Cognitive Critique

DO ANIMALS HAVE ELEMENTS OF LANGUAGE? A REVIEW OF THE CURRENT LITERATURE

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INTRODUCTION

> "For language is the one certain indication of latent cogitation in a body, and all men use it, even the most stupid and mentally deranged, and those deprived of their tongue and vocal organs, whereas on the other hand not a single brute speaks, and consequently this we may take for the true difference between man and beast." (Rene Descartes, in a letter to Henry More 1649/1970)

> "When any hypothesis, therefore, is advanc'd to explain a mental operation, which is common to men and beasts, we must apply the same hypothesis to both; and as every true hypothesis will abide this trial…no false one will ever be able to endure it." (David Hume, A Treatise of Human Nature 1739/1978)

We have made little progress in 400 years. The debate over the intelligence of animals continues, with both sides adding new evidence to support their views. Language has been at the center of the debate for or against the intelligence of animals. The Cartesian argument is that only humans have language because only humans *speak*. This viewpoint assumes that human language is the only animal communication system:

> "Nor should we think, like some of the ancients, that the beasts speak, although we do not understand their language" (Descartes 1637/1985, part five, p. 141).

On the other side of the debate, Hume (1739/1978, section XVI, p. 176) argued that,

> "...no truth appears to me more evident, than the beasts are endow'd with thought and reason as well as men."

Hume's assessment of the situation was that we humans have no grounds for assuming the mechanisms underlying our behaviors to be different than those that underlie animal behavior, an opinion that was surely shared by Tinbergen when he was creating his four questions of animal behavior (i.e., Tinbergen 1963).

In the debate about animal language and intelligence, then and now, two separate and distinct issues are confounded. One is whether animals are capable of language, in the sense of human language or a sophisticated communication system of similar structural complexity. The other is whether animals are intelligent enough to have language. These two questions were certainly conflated by Descartes, less clearly so by Hume, and they continue to be confounded today. These two debates are hierarchical in their assumption that, if we find aspects of language production or comprehension in other animals, then we can assume that they also have a level of intelligence.

This review will ignore the issue of animal intelligence and focus instead on their communication capabilities. As to what language is, a different issue arises. Hauser, Fitch and Chomsky (2002) argue for a distinction between language in the *broad* sense and language in the *narrow* sense, where recursion is a vital element that distinguishes the narrow sense. In a previous volume of this journal, Ellen Lucast (2010) offers a different viewpoint of language in its relation to communication. She advocates the idea of a continuum of communication off of which language is situated. I will not attempt to address this question as it is too large, and human lan-

guage cannot be understood in its entirety when specific aspects of language are still being investigated. Therefore, I will be using the term *language* in broad terms and focusing mainly on the presence of particular elements of language.

Given the current state of the matter, then, the question is as follows: what elements of human language are found in other animals? I will discuss the elements of syntax present in certain animals' natural communication with conspecifics, or their interactions with investigators. For this discussion I will depend primarily on a paper by Kako (1999) and the book *The Cognitive Animal* (2002). These two resources provide an overview of the studies that have been conducted over the past 40 years and their combined breadth and depth make for a good starting point for this discussion.

The purpose of this paper is to provide a summary of the available evidence rather than assess the current state of the field. One question that may arise is, Why should we bother assessing the language abilities of animals or their intelligence? My answer is that since each animal is related to every other by virtue of sharing a common ancestor at some point in evolutionary history, by understanding the capabilities of all animals we can form a better understanding of our own intelligence, what makes us special within the animal kingdom, and where it only appears we are special. Through this understanding, we hopefully can overcome our limitations and find solutions which nature has solved long ago in other species.

EVIDENCE OF SYNTAX

At first the question of syntax seems an easy one: if there is order in the signaling, then there is syntax. However, the problem is deeper. Syntax is more than a set of rules for assembling units (of any type; e.g., words) into larger units (e.g., sentences). It is a set of structural properties that define the core of the structure. Kako (1999) has described four core properties of syntax: discrete combinatorics — when two words combine their meanings are combined instead of blending to an intermediate meaning; category-based rules — the order of classes of words (e.g., nouns, verbs, adjectives); argument structure — who did what to whom; and closed-class items — elements that provide structure but have highly abstract meanings (e.g., prepositions, articles). Although Kako discusses the presence (or absence) of these four elements in animals communicating with human interlocuters, in either English or a created language, one

must also consider these elements in the natural communication system of animals. I will focus on the presence of these elements in animals communicating with their conspecifics. To date, there is little or no experimental or observational work designed specifically to recognize syntax as it naturally occurs in animal populations (however, see Arnold and Zuberbühler 2006; Miller and Ghazanfar 2002). I will therefore discuss the occurrence of elements of syntax as I interpret them.

