

The Role of Culture in Language and Cognition
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Abstract:

This paper provides an overview of some recent research on how culture is causally implicated in the understanding of human cognition. In particular I review studies on the influence of culture on short-term memory, grammar, numerical cognition, and language evolution. I also provide a list of desiderata for research methodologies on the connections between culture and cognition and a direction for future research.

"The effect of natural selection in man has probably been to render genotypic differences in personality traits, as between individuals and particularly as between races, relatively unimportant compared to phenotypic plasticity. Instead of having his responses genetically fixed as in other animal species, man is a species that invents its own responses, and it is out of this unique ability to invent, to improvise, his responses that his culture is born." Dobzhansky (1962)

1. Introduction

A number of philosophers have argued that there is such a thing as "shared knowledge" (e.g. Seeman 2012). Occasionally they intend this metaphorically, which is just as well, because the idea of shared knowledge literally cannot be correct. There is no idea that is in my head and yours in the same way or used by me then used by you, like a sock or occupied simultaneously like a shared house. Two or more people can of course think two (non-identical) tokens of a single idea type simultaneously, by design or by accident, though it is never exactly the same idea. This overlapping thinking, or "thinking alike," is a necessary condition for culture. But the notion of sharing ideas is not. And it obscures the issues. Although thinking alike is not itself culture, it is a reflection of culture and underlies culture.

Non-identical but similar, overlapping thinking arises for the simple reason that people develop knowledge in specific contexts, via apperceptions (see Everett (2016)), reacting to their experiences in part by imitating the reactions of those around them in apparently similar situations (see Boyd and Richerson (1998; 2005)).¹ Such individual knowledge may be overt or covert, subject to conscious reflection and social sharing, or not. The individual storage, especially of the usually unspoken or ineffable, I refer to as "dark matter of the mind" (Everett 2016). Massive overlap in individual knowledge and values within a society is a function of achieving via observation and imitation (tacit) consensus about what types of ideas, represented as tokens in individuals, are socially endorsed, or simply more common.

But figuring out what people are thinking either intra- or inter-culturally is not all that easy, as philosophers have often recognized better even than anthropologists or linguists. Christopher Hookway summarizes the problem:

"Anthropologists often attempt to ascribe beliefs and desires to the members of alien tribes that they are studying: they hope to secure an understanding of the aliens' behavior by attributing various cognitive attitudes to them and providing interpretations for the language they use... It appears that the theory of interpretation is underdetermined by the non-intentional evidence available – this can give rise to scepticism about the possibility of the kind of knowledge of other cultures promised by the anthropologist." (Hookway (1978, p17)).

Indeed such skepticism can only increase when we recognize that members of a culture are themselves not fully aware of what they know. This is the problem of "dark matter," which I define as:

"Dark matter of the mind is any knowledge-how or any knowledge-that that is unspoken in normal circumstances, usually unarticulated even to ourselves. It may be, but is not necessarily, ineffable. It emerges from acting, "languaging" and "culturing" as we learn conventions and knowledge organization, and adopt value properties and orderings. It is shared and it is personal. It comes via emicization, apperceptions, and memory, and thereby produces our sense of "self." (Everett 2016, 1).

This definition is partially influenced by Brandom's (1994) work, namely, that we know *that* sentences have certain meanings because we know *how* to use them, rendering understanding a form of action. Our actions are all motivated by some sort of dark matter, though we may be unable to express what it is that drives us linguistically (just as we are not usually able to explain why we vary our articulations of consonants in certain positions within their phonetic environment or why we grip a bike as we do in different modes of biking or how we write clearly or unclearly). Many types and tokens of things we know, based on the regularity of our behaviors, are sub- or un-conscious and we often do not even know that we know such things. And even if we did, we likely could not say what it is exactly that we do know. Dark matter is symbiotically related to culture, in that it is constrained socially and produces the requisite value hierarchies, knowledge structures, and social roles as a result:

"Culture is an abstract network shaping and connecting social roles, hierarchically structured knowledge domains, and ranked values. Culture is dynamic, shifting, reinterpreted moment by moment. Culture is found only in the bodies (the brain is part of the body) and behaviors of its members. Culture permeates the individual, the community, behaviors, and thinking." Everett (2016, p66).

As Quine argued (Quine 1960), we can only interpret knowledge – from word meanings to sentence meanings and beyond – as parts of larger discourses or theories. That is partially why "tacit knowledge" (Polanyi (2009)) often refers to actions ("languaging" and "culturing") rather than static states (nouns such as "language"). It is adopting the views (types of ideas) of fellow members of our community in shaping ourselves that is emicization by this definition. This is the component of the learning process which entails viewing and interpreting the world via overlapping, often nearly identical, value structures, social roles, and knowledge structures. Emicization, crucially, is what makes analytic sentences possible or at least makes them seem so iron-clad. Such sentences fit into our way of thinking such that they appear to have no alternatives (Quine 1960).

Culture is partly manifested in social roles, such as in my identity now as writer and yours as reader. Culture is found in my stronger preference for health over daily ingestion of high-calorie food (I know this is cultural if, say, a hunter-gatherer wouldn't value passing up on such food regularly in their native environment – unless they became overexposed to it and were aware of its adverse effects on health when abused, etc.). Yet culture is not found "out there," i.e. outside our bodies. It is located rather in individual behaviors (including verbal behaviors) and the dark matter that underlies those. Culture is a hypothetical entity that

connects multiple individuals, but only via abstraction. It is only via generalization across overlapping behaviors is there any sense to a "shared culture."

Why would we need such concepts in the study of human cognition? There are several reasons. Beyond the fact that such definitions are useful in anthropology, "culture" and dark matter exercise a causal role in cognition (and vice-versa). The components of culture listed in my definition help us understand what there is to achieve a consensus (broadly a culture) about.² My definition helps us understand how any behavior can fit into culture more broadly or not. The definitions of dark matter and culture given here are intended to provide both a basis for overlapping (some would say "shared") behaviors and knowledge, etc. and individual psychology and the role of the individual unconscious in forming a culture.

These concepts also provide for a notion of culture that is fluid, projected from individuals' dark matter, rather than in societies per se. These notions of culture and dark matter also provide alternative (see Everett (2016) for argumentation) hypotheses to content-based nativism (e.g. Chomsky (1986); Pinker (1994); Barkow, Cosmides, and Tooby (1995)).

