 2000) and Harris Winitz (Winitz, 1981) among others, also hypothesized that comprehension is the mechanism underlying language acquisition in publications that predate mine.

I describe here aspects of human language acquisition that will be relevant in our discussion of animal language.

Affective variables and club membership

Studies have shown that several affective variables are related to success in language acquisition – anxiety (low anxiety is correlated with more success in language acquisition), self-esteem (more self-esteem is related to success in language acquisition), and motivation, especially “integrative motivation,” (a desire to belong to a certain group).

To relate affective variables to the Comprehension Hypothesis, it has been hypothesized that for input to enter the “language acquisition device” the acquirer must be “open” to the input: the “affective filter” must be low, or down. This view considers affective barriers to be outside the “language acquisition device,” a hypothesis that predicts that affective factors will not influence the nature of acquisition or the order of acquisition of the parts of language (Krashen, 1982, 2003).

Smith (1988) hypothesizes that for language acquisition to take place, the acquirer must consider himself or herself to be a potential “member of the club” of those who speak the language. It is easy to translate this idea into the affective filter framework: When integrative motivation (Gardner and Lambert, 1972) is high and anxiety is low, the

affective filter is lowered, and those late-acquired aspects of language that mark club membership are acquired.

Club membership explains why we do not always acquire all varieties of language we are exposed to, why, for example, older children prefer the language of peers over the language of their parents.

Modified input

Consistent with the Comprehension Hypothesis is the finding that less advanced language acquirers typically receive modified input. Parents and other caretakers, for example, use “caretaker speech” when they speak to young children. Caretaker speech is known to be composed of shorter sentences, has less complex grammar, and uses a restricted vocabulary (Krashen, 1981).

Role of context

Context helps make input comprehensible. Caretaker speech is typically restricted to the “here and now,” to what the child can see, hear or touch at the moment. Similarly, teachers of beginning foreign and second language students typically use pictures and realia to make input more comprehensible (Krashen, 1981).

Silent period

Children acquiring first and second languages typically go through a silent period, or a period of reduced output, before they build up enough competence to produce language. (Adult second language acquirers are often not allowed a silent period. They are often forced to speak before they are ready, which they can only do by “falling back” on their first language grammatical competence. Adults typically find forced speech to be uncomfortable.)

An additional feature related to the Comprehension Hypothesis, the “*din in the head*,” will be introduced later, when we discuss the case of Cosmo.

RIVAL HYPOTHESES

There are two major rivals of the Comprehension Hypothesis. Both involve output and feedback.

The Instruction Hypothesis

This hypothesis maintains that we acquire language when we consciously learn rules of grammar and vocabulary, and we learn to read by first consciously learning the rules of phonics. Output helps us by making our knowledge more “automatic” through practice and by providing a domain for error correction, which helps us arrive at a better version of a rule we have learned imperfectly.

The Comprehensible Output Hypothesis

This hypothesis maintains that language acquisition occurs when we say something and our conversational partner does not understand, forcing us to notice a gap in our competence. We then try again until we arrive at the correct version of the rule.

ANIMAL LANGUAGE: VERVET MONKEYS

During the first two to three years of their lives, young vervet monkeys¹ acquire alarm calls that alert others to the presence of a predator. The calls are predator-specific. Hearing a specific alarm call from one monkey results in the others taking appropriate action, e.g. climbing a tree when hearing one alarm call, hiding in a bush when hearing a different one. The appropriate calls are gradually acquired. Very young monkeys (up to two to three years old) make “mistakes,” not distinguishing between predators and non-predators, and confusing types of predators.

Evidence for the Comprehension Hypothesis

Helpful context

Cheney and Seyfarth (1990) report that young monkeys look at adults before responding to alarm calls, and that looking at adults increased the likelihood of a correct reaction to the alarm call, suggesting that the adults' behavior is the context that makes the alarm calls comprehensible.