COMMUNICATING WITH INVESTIGATORS: LANGUAGE-TRAINED ANIMALS

In this section I discuss a review by Kako (1999) describing the linguistic abilities of three species of language-trained animals. These animals include an African Grey parrot named Alex, two bottlenose dolphins, Akekamai (Ake) and Phoenix, and a bonobo named Kanzi. All these animals were trained from an early age and have been studied for nearly 30 years.

The main difference in these animals, other than their being of vastly different classes, is the mode of language. Alex was taught to speak English by his caregiver and researcher, Irene Pepperberg, in order to assess his cognitive abilities. She quizzed him on his knowledge of objects and their features and he responded by producing the correct words. Ake was taught a gestural language using the format $object_1$ + $object_2$ + *relation,* while Phoenix was taught an acoustic-based language in the format of $object_1$ + *relation* + $object_2$ by Louis Herman and colleagues. The dolphins also differed in what the objects represented. For Ake $object_1$ was the destination object and $object_2$ was the transport object, while for Phoenix the object labels were reversed. Lastly, Kanzi was inadvertently taught to communicate via an artificial language called *Yerkish* by Sue Savage-Rumbaugh. He was not directly trained but rather learned from watching his mother's training, much as children learn language by eavesdropping on adult conversations. Further showing his remarkable talent for language, Kanzi also learned to comprehend spoken English. Although each of these animals learned language differently and understood different languages — natural or invented — they all demonstrated certain capacities for linguistic understanding.

DISCRETE COMBINATORICS

Kako (1999) describes the presence of discrete combinatorics in all three species of language trained animals he reviewed. Again, this element of syntax requires the combination of separate words to create a new meaning and is the easiest of the four elements to assess. Alex was able to combine words from two distinct categories in order to specify a particular object among a group of similar objects (e.g., *green paper*). Ake and Phoenix were able to identify the object of the action from the object to act with and the action to be taken (e.g., *water right basket fetch* for Ake). Kanzi not only understood new combinations of words and lexigrams he had never heard before, but also created them (e.g., *tomato cheese bread* to mean *pizza*).

CATEGORY-BASED RULES

Kako determined that each of the three sets of language-trained animals had this element of syntax, but to different extents. To demonstrate this ability, the animals needed to recognize that the words belonged to different classes and that these classes had a specific order of presentation. Their capacity to recognize such rules was, to some extent, dependent on what their trainers taught them, but also on what the animals could independently determine to be a coherent idea. Alex had category-based rules in part since he only had three rules: property + object, *wanna go* + location, and *want/wanna* + object. He was able to use his category knowledge to identify novel objects and to combine words into novel combinations (to best describe a novel object) — combinations he had never heard. Ake and Phoenix were both able to identify lexically and syntactically novel sentences and so could carry out a command they had never experienced. For example, in lexically novel cases known words were added to known syntactic frames that had not previously been shown together (e.g., new sentences, same word order). For syntactically novel cases, known words were rearranged in novel configurations. There were three types of these: a relational sentence with a modifier (e.g., *person left Frisbee fetch* for Ake); for Phoenix only, a modifier was added to the word *fetch* (e.g., *Frisbee fetch through/over/under hoop* rather than the standard *Frisbee fetch hoop* which indicated taking the Frisbee to the hoop); and, for Phoenix only, two nonrelational commands were combined to form a two-part sentence (e.g., *pipe tail-touch pipe over* directs her to touch the pipe with her tail and then leap over it). Although both dolphins showed

category knowledge throughout these manipulations, they were only approximately 60% accurate. Kanzi, on the other hand, was adept in a number of semantic categories (evinced by his ability to interpret novel orderings of words based on their category membership) and showed a preferred order when giving signals. Kanzi began to combine gestures with his lexigrams, even inventing his own word order by always giving the gesture before the lexigram, which in one case (action-agent) reversed the order used by his human interlocutors (agent-action).