2. Memory and culture

My first example here of the psychological causal power of culture on cognition is taken from field research with other cognitive scientists, focused on short-term memory. These researchers and I tested the short-term memory of Amazonian, hunter-gatherer subjects (Pirahãs) and compared our results with a baseline of US college students.³ On the Amazonian side, we engaged the Pirahãs in two tasks to test short term memory (STM, Fedorenko et. al. 2011, 4), looking at phonological and spatial short term memories.⁴ To test the former we examined Pirahãs' abilities to recall meaningless chunks of speech, a skill critical for acquiring language. In particular we had the Pirahãs repeat increasingly longer sequences of syllables that do not form meaningful units. The first few subjects had difficulty remembering the sequences we asked them to repeat. Their results were significantly below that of our controls. This puzzled us. Therefore, we reconsidered the design of the task, even though it is the standardly applied methodology for testing phonological STM. We organized the syllables prosodically to resemble Pirahã words, though without meaning. Presented with these syllable strings that had tones and appropriate stress patterns, subjects' performances improved dramatically, comparing favorably with our controls.

Phonological short-term memory is distinguished in the literature from verbal short-term memory, since the latter is reserved for remembering meaningful chunks of verbal material, as in a digit span task or a word span task, which involve repeating increasingly longer sequences of digits or words, respectively. These kinds of verbal tasks are different from phonological STM tasks (like syllable span or non-word repetition) because they involve meaningful units. Meaning entails reliance on long-term knowledge, presumably in the form of semantic representations. Consequently, such representations allow for a richer variety of "chunking" strategies. We administered a standard version of the digit span task to US participants in order to assess how representative our sample was of the general population in industrialized cultures.

Spatial STM on the other hand, the ability to recall spatial locations and sequences, is often assessed by means of a Corsi block task, originally developed as a non-verbal analog of phonological and verbal STM tasks. The Corsi block task requires subjects to remember increasingly longer sequences of taps performed on a set of blocks laid out in a spatially random arrangement.

Now, crucially, with regard to the spatial memory task, it is well to observe that the Pirahãs navigate both on land and by river very accurately. Their daily lives require intricate and vast spatial memories. In fact, they have divided the jungle and rivers around them mentally into relatively small areas (no systematic study has been conducted) and know each of these areas by name. In spite of their regular reliance on spatial memory, they nevertheless performed significantly below our control group in the Corsi task.⁵ Though we changed the methodology and improved the phonological STM results, we did not do this for the Corsi block task. Yet each of these tasks is foreign for the Pirahãs, whereas both are indirectly familiar to American college students (whose culture regularly involves use of smart phone passwords, ATM codes, and a range of other visual pattern matching behavior that is foreign to the experience of the Pirahãs).

The performance differences were not due to failure to understand the immediate tasks, as we discuss in the paper. I explained the task to each subject in their language (Pirahã).⁶ Each performed the tasks alone, with other subjects out of earshot.

Though the Pirahãs understood the tasks, it was clear to me that the requested performance was not "resonating" with them. Our tests were coming from outside their knowledge structures, social roles, and values. This was supported when their performance improved in the phonological STM task – it then made more sense to them, better fitting their cultural expectations.

Our results of STM differences based on different cultural backgrounds indicate to me at least that the methodologies of cognitive science are often culture-bound. But what does it mean to describe something as "culture-bound"? What is culture after all? And how does it, how *can* it, affect our cognition – our knowledge, thinking, and the union of the two? That is, again, the purpose of this brief overview. There are several questions addressed in order for us to accomplish this purpose.

I am of course not the only researcher in recent years who has called for more attention to culture in the study of cognition. Stephen C. Levinson is another of many who argues for the significance of culture in understanding cognition. Levinson's concerns are summarized in "The Original Sin of Cognitive Science," (Levinson 2011), wherein he offers the following public service announcement to cognitive scientists: *understanding cognitive variation is a prerequisite to understanding cognition more broadly*. Levinson's arguments have been solidly confirmed in many studies over the years, not only by means of new methodologies and fields of study, such as the imaging genomics he discusses, but also by old-fashioned field research by which psychologists, anthropologists, linguists, philosophers, neuroscientists, and others in the cognitive scientists have discovered otherwise unanticipated degrees of cross-cultural variation in cognition.

Several researchers have explored ways in which life histories intertwine with culture in the formation of individual cognitive abilities, shared in interesting

ways across the communities of which they are a part. Everett (2016) summarizes and extends much of this research, drawing on the work of several other thinkers, such as Michael Polanyi ("tacit knowledge," Polanyi (2009[1966]; 1974)), Edward Hall (1973; 1976; 1990), and John Searle (1980a; 1980b; 1983; 1997). Dark matter of the mind is the combination of individual apperceptions and "culture" (as defined earlier) that at once makes each individual unique and part of a homogeneous community.

In order to appreciate the profound effects of culture on cognition, in what follows I review additional findings on the role of culture in perception, numerical cognition, grammar, and color, as well as how culture can provide insights into the origins of language and other components of human abilities we take for granted as being both invariant and unique to *Homo sapiens*. We conclude with some ideas for further study.

3. Culture and Dark Matter of the Mind

As we have seen, culture is an abstract concept. It elicits a range of understandings and definitions. Kuper (2000) discusses its variability, controversy, and difficulty to define in detail. Some anthropologists go so far as to reject culture as a useful construct for anthropological investigation. As mentioned earlier, a "verby" concept is more appealing to many than a "nouny" concept of culture. In this view, people don't "have" cultures; they "culture." But what does one do when they culture? According to the definition offered earlier, culture and culturing above engage three separate, broad, but integrated cognitive domains (as per Everett 2016): knowledge structures, violable value hierarchies, and multi-linked social roles. Language and other domains are also involved, as they come to be shaped by these broader ones.

4. From Etic to Emic

The crucial component of my model for explaining cultural effects on cognition and the formation of dark matter is emicization. Our apperceptions, personal experiences that mark us consciously or not, occur within and are interpreted by our emically-formed unconscious.