Silent period

Comprehension appears to precede production of alarm calls: Cheney and Seyfarth report that six to seven month old monkeys consistently respond appropriately to alarm calls, but the ability to produce an adult-like alarm call takes another 18 months to develop (1990, p. 137). They experience, in other words, a silent period.

Rival Hypotheses

Instruction

There is some evidence that suggests that correction works for vervet monkeys. Hauser (1987, reported in Cato and Hauser, 1992) observed five cases in which a young monkey gave an inappropriate alarm call and was punished (bit or slapped) by the mother. In three out of four cases, the young monkey's next attempt to give the same alarm call was correct, suggesting (but not demonstrating) that correction worked. Cheney and Seyfarth (1990), however, “found no indication that mothers pay particular attention to infants who have behaved inappropriately” (p.135).

Comprehensible output

When young monkeys get the alarm call right, the call is often repeated by an adult, and this “reinforcement” is more likely to result in a correct alarm call by the young monkey the next time. This has been interpreted as evidence for a feedback model of acquisition (Cato and Hauser, 1992; Hauser, 1996), similar to the Comprehensible Output Hypothesis.

ANIMAL LANGUAGE: BIRDSONG

The research on birdsong is very extensive and rich. Pepperberg and Neapolitan (1988) and Neapolitan, Pepperberg, and Schinke-Llano (1988) have provided detailed discussion of birdsong acquisition and its relationship to a number of research findings in second language acquisition. I limit this discussion to the hypotheses presented in the

introduction. A major breakthrough in research on the acquisition of birdsong was Marler's discovery that the white-crowned sparrow will only acquire the song typical of its species if the song is presented during a critical period, 10-50 days after birth. Marler demonstrated that birds that were raised in isolation and presented with tape-recordings of their species' song acquired "abnormal" versions of the song if they heard it before they were 10 days old or after they were 50 days old (Marler, 1970).

Evidence for the Comprehension Hypothesis

Marler's birds acquired the songs from input alone: there was no interaction with other birds (songs were presented on tape), no communicative use of the song, no feedback on success, no comprehensible output.

Club membership

Baptista and Patrinovich (1984) reported that white-crowned sparrows can acquire songs beyond the 50 day limit (up to 100 days) if they hear the song from a live bird, not a tape recording. In fact, if the first song has been solidly acquired, a second song can be acquired up to 200 days later, even if both are not the regular song of the bird's species (Petrinovich and Baptista (1987).

What is particularly interesting and supportive of the club membership concept is the finding that birds prefer the live song of a different species to the recorded song of their own species. For birds, apparently, a close friend is better than a distant relative.

Not all species can fully succeed in song acquisition from tape-recorded input alone. Starlings can acquire some features of song from tape, but do much better with a "live tutor." Chaiken, Bohnhert and Marler (1993) reported that both "tape-tutored" and "live-tutored" starlings "developed songs displaying the basic features of species-specific song formation" (p. 1079), but the tape-tutored starlings' songs had "syntactic and phonological abnormalities" (1079). Nevertheless, the tape-tutored starlings did much better than starlings raised in isolation, and "were able to abstract general rules of song organization from the training tapes ..." (p. 1079).

The interesting question for the Comprehension Hypothesis is which aspects of the live input are essential for full acquisition of birdsong for all species. The advantage of live input could be context and/or affective factors (club membership). And, of course, some version of the comprehensible output or output plus correction hypothesis may be at work, with the live bird providing feedback on appropriateness (comprehensible output) or form (output plus correction).

From the description in Chaiken, Pepperberg and Schinke-Llano (1993) it appears that starlings who were live-tutored were very focused on the input: "The young birds appeared attentive to their tutors' singing. They perched near the tutor, oriented towards him, and ceased other activities" (1993, p. 1089). West, King and Goldstein (2004) also note that starlings, like other species, have a "listening posture," a position in which they are quiet and cock their head to and fro while listening. When a starling hears a new sound, they "stop vocalizing to digest the vocal bite" (p. 384).

Is output/singing necessary to acquire song?