There is also evidence for category-based rules in California sea lions who were taught a gestural language by Schusterman and colleagues beginning in the 1980s (e.g., Schusterman et al. 2002). They taught three sea lions to relate gestural signals to objects, modifiers and actions, which could be combined in over 7000 different combinations, in order to carry out a specific behavioral sequence. The sea lions learned the language and were able to ignore irrelevant objects that were available in their pool while successfully completing such tasks. The sea lions were also asked to identify whether a particular object was present or not, or to select one object and bring it to another object, the latter of which could be considered a relational sequence. Although the animals were successful, the researchers were not convinced that they were solving the task using language. Rather, they proposed that syntax is accomplished through a general learning process. However, Schusterman and colleagues made this Cartesian argument based on the life histories of the species and because sea lions are less social animals and smaller brained than more famous language learners such as dolphins and apes. I argue that the mechanisms involved in these animals, or any language learners (including humans), cannot yet be determined. Therefore, I suggest that we invoke Hume's proposition that we dare not make an assessment based on our own biases, but instead must draw similar conclusions regarding the mechanisms of analogous traits. After all, seeming disparities are often more closely related than they first appear, and such similarities are only evident after looking under the surface of things. For example, the wings of bats and tails of dolphins, though they appear drastically different, are actually modified limbs with structures similar to the limbs of other mammals.

ARGUMENT STRUCTURE

There are mixed results for evidence of argument structure in language trained animals. Alex had learned only a limited argument structure before his death in 2007, so it is difficult to assess his ability. In 1999, according to Kako, Alex knew six action words and phrases, two of which were requests and four were commands. It is unclear whether his utterances grew more complex later in life, even though he was learning numerous other concepts including numbers and phonemes. In order to test his knowledge of predication, he would have needed to learn additional verbs and then be tested on his ability to act on various commands to show that he understood what they meant (Kako 1999). However, on a lexical level, he did show an ability to create new words by combining parts of words already in his lexicon. For instance, Pepperberg (2007) describes Alex's creation of the word *banerry* to refer to an apple since *apple* was not a word he knew. Pepperberg believed that Alex put together elements (e.g., phonemes or morphemes) of two words he already knew which referred to fruit: *banana* and *cherry*.

It is even more difficult to confidently credit the dolphins Ake and Phoenix with argument structure, although both show some signs of understanding structure. For instance, both make few errors in responding to relational sentences, rarely reversing the roles of the two objects on which they acted. As Kako stated, the accuracy of the dolphins is quite remarkable and suggests they do indeed understand the links between syntactic position and thematic role, which Herman also emphasizes (Herman and Uyeyama 1999). However, inconsistency in other areas of argument structure requires attention. For instance, Ake was given relationally anomalous commands with either an extra destination object or an extra transport object. She refused only one of the anomalies and extracted some of the information contained in the commands to repair a nonsensical statement and carry out a possible act. However, it is difficult to interpret her actions since it could be that she responded to the nonsense commands in order to fulfill a request from her trainers rather than do nothing. Since it is impossible to know what she was thinking or responding to, we should conclude that her knowledge of argument number is uncertain rather than reject her knowledge outright. At the very least, we can comfortably say that the two dolphins displayed the capacity to learn an arbitrary order for symbolic communication, as demonstrated in the fact that they

each learned different syntactic orders and were not limited to some species-specific set.

Kanzi's understanding of argument structure is perhaps the most controversial. Greenfield and Savage-Rumbaugh (1990) argued that Kanzi systematically encoded the relation of events to their participants and that his system shows signs of ergativity in his placing both intransitive agents and transitive patients after the action. However, Kako (1999) notes that this assessment is difficult to make since Kanzi produces mostly two word sentences and these are limited in structure due to his rule of *gesture first*. However, what is clear is that Kanzi understands the importance of word order when interpreting spoken English. Savage-Rumbaugh gave him reversed sentences in which one of the following occurred: changed word order and changed verb, same word order but different verb, or different word order but same verb. Kanzi's success at these three sentence transformations indicates that he correctly encodes the syntactic position, thematic role, and the links between them. As with Ake, it is difficult to assess whether Kanzi has knowledge of argument number, but it is clear that he has a strong understanding of argument structure.