Emicization emerges from Pike's work on the *emic vs. etic*. He coined these words based upon the widely used linguistic terms *phonetic vs. phonemic*. Phonetics (articulatory, acoustic, or auditory) is the study of speech sounds from the perspective of a non-native speaker, say, a physicist or linguist. Phonemics is the study of sets of phonetic sounds that native speakers perceive as single sounds, i.e. the sounds that are important from the perspective of a native speaker, an insider.⁷ For example, English speakers all hear one sound, /p/ in the words [park], [spark], and [carp], when in fact there are at least three sounds, all written as 'p' in these words, namely, [p^h], [p], and [p̃], respectively.⁸ Native speakers thus know less *explicitly* about the sounds of their language than they tacitly know about them, since speakers in general never perceive the separate etic sounds but only the single emic sound that an etic sound is associated with. Yet they never confuse etic sounds in use. Thus even though native speakers lack overt knowledge of the the distribution of the etic sounds of their language, e.g. the three separate manifestations

(technically, *allophones*) of /p/ in the examples just given, their own emic knowledge produces behavior that can be described as: "Use [p] in syllable-medial positions, [p^h] in (some) syllable-initial positions, and [p̚] in phrase-final position."

Emicization and dark matter represent together a process of "de-alienization." All of us are born as aliens (modulo what we learn in the womb), faced with the task is of becoming natives, via the emicization of our experiences such that our interpretations, actions, and full set of behaviors fall into the range expected as "normal" by the society in which the learning is taking place, a learning process that to me at least includes language.

Emicization is the notion that the understanding of the world – including cognition, language, behavior more generally, and so on – is profoundly different for those inside a culture, "native-culturers" or "native-speakers," than for those outside the system. The term is interpreted slightly differently among two major anthropologists, as seen in the debate between Pike and Harris (1990), but for our purposes these differences are orthogonal.

When I walk with a Pirahã man in the jungle, for example, a slight motion in a tree branch to me appears to me as nothing of significance. I do not know why the branch is moving. I have an etic perspective of the local ecology But the Pirahã man, having an emic perspective of his environment, usually knows whether that motion is an index that signals the wind, a monkey, a bird, or some other object. Emic perspectives shape our languages, cultures, and cognition, from the interpretation of nature to art, science and the shaping of our thinking processes.⁹

With these preliminaries out of the way, let's turn to an example of the role of culture in visual perception.

5. The anthropology of perception

Dark matter and culture determine not only how we interpret images, but whether we can perceive them at all.¹⁰ The crosscultural ability to interpret photographs is directly relevant to the idea that culture might provide a hermeneutics for interpreting the world. Moreover, a bit of reflection suggests that differential perceptual ability in this regard might not be unexpected. After all, in the natural world, there are few if any two-dimensional visual experiences, aside perhaps from reflections in water. Therefore, there is a special interest in investigating cultures that lack two-dimensional visual arts, exposure to photography, or literacy, because such cultures could provide us with information on the origins of visual representation, in particular whether two-dimensional visual perception and interpretation is learned culturally or innate.

My interest in this topic began after I had noticed that when I showed the Pirahãs photos of themselves and others in the community, they would stare at the photos and then ask me what or who a given picture was about, even when the photo was a portrait of the beholder or a loved one. I commented on this later to a few colleagues, expressing my belief that this was "because they haven't had much experience with pictures." Some of my psychologist colleagues thought the observations were worth following up on experimentally.

Before going into a discussion of our efforts to understand the Pirahãs' interpretation of two-dimensional objects, we should first observe that their

difficulty in this regard is no different than Westerners' effort to understand representations of other kinds, such as in art generally, from modern to impressionistic to realist, it all must find a place in the observer's cultural matrix to be interpreted. Susan Sontag (2013 [1973], 1) insightfully observes that *"In teaching us a new visual code, photographs alter and enlarge our notions of what is worth looking at and what we have a right to observe. They are a grammar and, even more importantly, an ethics of seeing."* And also *"Finally, the most grandiose result of the photographic enterprise is to give us the sense that we can hold the whole world in our heads—as an anthology of images."* Philosopher John Searle (Searle 1980) also discusses the role of culture in the perception of paintings.

The technical argumentation that follows, based on my field research is taken largely from Yoon, Witthoft, Winawaer, Frank, Everett, and Gibson (2014). The question that exercises me is "Does our dark matter – derived from culture and psychology – help or impede our ability to perceive the world around us?" The short answer is that it does both. But to see this more clearly, I will first examine my own difficulties in seeing what Amazonian peoples see. Then I turn to the Pirahãs' difficulties in seeing some of what I see.

In the rainy season, jungle paths flood. Snakes exit their holes. Caimans come further inland. Sting rays, electric eels, and all manner of creatures can then be found on what in the dry season are wide, dry paths. It is hard to walk down these paths even in daylight during this period, covered as they are by knee-deep, even chest-high deep water (I have had to hike for hours from village to village in such conditions). At night, these paths are intimidating. As I walk with the Pirahãs, I am usually wearing shoes, whereas they go barefoot. Two memories stand out here. The first was me almost stepping on a small (three feet long) caiman. The second was me almost stepping on a bushmaster. In both cases my life or at least a limb was saved by Pirahãs who, shocked that I did not or could not see these obvious dangers, pulled me back at the last moment, exhorting me to pay more attention to where I stepped. Such examples were frequent in my decades with Amazonian and Meso American peoples. And each time they were astonished at my apparent blindness.

Thus, I want to underscore that even as we explore cultural constraints on Pirahã perception, there are equally profound cultural constraints on Westerners' perceptions (see Everett (2016) for several detailed studies). In a collaborative effort, Mike Frank, Ted Gibson, and I conducted a number of experiments among the Pirahãs in 2007 (designed by and coanalyzed with all the co-authors of Yoon, et.al.), we eventually reached several conclusions, summarizing our findings in the following:

"A core principle of vision science is that perception is not simply a passive reflection of the external world, but a process of constructive interpretation of inherently ambiguous input. Consider a shadow projected onto a wall. The same silhouette can be created by different objects of different sizes at different distances from the viewer. Images projected onto the retina have the same inherent ambiguity, and a wide range of perceptual judgments ranging from lightness ... , to color, to depth, to shape and identity, are the result of "unconscious inferences" by the visual system ... Such inferences are often presumed to be automatic and culturally universal ..."