Songbirds typically go through several stages in acquiring song (Marler, 2004; p. 19), a *subsong* stage ("reminiscent of infant babbling"), a *plastic song stage* in which the bird

sings a variety of songs heard previously (60 days duration), and a *crystalization stage* in which the bird chooses among the plastic songs. Anesthetizing parts of the vocal control mechanism during the subsong and plastic song stages does not result in any deficit in subsequent song production in the zebra finch (Pytte and Suthers, 2000), supporting the hypothesis that actual production is not necessary for the development of song. Disruption of the speech mechanism in later stages, however, did impair song development.

Analogous studies with humans, the result of injury, have shown that language acquisition can proceed normally without babbling (Lenneberg, 1962) and that aural comprehension and written competence can develop without the ability to speak (Fourcin, 1975).

ANIMAL LANGUAGE: CHIMPANZEES ACQUIRING HUMAN LANGUAGE (SIGN)

Evidence for the Comprehension Hypothesis

Roger Fouts' descriptions of the acquisition of sign by one chimp, Washoe, contain a great deal of evidence for the Comprehension Hypothesis (Fouts, 1997). Attempts to teach Washoe sign using direct instruction and conditioning failed, but "Washoe was picking up signs left and right by seeing us use them" (p. 78).

"Nobody was teaching, much less conditioning, Washoe. She was learning. There is a very big difference. Despite the misguided attempts in the first year to treat Washoe like a Skinnerian rat, she was forcing us to accept a truism of chimpanzee and human biology: The child, not the parent, drives the learning process. If you try to impose a rigid discipline while teaching a child or a chimp you are working against the boundless curiosity and need for relaxed play that make learning possible in the first place. As the Gardners finally conceded: 'Young chimpanzees and young children have a limited tolerance for school.' Washoe was learning language not because of our attempts to school her but despite them" (p. 83).

By the time Washoe was 5, she had acquired 132 signs and a rudimentary syntax similar to that developed in early human language acquisition (pp. 101-103).

Loulis, Washoe's adopted son, was the first non-human to acquire human language from another nonhuman. Loulis began acquiring sign right away, "by watching his mother" (Fouts, p. 244), eventually acquiring 24 signs in 18 months.

Instruction

There is, however, also evidence suggesting that direct teaching works in helping chimps learn sign. In several instances, Washoe attempted to teach Loulis signs directly, using "molding," taking Loulis' hand and shaping it into the appropriate sign. In one instance, "with Loulis watching, Washoe signed FOOD over and over when one of the volunteers brought her a bowl of oatmeal. Then Washoe molded Loulis's hand into the sign for FOOD and touched it to his mouth several times ... This maternal hands-on guidance seemed to work because Loulis promptly learned the FOOD sign" (Fouts, p. 244). Fouts, however, notes that Washoe was not corrected: "Most parents do not correct their children's 'child-speak' and, having given up on conditioning Washoe, neither did we" (p. 79)

ANIMAL LANGUAGE: PARROTS (COSMO)

Cosmo² is an African Grey parrot who has lived with Betty Jean Craige for ten years (since May, 2002). Cosmo was six months old when she moved in with Prof. Craige. There is no question that Cosmo has acquired an amazing amount of English. By the time she was six years old, she had a vocabulary of about 100 words and 200 phrases (Craige, 2010, p. 17), somewhat similar to Washoe's competence, and it is clear she uses her knowledge of English appropriately. Here are just two examples of how well Cosmo understands and speaks English, (from Prof. Craige's remarkable book, *Conversations with Cosmo*, and her posts on *Online Athens*):

Poop

“When she awakens in the morning, Cosmo calls me to her cage: ‘I’m here! Cosmo wanna poop!’ I lift her to the perch on top on her cage, where she poops. Cosmo then declares proudly, ‘Cosmo poop on paper! Cosmo is a good bird!’

Cosmo is not such a good bird when she walks around the house. Fortunately, I have hardwood floors. If she poops near me, she immediately confesses, ‘Cosmo poop on floor.’ If she poops out of my sight, she mutters to herself, ‘Cosmo poop.’ I hear her, and I hurry to the site with a paper towel and a vinegar-based multi-surface cleanser. As I spray the spot, Cosmo mimics the sound, ‘Whiss,’ and adds, ‘That’s for Cosmo poop!’” (from: Craige, 2012a).