CLOSED-CLASS ITEMS

The presence and understanding of closed-class items are the most difficult to assess in language-trained animals. Alex has two of these: *what* and *want/wanna*. However, these terms are not used to restructure the sentence since they always appear in the same position (Kako 1999). Because these are the only two closed-class items he was taught, not much more can be said about his knowledge of closed-class items. Since Alex had a number concept, it is likely that he could have picked up on the plural forms of words, but he had difficulty in pronouncing sibilants (e.g., /s/). Because of this difficulty, Pepperberg did not pursue this avenue of work (see Kako 1999). However, when she taught Alex ordinality, he did understand *–er* endings in assessing which number was *bigger* or which one *smaller* (Pepperberg 2006). This suggests that the conceptual framework was in place but does not resolve whether Alex understood the linguistic use of *–er* more broadly since he only generalized the terms *bigger* and *smaller* within the number concept. Also, it is unclear whether the ending was tested with other concepts (such as *better*).

The dolphins similarly do not display convincing evidence since there have not been enough tests to solidly support the claim.

Phoenix's accomplishment of understanding prepositions suggests that she understood the commands as modifiers but not definitively. She could be interpreting these as commands which would belong with the open-class words. On the other hand, Herman argues that the dolphins are in fact using closed-class words as they are used by humans, and that they use these functionally as demonstratives, prepositions, conjunctions, and locatives (Herman and Uyeyama 1999). Also, Ake was taught to answer questions with yes or no by hitting the associated paddle. She not only could answer whether an object was present, but whether it was one of a number of objects presented to her, thus indicating that she understood the gestural signals of her trainers as referring to specific objects (e.g., referential signaling; Herman 2010).

As discussed in Kako (1999), Kanzi does not have any closed-class items in his lexigram. Nor does he appear to use morphological modifications in his gestural repertoire, according to Greenfield and Savage-Rumbaugh (1990). Against Kako's assessment, Kanzi's comprehension of the English language suggests that he understands the role of closed-class items in sentences (e.g., *put the dog in/on the refrigerator*; Savage-Rumbaugh et al. 1993). However, his lack of production makes a deeper assessment difficult. Therefore, it appears that Kanzi understands prepositions and probably some morphological modifications. But it is unclear whether he understands these as modifications and not just as new words and ideas. If he were to produce such modifications himself in a generalized way, this would be sufficient evidence to say that he does indeed understand these as modifications. However, Savage-Rumbaugh and colleagues (1993) suggest that Kanzi has some sense of recursion — which is certainly dependent on closed-class items (e.g., *that's*) — for at least some sentence types, especially compared with a young child. Further evidence of apes understanding human language is demonstrated by the gorillas Koko and King. Koko was taught American Sign Language by Francine Patterson (1978) and used some closed-class items in her conversation.She also invented some new signs of her own which were combinations of known signs, actions and onomatopoetic concoctions (Tanner et al. 2006). King spent many years in a circus and did not receive formal language training, nonetheless when asked (in spoken English) what he had eaten the day before, he understood the past tense of the sentence and indicated, with cards, which food he had eaten and who had given it to him (Call 2011).

COMMUNICATING WITH CONSPECIFICS

There is a limit to the understanding we can obtain from language-trained animal studies. It is therefore necessary also to consider the natural *languages* that animals use and create with members of their own species. Because of the difficulty in conducting these studies, most of the work is done with vocal communication rather than gestural communication of animals, even though gestural communication is used more flexibly and in less evolutionarily urgent contexts (Tomasello and Zuberbühler 2002).

DISCRETE COMBINATORICS

Evidence of the discreteness of signaling is limited by what signals can be produced and who can produce them. The kinds of signals that can be produced reflects the morphological constraints of the particular species in their range of movement (see Scott and Pika 2012 for further description and examples). Who produces which signals depends on the social constraint of age- and sex-specific patterns of behavior (e.g., vocal signaling: Bouchet et al. 2010; gestural signaling: Scott 2007). For instance, Bouchet, Pellier, Blois-Heulin and Lemasson (2010) studied De Brazza's monkeys, a monogamous species of guenons, and recorded ten unique call types of which only three were shared by all age-sex classes. In comparison to other guenons, call production and usage are quite parallel, so the authors believe that this species is not unique in these respects and therefore cannot contribute to such differential use of the call types. In addition, phylogeny and sexual dimorphisms have important roles for vocal communication in these monkeys. The authors therefore conclude that since both sexes have the capacity to produce calls of the other sex, it is their sex roles that may constrain the expression of these calls. A similar finding and conclusion was drawn by Scott (2007) in her study of the natural gestures produced by a colony of zoo-living chimpanzees.