As we interpret the world around us, the problem is not seeing the details but putting them together - knitting what we are seeing into coherent percept or "gestalt." This "putting together" occurs effortlessly and without awareness. Our initially etic "seeing" morphs via culture into emic perceiving, producing a gestalt, our interpretation.¹¹ Properly emicized, we see the whole better – seeing things that are not there and not seeing things that are. Consider how a degraded image might be viewed in a culture without two-dimensional viewing experience (discussed in detail in Yoon et. al.) People often failed to recognize two-tone images. When shown corresponding photographs, however, the two-tone often transforms into a coherent percept. Are Pirahã subjects using emic knowledge to interpret etic images or do they simply get better information, unconnected to outsider or insider knowledge? Subjects viewing the ocelot in the two-tone often made figure-ground errors, incorrectly assigning some background regions to the figure, some figure regions to the background. Reconfiguring figure-ground assignments after viewing the photograph is to "reorganize" one's initial grouping to achieve a different perceptual state ... If the viewer ultimately recognizes the previously unrecognized image, perception reorganization is said to have been successful.¹²

An important question that arises in the present discussion then is whether the perceptual reorganization reported by adults results from the intellectual maturation presumably common in all cultures or whether it is the result of dark matter acquired in specific cultural contexts (and particular individual histories). Pirahã adults have little experience or knowledge of the visual transformation that links a photo and two-tone image. On the other hand, Pirahã adults do possess both physiologically mature visual systems and a lifetime of experience with complex visual tasks such as hunting and fishing.

We concluded that Pirahãs and U.S. control participants both successfully pointed out accurately the target locations in our 2-D representations (we always asked them to point to an eye or person) on the non-two-tone images without seeing the corresponding clear photos (our controls with 100% accuracy and our Pirahã subjects with 88.9% accuracy), showing that participants understood the task. US participants located the targets successfully in two-tone images without a corresponding clear photo with a success rate of 72.5%. For Pirahãs the percentage of correct judgments was much less (22.5% of trials). Controls identified the targets in the clear, unaltered photos 100% of the time, while the Pirahãs had a 90.3% accuracy rate. All Pirahã participants correctly indicated the target on at least 7 of the 10 photos. Data from trials where the Pirahã did not correctly recognize the photo were excluded from subsequent analysis."

We tested whether Pirahãs were able to perceptually reorganize two-tone images when they were viewing the latter along with the original (unphotoshopped) photos. U.S. participants performed nearly perfectly. The Pirahãs, on the other hand, struggled. The contrast was striking.¹³

The question that we get to then is why this recognition and perceptual reorganization task was so much harder for the Pirahãs. There are a couple of potential explanations for our findings. One we can discard is that the Pirahãs might not have understood the task. The next is the Pirahãs' familiarity with the stimuli they were asked to judge, and the difficulty of the task. In a sense this is the point,

but there seemed to be no misunderstanding of what they were trying to do nor with the handling or the purpose of the stimuli – they were given things to describe. After deciding what it was that we were observing, our next task was to consider the range of possible differences in perception and discuss possible conceptual or experiential sources of differences in the groups' perceptual reorganization.

We determined that US adults are accurate at detecting the correspondence between photos and corresponding photo-shopped two-tone images even when the images no longer share a predictable coordinate frame relative to one another. This means that the US adults have to use emic understanding of the concept of two-dimensional representations, perceptual reorganization, in order to identify the unpredictably displaced location in the two-tone image within the figure. We accounted for the US vs. Pirahã performance differences in terms of "perceptual literacy," attributing to Pirahã and US performance differences to cultural differences in training and education with visual symbolic materials.

Moreover, since the photographs we used were of people and animals the Pirahãs knew their performance, it is also unlikely that the result is due to a lack of familiarity with the pictured items. In fact, the Pirahãs knew the items, fauna and people, better than the US control subjects.

The Pirahãs inability on the two-dimensional tasks, like mine on seeing dangerous animals, etc. in the forest, simply shows that a mature visual system is insufficient to guarantee recognition of what one sees. The mature system "sees" only the etic until it has undergone emicization into a particular culture, with particular experiences, expectations, and so on.

Again, these experiments not only demonstrate the relevance of culture to perception, but they support the Peircean notions of firstness, secondness and thirdness. Firstness in this case is the raw perception – a sense of something in front of me. Secondness is a view of what that is. Thirdness is a generalization relating one perception to others beyond the present stimulus (as seeing something red, recognizing it is red, and then seeing it as an exemplar of redness; Everett in progress).

6. The anthropology of numbers and numerical cognition

Another observation I made years ago (see Everett 2005, 2008, 2012, 2016) was that Pirahãs have no number words and no concept of counting. As I have done with all other controversial comments from my field research, I recruited help for rigorous testing of Pirahã number vocabulary and numerical cognition.

After completing our research on numbers and numerical cognition, Mike Frank, Ted Gibson, Evelina Fedorenko, and I (Frank et. al. 2008) were led to ask whether speaking a language without number words might change the way speakers perceive exact quantities. This was the perspective too of earlier work by Peter Gordon on Pirahã (Gordon (2004)). We showed in our later study that the Pirahã have no linguistic method whatsoever for expressing exact quantity, not even "one." Nevertheless, when asked to perform matching tasks (unlike their performance for Gordon; see C. Everett and Madora (2012)) Pirahã speakers were able to perform exact matches with large numbers of objects perfectly but they were unable to perform matching tasks involving memory. These results suggest that

language for exact number is a cultural invention rather than a linguistic universal. That is number words are a cognitive technology for keeping track of the cardinality of large sets across time, space, and changes in modality. And, I should add, such technology is only invented, borrowed, or otherwise implemented if it satisfies a broader cultural need.

This research is crucial in understanding that number is a tool, not a biological gift. C. Everett (2017) offers additional support this view in his survey of numbers and numerical cognition and their effects cross-culturally and cross-linguistically.

Other works such as Wnuk and Majid (2014) and Gibson, et. al. (2017) demonstrate the role of culture in color and olfactory perception. And these hardly exhaust the studies.¹⁴

7. Cultural effects on grammars

7.1. Phonology

Though I have discussed these data elsewhere (Everett 1979; 1985; 2008) it is worth reviewing them here to round out our picture of the effects of culture on grammar more generally. As pointed out in Everett (1979; 1982; 1985) Pirahã phonology cannot be fully described or understood without a knowledge of how it interacts with culture. Here is why I think this.