Okay

“Como and I use ‘okay’ to consent to a request made by the other, and “okay” to ask for consent. For example, if Cosmo has done something bad, like biting me, and I have put her ‘back in her cage’ ... we may have this conversation:

COSMO: ‘Cosmo wanna go up, okay?’ [go up = leave the cage]

BJC: “No, Cosmo is a bad bird. Cosmo stay in cage.”

COSMO: “Cosmo be a good bird, okay?”

BJC: “Cosmo be a good bird. Stay in cage.”

COSMO: “Cosmo wanna be a good bird, okay?”

BJC: “Cosmo stay in cage.”

COSMO: “Cosmo don’t bite, okay?”

BJC: “Okay, Cosmo go up.” And I open the cage door to let her out. I’m not much of a disciplinarian” (Craige, 2010, p. 43).

Colbert-White, Covington and Fragaszy (2011) confirmed that Cosmo uses language that is appropriate to the situation. They reported, for example, that Cosmo made more attempts to start conversations when Prof. Craige was clearly able to communicate with Cosmo than when Cosmo was alone or it was clear that she was being ignored. They also found that Cosmo was more likely to talk about her own location (“I’m here”) and Prof. Craige’s location (“Where are you?”) when she and Prof. Craige were in separate rooms

but within hearing range, and Cosmo also talked louder in this situation.

Evidence for the Comprehension Hypothesis

Amount of input

There is no question that Cosmo got a great deal of input from Betty Jean Craige. Craige and Cosmo have been talking with each other nearly every day for ten years. Craige tells us that “When I am home Cosmo and I talk constantly” (Craige, 2010, p. 40).

Modified input

Craige clearly uses caretaker speech with Cosmo, simplified in order to help comprehension: “... like foreign language teachers I used a simplified vocabulary with Cosmo. I look at her when I speak, and I consistently use the same words and phrases. For example, I always say, ‘Cosmo wanna go in a car?’ and never vary the question with synonyms. I don’t say ‘Cosmo wanna ride?’ or ‘Would you like to go for a drive in the automobile?’ I say ‘peanut’ for all kinds of nuts: peanuts, walnuts, pecans ... cashews ...” (Craige, 2010, p. 41)

Helpful context (and relevance)

As is the case with caretaker speech, the talk is about the here (Cosmo’s immediate environment) and now (or immediate past and future), which provides context for helping Cosmo understand. Also, all discussion with Cosmo relates directly to Cosmo’s needs, interests and desires, insuring that the input will be highly interesting and relevant to Cosmo.

Silent period

Cosmo went through a “silent period” during her first year of life (Craige, 2010, p. 59): “In January of 2003, at about thirteen months, Cosmo started repeating the phrases I had been saying to her since I got her: ‘Hello!’ ‘Hi!’ ‘Wanna peanut?’ ...” (p. 25; for other examples, see p. 43, 44).

Cosmo had apparently been listening and acquiring during her silent period: Most likely, when she started to produce English words, it was not the beginning of her acquisition of English.

Cosmo’s monologues: The *din* externalized?

It has been suggested that an indication that acquisition has taken place is the *din in the head*, spontaneous mental rehearsal of words, phrases and sentences we have heard in a second language, often in the voices of people we have been interacting with (Krashen, 1983). The “*din*” appears after we have had a good dose of comprehensible input and can make us less hesitant to use the language (Bedford, 1985; de Guerrero, 1987).

The *Din Hypothesis* explains the “language in the crib,” phenomenon (Krashen, 1983). Ruth Weir (1962) tape-recorded her 28-month-old son’s evening monologues, speech he produced alone while falling asleep. This “crib talk” might be the *Din* externalized, a result of language acquisition and not a form of “practice.”