Despite these morphological and social constraints, a number of studies have found evidence of distinct combinations of signals. Call combinations have been recorded in a number of cercopithecine monkeys (e.g., Seyfarth et al. 1980; Zuberbühler 2002; Arnold and Zuberbühler 2006). For instance, Campbell's monkeys combine a *boom* call with a (functionally) referential alarm call and thereby modify the information provided by the alarm call to indicate a less dangerous situation (Zuberbühler 2002). Chimpanzees are also known sometimes to combine two distinct calls, but at other

times combine calling with a nonvocal signal. For instance, the *pant hoot* is produced either as *hoos* alone (progressively getting louder with each breath), as *hoos* plus *screams* or *barks*, or as *hoos* plus drumming — nonvocal auditory signal produced by beating hands and feet against large resonant buttresses of trees (Goodall 1986). These combinations of calls or calls plus signals may serve to create a new meaning or to add an additional long-distance acoustic element (Crockford and Boesch 2003). Additionally, chimpanzees have been reported to combine gestures, defined as intentionally produced nonvocal signals, in naturally occurring conspecific interactions (e.g., Liebal et al. 2004). These combinations occurred as sequences of the same repeated gesture, as sequences of distinct gestures within a modality, or as a sequence of gestures of different modalities. However, the combinations were primarily a result of the recipient's lack of response and were not entirely premeditated.

CATEGORY-BASED RULES

Prairie dogs appear to have nounlike, verblike and adjectivelike elements in their alarm calls (Slobodchikoff 2002), which could indicate a form of primitive grammar. These elements are found at both the individual and the colony level, although it is unclear whether this calling performance is cultural or innate. A cultural explanation indicates a higher level of cognition than the innate explanation and necessitates acknowledgement of an intelligent communication system. Slobodchikoff (2002) provides evidence which leans towards a cultural explanation. First, there is the finding that different colonies have different dialects, similar to humans. In an experiment, prairie dogs were shown novel stimuli (e.g., a black oval). The object elicited a signal distinct from the signal made when the prairie dogs were shown a silhouette of a coyote or a skunk, and each of these also had a distinct call. However, it is unknown to what extent new calls can be created and whether there is a limit to the number of distinct sounds or sound combinations which can be emitted, similar to the alarm call studies of monkeys.

ARGUMENT STRUCTURE

In the above examples, the meaningful (acoustic or gestural) unit is equivalent to a syllable in language (Miller and Ghazanfar 2002). *Meaningful*, that is, to members of the species. However, it is incorrect to think of these combinations as unintentionally produced or emotionally driven. We can look at long calls of many non-human primate species and find syntactic specificity. For example, the

chimpanzee pant hoot is a species specific call produced both in wild and in captive groups. When a new element is added (e.g., bronx cheer) to the end or start of the pant hoot call the meaning has not changed. But add a new element to the middle of the call and the meaning of the signal has been interrupted and the call is rendered meaningless (Marshall et al. 1999). Chimpanzees add such elements naturally. But the fact that these new elements never appear inside other elements, but only as a series, indicates that the individual elements represent distinct meanings. There have also been experiments which change the order of syllable arrangements in the long call series of other species. When these alterations were played to gibbons (a lesser ape) and titi monkeys they did not recognize the altered calls as being from their own species, as was evident from their vocal response (e.g., Miller and Ghazanfar 2002: Mitani and Marler 1989; Robinson 1979).

CLOSED-CLASS ITEMS

Probably there is no easy way to make an assessment of the presence or absence of closed-class items in the vocal and gestural signals of non-human animals. Although there are clearly distinct types of words in their repertoires, such as warning calls and mating signals, the internal structures of these displays are difficult to determine without a better understanding of what the signals represent. Some researchers have suggested that the meaningfulness of a signal depends on *who* is signaling and *how* it is being signaled, rather than *what* is being signaled (Rendall and Owren 2002). This explanation is insufficient and defaults to the animal's ability to infer meaning based on the situation. This sort of explanation distracts from where the representation is taking place, directly in the signal or indirectly through a complex web of inference-making and long-term memory.