Imagine that a language could have various systems/modalities of sound structure, beyond its phonetics and phonology. And then consider the possibility that one modality can affect another, but not necessarily via constraint-rankings or rules, the standard devices of phonological theory proper. If so, then to understand the sound system of language, **L**, at any level (e.g. 'what happens' or 'what native speakers know when they know the sound system of their language') we must look carefully at the modalities of expression made available via an ethnography of communication and not merely at a supposed universal formal apparatus. Corollaries of this scenario might include, e.g. the appearance of new roles for old constraints (e.g. mode-faithfulness of segments being highly ranked to mark syllable types; syllables are maintained, a form of prosodic faithfulness, in order to parse the larger speech stream, not merely to enhance the perception of segments; and thus arguments for syllables may go beyond phonotactics and segmental enhancement and the syllable may have roles not envisioned by the so-called 'phonological hierarchy'). If this were true, then coherent fieldwork (Everett 2004) would evolve from a curiosity or desideratum to an imperative. Is there such a case? Indeed. Consider the following facts about Pirahã phonology, beginning with its phonemes.

Table One
Pirahã Phonemes

Consonants () = missing from women's speech

p	t	k	?
b		g	
	(s)		h

Vowels

Pirahã 's segmental inventory is one of the smallest in the world (the only language with smaller inventory us Rotokas, which lacks tones). It is also worth noting that the /s/ is in ()s because it is not found in women's speech, but only in men's (women use /h/ where men use /s/ and /h/).

Though this is one of the simplest segmental phonemic inventories in the world (the women's inventory does seem to be the simplest known), we should juxtapose alongside this simplicity, the complexity of Pirahã's prosodies. Pirahã's stress rule is a good place to begin, since it is well-known.

This rule, from Everett & Everett (1984), is considered one of the more complex and unusual stress rules in the literature, mainly for its phonological consequences (rather than, say, any difficulty in stating or recognizing it):

Pirahã stress rule: stress the rightmost token of the heaviest syllable type in the last three syllables of the word.

The phonetic basis of 'heaviness' in (1) is just this: Voiceless consonants are always longer than voiced consonants and there are five syllable weights based partially on this contrast:

Pirahã 's five syllable weights: CVV>GVV>VV>CV>GV

Pirahã is a tonal language, as well. But stress, tone, and syllable weight vary independently in the language. To see this, I will just review the simple set of examples below. In these examples tone is independent of stress. ´ = high tone; no mark over vowel = low tone. The stressed syllable is marked by !. There are no secondary stresses.

- | | | |
|-----|-----------|----------------|
| (1) | a. !tígí | 'small parrot' |
| | b. !pìgì | 'swift' |
| | c. !sàbí | 'mean, wild' |
| | d. !ʔábì | 'to stay' |
| | e. tí!híf | 'bamboo' |
| | f. ʔì!tì | 'forehead' |
| | g. tì!ʔí | 'honey bee' |
| | h. tí!hì | 'tobacco' |

Thus alongside Pirahã's extremely simple segmental phonology, it manifests a rich set of prosodies. This leads us to ask a whether the language exploits this differential complexity in any way. Indeed, as Everett (1985) describes it, Pirahã communication makes crucial use of the CHANNELS in (4), below, where Hymes (1974) defines a channel as 'sociolinguistically constrained physical medium used to carry the message from the source to the receiver'. The four principal modalities or channels in Pirahã after 'normal' speech are:

CHANNEL
a. **HUM SPEECH**

FUNCTIONS
Disguise
Privacy

	Intimacy Talk when mouth is full Caregiver-child communication
b. YELL SPEECH	Long distance Rainy days Most frequent use – between huts
&	across river
c. MUSICAL SPEECH ('big jaw')	New information Spiritual communication Dancing, flirtation Women produce this in language teacher sessions more naturally men. Women's musical
than speech	shows much greater separation of high and low tones, greater
volume.	
d. WHISTLE SPEECH (sour or 'pucker' mouth' – same root as 'to kiss' or shape of mouth after eating lemon)	Hunting Men-only One unusual melody used for aggressive play

The Example below illustrates how prosodic information in Pirahã is exploited to create these channels. The inventory above also partially shows how little the segments contribute to the total set of phonological information in a given Pirahã word. We see that the phrase 'There is a paca there' has a quasi-musical tonal representation (where an acute accent over a vowel represents high tone and no mark over the vowel means that the vowel has low tone), the basis for the channels just summarized.

(2) **kái?ihí?ao** **-?aagá** **gáihí**
paca -poss/exist-be there
'There is a paca there.'

All channels must include full prosodic information (stress, tone, length, intonation), though only the consonant and vowel channel needs to include the vowels and consonants.

In the musical form there is a falling tone, followed by a short low, with a preceding break in the whistle (where the glottal stop, **ʔ**, would have been in **kai?ihi**), followed by another short break (where the **h** would be) and a short high tone, and so on. Thus, the syllable boundaries are clearly present in whistle

(humming, and yelling) channels, even though the segments themselves are missing. The syllable in this case indicates length, offers an abstract context for tone placement, and the overall word is stressed according to syllable weight (see Everett (1988) for details). The syllable in these cases is vital to communication in differing channels, primarily in parsing the input.

But does the discovery of channels like this imply any causal interaction between culture and grammar? Or are these channels outside the grammar proper? Notice that these channels rely crucially on the syllable weights and stress rule above. So, if nothing else, they help account for what is otherwise an anomalous level of complexity in the stress rule. Yet the facts cut deeper than this. Consider the following example of what Everett (1985) calls the 'sloppy phoneme effect' :

- (3) **tí píai ~ kí píai ~ kí kíai ~ pí píai ~ ?í píai ~ ?í /íai ~ tí píai, etc. (*tí tíai, *gí gíai, *bí bíai) 'me too'**(4) **?apapai ~ kapapai ~ papapai ~ ?a?a?ái ~ kakakai ~>(*tapapai, *tatataí, *bababai, *gagagai) 'head'**
?ísihoái ~ kísihoái ~ písihoái ~ píhihoái ~ kíhihoái ~ 'liquid fuel' ¹⁵

Pirahã allows a tremendous amount of variation among consonants, though not for the features [continuant] or [voice]. This can be accounted for, but only if we refer to Pirahã's channels. The ungrammatical examples above show that the features [continuant] and [voice] are linked in the sense that they may never vary in the effect. Only place features may vary. With no reference to channels this is without explanation. But in light of the channels this follows because [continuant] and [voice] are necessary for stress placement (Everett (1988)) which in turn must be preserved in every discourse channel, or the constraint below is violated:

Constraint on functional load and necessary contrast (Everett (1985)):

- (4) a. Greater Dependence on the Channel → Greater Contrast Required
 b. Lesser Dependence on the Channel → Less Contrast Required

Notice that I am not claiming that the absence of variation for different values of [continuant] is predicted by 'channels' alone. This case in fact demands that we further investigate the connection between [continuant] [voice]. There is no claim that ethnography replaces phonology! But I am claiming that without the study of channels and their role in Pirahã culture, even an understanding of Pirahã's segmental phonology is impossible.