Like Pepperberg’s parrot Alex, (Pepperberg, 1999), Cosmo has also talked to herself when alone, using language she had acquired, as well as producing other kinds of output, a combination of “words, whistles, squeaks, environmental noises, and silences that went something like this: Hello, Chirp, Hi Woo woo woo (imitating dog barking) How are you? Fine Whee whew Here are you? Here I am! I am here! Squeeeek What are you doing?

Beep beep What doing? Chee chee Up Wanna go up There you are! I love you. Wanna kiss. Thank you” (Craige, 2010, p. 26).

Cosmo’s monologues took place “in the months when she was first learning to talk” (Craige, 2010, p. 37), consistent with the idea that this was an “externalized din” and a result of language acquisition.

Rival Hypotheses

Instruction

Cosmo received at least some direct instruction: Prof. Craige labelled objects for Cosmo and also “... (corrected) Cosmo’s misuse and mispronunciation of words” (Colbert-White, Covington, and Frigaszy, 2011, p. 1). But Prof. Craige did not give Cosmo “language lessons,” activities deliberately designed to increase her vocabulary. Cosmo herself, however, has asked for the names of things.

Craige reports that Cosmo likes to play the game, “What’s that?”, which apparently helped her learn the names for “clothes”, “television,” “bark” and other words (Craige, 2010, p. 42,47). The game produced some remarkable exchanges, including this one in which Cosmo began by imitating a dog barking:

COSMO: “Woo, woo, woo. What’s that?”

BJC: “That’s doggy!”

COSMO: “That’s doggy bark!” (Craige, 2010, p. 47).

Whether this kind of direct instruction contributed significantly to Cosmo’s competence in English is undetermined, but what we can say for sure is that there are cases in which direct instruction did not work and cases in which Cosmo acquired words without instruction:

A case of direct instruction not working

“I tried to teach Cosmo to distinguish between red feathers and gray feathers. Cosmo had already learned the word ‘feather’ ... But she could, or would not, say ‘red feather’ or ‘gray feather.’ She would simply grab the feather with her beak and fling it away ...” (Craige, 2010, p. 51).

A case of direct instruction not working, but incidental exposure succeeding

“Lately, Cosmo has been trying to say the word desk ... I hadn’t tried to teach her the word. Actually I tried to teach her ‘Betty Jean’s study,’ which she never learned to say. I must have said ‘desk’ once or twice before she tried to say the word to refer to the table where my computer rests ...” (Craige, 2010, p. 46).

Pepperberg’s parrot, Alex, who was heavily instructed, also “picked up” at least some expressions incidentally, without instruction. Pepperberg gives three examples: “calm down” (Pepperberg, 2008, p.157, 159), “pay attention” (p. 121), and “You turkey!” (p. 149). Alex used all three of these expressions appropriately.

Evidence for Comprehensible Output

Craige certainly makes sure that Cosmo has plenty of communicative success: “As much as I can - and within reason - I comply with (Cosmo’s) spoken wishes, because I want her to know that language works. I want her to know that use of language enables her to manipulate the environment: to obtain peanuts, go to the kitchen, make people laugh, get a misting [spray with water], get a kiss on her feathers, and get my rapt

attention. When she speaks she has power, for she can tell me what to do, even though she's little and I'm big" (Craig, 2010, p. 80). The existence of incidental acquisition shows that "comprehensible output" was not necessary for Cosmo to acquire English. The possibility remains that it could have been helpful.

The affective filter and club membership

Perhaps the most significant factor in Cosmo's case is the fact that she has had a warm and loving interaction with a single person over a long period of time, and they have talked about topics that are of great personal interest to Cosmo. Unconditional love is clearly the best way to insure low anxiety, self-confidence, and motivation to join the group, in other words, a zero affective filter: "... Cosmo knows that I love her, that I will always give her attention, that I will always feed her, and that I will never strike her, even when she bites" (Craig, 2012b).

Post-script: A critical period?

Craig (2012c) notes that "By the age of 3 (Cosmo) had acquired the vocabulary and grammatical tools she would use in her speech from then on." According to Prof. Craig (personal communication), since she was five or six, Cosmo has not acquired many new words: "Occasionally, very occasionally, she'll pick up a new word, but not often."