We do know that few mammals modify vocalizations in response to auditory experience. However, cases of vocal mimicry have been reported. For instance, a captive group of African elephants displayed vocal learning when they matched their vocalizations to familiar sounds outside of their natural vocal repertoire (Poole et al. 2005). One adolescent female elephant, whose enclosure was close to a highway, began imitating truck sounds. An adult male, who lived nearly 20 years with Asian elephants, began imitating Asian elephant calls. The limited use of these vocalizations could put them in the category of *closed-class items*. However, it

may be more likely that these calls belong to a more onomatopoetic or gestural category of linguistic use.

In summary, there appears to be strong evidence for some of the core properties of syntax (i.e., discrete combinatorics and category-based rules) in both the language of trained animals and in the natural communication of some animal species. There is convincing evidence for argument structure in both types of animals, but weak evidence for the presence of closed-class items. Cleary, more species need to be studied for both language-training and natural communication (between conspecifics) to provide more definitive answers as to the extent that non-human animals have language or language-like properties.

CONCLUSIONS

This paper began with two quotations, one from Descartes in which he doubts the intelligence of animals by denying their language abilities, and one from Hume in which he questions the efficacy of attributing similar mental operations to different animal species (e.g., cogitation for humans but stimulus-response for animals). I attempted to provide strong evidence that suggests similar mental operations (for communication) in animals and humans. As I show in the section on syntax, certain animals have some innate language traits, and *with* formal training, those animals display even *more* language properties. This illustrates that animals are better equipped for language than previously assumed. Additionally, the mechanisms that make language possible may also be linked to other areas of intelligence. Further research on language abilities may increase our understanding of animal intelligence. Researchers use language ability to test human intelligence (i.e., IQ), and some, like Pepperberg, are now using it to test animal intelligence.

One caveat about these studies is the necessity to consider the ecological pressure on the species. Another is to consider the social pressures the animals experience. Studies that have considered these pressures indicate that it is ecological and social conditions, rather than phylogenetic mechanisms, which lead to the adaptive selection of language-like traits, as evidenced by the wide array of species that show language-like traits. For instance, why would an elephant mimic the sound of a passing truck? One suggestion is that having a variety of call types and specific call structures is important in a fission-fusion society whose members frequently separate

for extended periods and later reunite (Poole et al. 2005). Having strict structure (e.g., for species identification) but flexibility to add new calls (e.g., for communicating more precisely) is therefore an important adaptation for meeting the communicative and social demands of a fluid society.

Of course, there are other assessments of animal communication abilities that are not discussed here, including both elements of production and comprehension. I have not discussed research concerning an understanding of televised commands, innovation of new signals, or cross-modality equivalence, and I have only slightly touched upon vocal imitation. These are areas of future research that should be conducted with an array of other species and classes in order to better understand the evolutionary pressures responsible for and evolutionary presence of these abilities. Also, the animals' natural behaviors should be considered in the formulation of the task (instructions or requirements). Innovators such as Pepperberg, Herman and Savage-Rumbaugh should be applauded for their applications of such methods, in tasks relevant to the animal's ecology and physiology, in situations which are often different from humans' (Pepperberg 2002). Such studies are better suited to answer the question at hand while avoiding false negatives. After all, absence of evidence is not evidence of absence.

Perhaps Descartes was wrong to suggest that animals could not have a language we do not understand, or that it was more likely that they simply had none (Descartes 1637/1985, Part five, p. 141). Hume appeared to explain the human bias toward species superiority as a sense of control required for the sanity and identity of all human beings (e.g., Hume 1777/1975, VIII.I). Perhaps we delude ourselves so that we can maintain a sense of control over the world? After all, either elevating animals to our level or demoting ourselves to theirs is an indirect way of relinquishing some of the control that we feel as both protector and dominant force over the land and sea. What we forget is that many of the world's animal species dominated the land and sea long before we evolved. There is little reason to assume that we evolved from a species that was so unlike all others, that we are unique in our possession of *higher cognition* and use of *higher communication* such as language.

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