The lesson for the field researcher and theoretical linguist to be drawn from these examples is just this: first, language and culture should be studied together; second, as a modality-dependent channel, phonology may be subject to constraints that are (i) language specific and (ii) grounded not only in the physical properties of the instantiating modality (the phonetics) but also or alternatively on the culture-specific channels of discourse employed. This is a very important result because it shows that the 'interface conditions' of the HUMAN COMPUTATIONAL SYSTEM, in Chomsky's (1995) terms, may range beyond PF and LF, if we define an interface system as a system setting bounds on interpretability for HCL. Such examples also show how coherent fieldwork can be useful for theory. Thus not only the fieldworker, but also the phonologist must engage the language as forming a coherent whole with culture. And this in turn entails more culturally informed fieldwork.

7.2. Morphosyntax

Until this point, the facts reported may have been surprising, but not terribly controversial. As we turn however to look at cultural effects on grammar, we run against a major current of thought that denies this possibility a priori. I will not review the controversy on culture and grammar in Pirahã here, focusing instead on the facts. I am hardly the first researcher to suggest that cultures affect grammars. In the theory known as "Cognitive Grammar," this is vital: "Cognitive linguistic theories recognize cultural knowledge as the foundation not just of lexicon, but central facets of grammar as well." (Langacker (1994: 31)). On the other hand, in his 1921 monograph, *Language*, Edward Sapir pointed out that distinct languages may share a single culture (as has been the case to some degree with Western Civilization for centuries) and therefore that cultures and languages cannot always be mapped onto each other easily. In my book, *Language: The Cultural Tool* (Everett 2012), I argued that though grammars and cultures are distinct and though they may run semi-independent historical courses, they intersect in ways far more profound than is often thought by linguists, especially formal linguists. The entire field of linguistic anthropology, after all, is dedicated to examining the various ways that culture and language, including grammar, interact.

Let's take an example from New Guinea first. In his grammar of the Amele language of New Guinea, John Roberts discusses how and why the expression of the predicate "to give" uses no verb, treating the verbal agreement morphemes as types of predicates in order to communicate the cultural immediacy "experiential basicness" (Newman (2002, 79) of giving in this language (and this type of analysis is facilitated in theories that are more functionally or semantically based, such as in Role and Reference Grammar (Everett (2016, 173ff)):

- (5) a. Naus Dege ho ut -en.
Naus Dege pig 3_{SG.IO} -3_{SG.SUBJ.PAST}
'Naus gave Dege the pig.' (Roberts 1987: 34)
- b. Ija dana leis sab al -ig -a.
I man two food 3_{DU.IO}-1_{SG.SUBJ.PAST}
'I gave the two men food.' (Roberts 1987: 316)

There is no verb "to give" in Amele, only agreement pronominals occurring in clauses of giving. However, for other expressions verbs are required:

- (6) Jo eu ihac -i -ad -ig -en.
house that show PRED -2_{PL.IO} 1_{SG.SUBJ} - FUT
'I will show that house to you (plural).' (Roberts 1987: 69)

This is unlike languages with overt verbs of giving, since it is claimed that the experiential basicness of giving in Amele culture favors deriving the semantics from the reversal of the pronominals marking indirect and direct objects along with simultaneous zero marking of the verb.

Wierzbicka (1992, 1997, 2014) provides examples of cultural constraints on grammar in Russian. She shows how the "key word" *sud'ba* "fate, destiny", for example, designates a Russian way of looking at life, manifesting itself in the Russian lexicon, phrase structure, and morphosyntax (see Goddard (2002) for details). For Cliff Goddard (2002, 55) ethnosyntax is the encoding of a "particular 'ethnophilosophy'" in the grammar proper (as in Wierzbicka's and Roberts' examples). I accept this conceptualization as well.

Moreover, I have also argued (Everett 2008) for a similar "key word" encoding a key cultural value in Pirahã. The word is *xibipiio* and it indicates experiential liminality. Everett (2005), describes a range of unusual features of Pirahã culture and language, many of them never documented for other languages (though one would not be surprised if many other languages had similar features or lacked such features). These include: simplest kinship system known, lack of color words, lack of numbers and counting, no perfect tenses, no creation myths, no historical or fiction myths, being monolingual after more than three hundred years of regular contact with Brazilians, and no recursion (contra Hauser, Chomsky, and Fitch (2002)). I proposed to account for all of these facts by the IMMEDIACY OF EXPERIENCE PRINCIPLE, IEP. This is a principle found in some degree of strength in many Amazonian languages (see Gonçalves (2005) for a discussion of the pervasiveness of immediacy of experience as a cultural value throughout Amazonia.)

Dark matter's effects are far-reaching. In fact the IEP affects Pirahã grammar profoundly. To see how, let's begin by restating this principle:

Immediacy of Experience Principle (IEP): Declarative Pirahã utterances contain only assertions related directly to the moment of speech, either experienced (i.e. seen, overheard, deduced, etc. – as per the range of Pirahã evidentials, as in Everett (1986, 289)) by the speaker or as witnessed by someone alive during the lifetime of the speaker).

Everett (2005) offers a range of arguments for the IEP, based on the empirical points mentioned earlier, as well as (among other things) the culturally important notion of **xibipiio** 'experiential liminality', as discussed in Everett (2008). This word is further evidence that liminality as an important cultural and individual concept in Pirahã. It is used to describe things that go in and out of vision or hearing, from the flickering of a match to the disappearance or appearance of a canoe around a bend in the river.