Several possible explanations come to mind: (1) A neurologically-based critical period for language acquisition exists in parrots that holds for their acquisition of human language. (2) By age three, Cosmo had acquired all or nearly all the language she needed and resisted acquiring vocabulary that she considered irrelevant. (3) Betty Jean Craig either consciously or subconsciously changed her style of interaction with Cosmo when Cosmo was three years old.

But Cosmo is still learning new things: "... she does pick up new tunes to whistle. This past year she learned 'Yankee Doodle,' after I had whistled it only a few times. To learn it she'd whistle a line, wait for me to do the tune, and then try it herself, stopping whenever she forgot the next line and waiting for me to help her out. She also learned 'Wooden Heart' a year or so ago" (Betty Jean Craig, personal communication, May 5, 2012).

SUMMARY

Table 1 presents a summary of the results. In my interpretation, all four cases provide evidence for the Comprehension Hypothesis; in all cases, it is clear that comprehensible input was supplied, suggesting that it is essential for language development, as features of rival hypotheses occurred only occasionally. In addition,

- * Cosmo was the only case in which it was clearly recorded that input was specifically modified; this was probably also the case with Washoe; it is unlikely that Washoe's caretakers used highly complex signs with her.
- * Helpful context: Young vervet monkeys observed older monkeys making and reacting to alarm calls, which made correct reactions more likely. Cosmo's input was focused on the here and now, and her interests and desires.
- * Vervet monkeys clearly went through a silent period, a period of comprehension

- without production, as did Cosmo.
- * Cosmo experienced a "din in the head," which may be a reflection of language acquisition. There is a hint that Washoe experienced the din as well; Fouts reports that he often found Washoe signing to her favorite doll (p. 73).
 - * In general, direct instruction did not work with Washoe. But Washoe attempted to teach her adopted son, and may have had some success. Instruction may have worked with Cosmo, but the results were inconsistent.
 - * Vervet monkeys appear to have profited from attempting alarm calls and experiencing communicative success, and Cosmo may have also have acquired some language through comprehensible output, thanks to her rich interactions with Betty Jean Craige. Some evidence in favor of output in general comes from the finding that not allowing production in late stages of acquisition harms the acquisition of birdsong.
 - * Remarkable evidence for the power of club membership was documented with birdsong, with birds preferring the live song of another species over the recorded song of their own, and additional evidence is the warm relationship between Cosmo and Betty Jean Craige.

Table 1: Observed behavior related to the Comprehension Hypothesis and rival hypotheses

	Vervet Monkeys	Birds	Chimpanzie	Parrot
	Alarm Calls	Song	Sign	Spoken English
COMPREHENSION HYPOTHESIS				
CI available	Yes	yes	yes	yes
modified input			yes?	yes
helpful context	yes			yes
silent period	yes			yes
din			?	yes
club membership		yes	yes (Loulis)	yes
RIVAL HYPOTHESES				
instruction			yes	yes
correction	disputed		no	yes
comprehensible output	yes			yes

CONCLUSION

I have attempted to present the major hypotheses about human language acquisition and begin to determine if any of them are consistent with what is known about animal acquisition of communicative systems. The Comprehension Hypothesis appears to fit in all cases, but there is evidence suggesting that rival hypotheses make contributions as well. My hope is that the framework presented here will help interpret the results of other studies.

Notes.

1 An earlier version of the discussion of vervet monkeys, birdsong and Washoe was published in Krashen, S. (2009). The Comprehension Hypothesis extended. In T. Piske & M. Young-Scholten (Eds.) *Input matters in SLA*. (pp. 81-94). Bristol: Multilingual Matters.

2 My thanks to Prof. Betty Jean Craige for her comments, help and inspiring book, *Conversations with Cosmo*. Parts of this section were originally published in Krashen, S. (2012). How is Cosmo acquiring English? *Language Magazine*, July 2012.

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