Moving from this initial cultural statement to the grammar (and later back to link them) the evidence that Pirahã lacks recursion, also discussed in Everett (2012a) is as follows (though see Perfors, et. al. (2010) for another type of approach to checking the grammars of languages):

First, the lack of recursion correctly predicts that factive and epistemic verbs will be absent. This follows because if Pirahã lacks recursion, then there is no way to express factive verbs as independent verbs, since these would require a complement clause. That would in turn require embedding and thus, *ceteris paribus* (in some analyses), a recursive rule in Pirahã syntax. Pirahã expresses such notions via verbal suffixes, consistent with the 'no recursion' hypothesis, not with complement clauses.

Second, Pirahã has no marker of subordination. This is also predicted by my hypothesis, because if Pirahã lacks recursion, there is no subordination to mark.

Third, Pirahã has no coordinating disjunctive particles (e.g. 'or'). The absence of explicit markers of disjunction is predicted by my hypothesis, since disjunction entails recursion.

Fourth, Pirahã has no coordinating conjunctive particle (e.g. 'and'). There is only a more general particle, **píaii**, which may appear preverbal or sentence final and which means 'is thus/simultaneous' (vague meaning), which never works like proper conjunction, but only supplies the information that these two things were simultaneous. Again, this is predicted by my analysis, since coordination also entails recursion.

Fifth, Pirahã has no syntactic complement clauses. If Pirahã has recursion, where is the unambiguous data?¹⁶ I have claimed that it lacks embedded clauses. Others claim, based on my own data and my own earlier analysis, that it has them (Nevins, Pesetsky, and Rodrigues 2009).¹⁷ But although quotatives *could* be embedding, there are no multiple levels of embedding, which would be expected if Pirahã has recursion.

Sixth, Pirahã does not allow recursive possession. The point of Pirahã possessives that I have made is not simply that it lacks prenominal possessor recursion, but that it lacks recursion of possessors *anywhere* in the noun phrase. Nevins, Pesetsky, and Rodrigues (2009) might be correct to suggest that German, like Pirahã, lacks prenominal possessor recursion. But German *does* have postnominal possessor recursion, while Pirahã has *none*. This is predicted by my analysis.

Seventh, Pirahã prohibits multiple modifications in the same phrase. As I have discussed above and in Everett (2008) and (2009), there can at most be one modifier per word. You cannot say in Pirahã 'many big dirty Brazil-nuts'. You'd need to say 'There are big Brazil-nuts. There are many. They are dirty.' This paratactic strategy is predicted by my analysis since multiple adjectives, as in English, would entail recursion. But the paratactic strategy does not.

Eighth, Pirahã semantics shows no scope from one clause into another, e.g. no "Neg-raising." Pirahã lacks examples such as 'John does not believe you left' (where 'not' can negate 'believe' or 'left', as in 'It is not the case that John believes that you left' vs. 'It is the case that John believes that you did not leave'). In this example 'not' can take scope over 'believe' or 'left'. That is not possible without recursion, so my analysis predicts the absence of such scope relations. This is also predicted, correctly, to be impossible in Pirahã under my account, since it would entail recursion.

Ninth, Pirahã shows no long-distance dependencies except between independent sentences, i.e. discourse. The kinds of examples that are standardly adduced for long-distance dependencies include:

'Who do you think John believes __ (that Bill saw __)?'

'Ann, I think he told me he tried to like ___''

We have stated the IEP and rehearsed the evidence against syntactic recursion in Pirahã. It remains now to show how these fit together causally. It turns out that they engage like the teeth in cogs, via evidentiality. Pirahã, like many other

languages (see, inter alia, Aikhenvald (2003); Faller (2007)), encodes evidential markers in its verbal morphology as affixes: **-híai** 'hearsay;' **-sibiga** 'deduction;' **-ha** 'complete certainty;' and **-0** (zero affix) 'assumption of direct knowledge.' The Pirahã IEP in conjunction with its requirement that evidence be provided for all assertions, produces a narrow domain in which assertions and their constituents need to be warranted. Reminiscent of the Potential Focus Domain developed by Van Valin (2005, 70ff), I label this domain in Pirahã (and presumably some version of this will exist in all languages, at least those with evidentiality morphology) the **POTENTIAL EVIDENTIALITY DOMAIN** (PED), i.e. the range of structures where the actual evidentiality domain could in principle fall. The actual domain of evidentiality in a given utterance will be as follows:

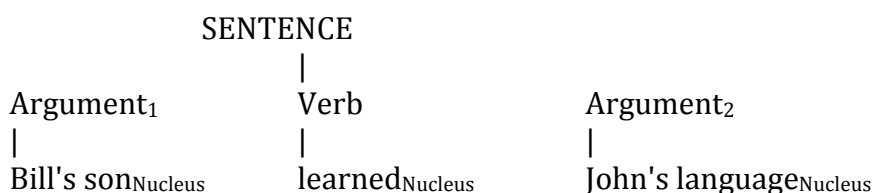
EVIDENTIALITY DOMAIN: *The syntactic domain in a sentence that expresses the evidentiality component of the pragmatically structured proposition.*

The PED in Pirahã is limited to the lexical frame of the verb, i.e. the verb and its arguments (more technically, the phrasal nuclei of the predicate and its arguments in Van Valin's Role and Reference Grammar terminology)¹⁸. Let's assume that the IEP is one of the reasons that Pirahã has evidentiality markers and that it dramatically strengthens their effect by narrowing their scope to the PED just mentioned.

The PED then rules out syntactic recursion in Pirahã. As stated, the PED clearly depends on the main verb as the core of the speech act. The PED will include only nuclei (semantic-syntactic heads, not heads in the X-bar sense) directly licensed by the predicate (its semantic frame). No nuclei are allowed outside the PED of a containing sentence.

By the PED there are no embedded possessors; no embedded predicates – only arguments licensed by the main predicate. For example, in a noun phrase like "John's house", "house" is the nucleus – the semantic core, what this phrase is about. John is the possessor, a type of modifier of the nucleus house – the possessor tells us which house we are talking about. On the other hand, in a larger noun phrase such as "John's brother's house", "house" and "brother" are each a nucleus of a separate containing phrase. "House" is the nucleus of the phrase "brother's house" and "brother" is the nucleus of the phrase "John's brother." "John" is not a nucleus of any phrase. This means that 'John,' not being the possessor of an argument of the main verb (it is a nucleus of 'John's brother' but 'brother' is not a nucleus of the verb) is unwarranted in the PED and the sentence is disallowed. An embedded predicate would contain arguments not licensed by main predicate. Therefore, there can be no phrases within phrases and no sentences within sentences in Pirahã. There can also be no productive compounding in the morphology. Such apparent compounds as are found are in fact synchronic or diachronic phrases.

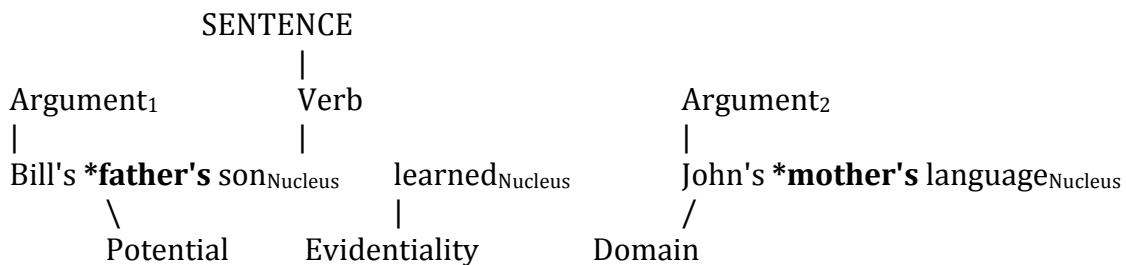
This is exemplified below, in a theory-neutral representation:



\ | /
Potential Evidentiality Domain

This example is allowed because each Nucleus is found in the semantic frame of the verb, represented along the lines of the following lexical representation: [BECOME **know** (son, language)]. This is a very strict evidentiality requirement. It predicts that the number of arguments in a sentence cannot exceed the number allowed by a standard (e.g. RRG) verbal frame. It rules out all embedding and all syntactic recursion.

The lexical representation of an "accomplishment verb", e.g. 'learn' ([BECOME **know**] indicates the change of state of knowledge) projects three nuclei to the syntax – the verb 'learn,' and the nominal nuclei/arguments 'son' and 'language.' Each of the nominal nuclei is possessed by a non-nuclear nominal. So the requirements of the PED are met. However, in the example below, there are two non-warranted nuclei, i.e. appearing in the PED without being found in the lexical representation:



This sentence would therefore be ungrammatical in Pirahã, though it is fine in English. My analysis claims that the existence of evidentials, their scope, and the consequent lack of recursion are all reflexes of the cultural value IEP in Pirahã grammar.

Although the PED (forced by the IEP) rules out recursion in Pirahã, my analysis does not require that any another language, e.g. Riau (Gil (1994)), necessarily derives the absence of recursion in the same way. Recursion serves several purposes (Everett 2012) and thus there is more than a single reason why a language might use or not use recursion in its sentential syntax. For example, Riau might simply rank a value of slower information rate above a value favoring recursive sentences in its language. Many oral traditions use repetition and slower information rate as aids to communication in the noisy environments of human speech. So this is a cultural explanation of some very complex syntactic facts that affect the Pirahã language as a whole.

Everett (2005, 2) concluded therefore that the Pirahã language's culture affects its grammar:

"... the conclusion is severe – some of the components of so-called core grammar are subject to cultural constraints, something that is predicted not to occur by the universal-grammar model. I argue that these apparently disjointed facts about the Pirahã language gaps that are very surprising from just about any

grammarian's perspective ultimately derive from a single cultural constraint in Pirahã, namely, the restriction of communication to the immediate experience of the interlocutors."

This has resulted in more than a decade of controversy (inter alia, Everett 2008, 2009, 2010a, 2010b, 2012a, 2012b, 2013a, 2013b, 2014a, 2014b). The final word on the subject, for now, again, from independent investigation, is Futrell, et. al. 2016. In this paper my co-authors and I argue that there is no clear evidence for recursive structures, coordinating or disjunctive particles, and so on in a sample of many texts collected by myself and Steve Sheldon, a missionary who worked about ten years among the Pirahãs and still speaks their language fluently. In, inter alia, Everett (2005, 2009, 2010a, 2010b, 2012a, 2012b) I offer additional evidence and explain this lack of recursion in terms of information flow and a general cultural value, which I term "Immediacy of Experience." I argued in detail in these and other works that this value further explains a variety of aspects of Pirahã culture and language, such as lack of fictional and historical texts, the simplest kinship ever documented, the absence of perfect tenses, and so on. In fact, the theme of all of these works is that culture is inseparable from understanding Pirahã cognition.

8. The anthropology of language origins

In more recent work, Everett (2017), I have argued that archaeological evidence supports the thesis that *Homo erectus* invented language and that it did this by developing a symbiosis of culture and language.

The core of language in my understanding is the symbol, a combination of a culturally-agreed upon form with a culturally-developed meaning. Human perceptual constraints and thinking limitations guide this process, but it is largely the output of human societies, their values, their knowledge, and their social structures.

For Peirce a symbol was quite different than a "sign" was for Saussure. Symbols are triadic and recursive. Signs are dyadic and non-recursive. A symbol encodes the relationship between an object, an interpretant (the effect of the object on the hearer, roughly similar to an interpretation), and a form. By convention the form links the object and the interpretant. This becomes crucially different from the dyadic signs of Saussure, which are simply form:meaning pairs, in that although a non-human animal can recognize and produce signs it isn't clear that they can recognize or produce symbols. The reason is that an interpretant of a symbol is also a sign-type which also elicits an interpretant and so on recursively. Interpretants can only be grasped as part of culture, they are more than mere responses but indicate the abstract network of interpretation that only arises via a culture. Hence the appearance of symbols in the Peircean sense indicates the birth of language, but the existence of signs is common throughout the animal kingdom (and likely the plant kingdom as well) and is not alone indicative of the existence of language (Everett to appear, inter alia).

Assuming that this is correct and that the symbol is the linguistic dividing line between humans and other creatures, we produce a simple distinction between the communication systems of non-humans and humans (of all species of *Homo* through time; Everett (2017)):

COMMUNICATION *is the transfer of information.* (roughly for the purposes of discussion, something contingent, external to the organism that affects the organism's behavior.)

LANGUAGE *is the transfer of information via symbols.*

Formal linguists might dispute this, since it has long been assumed that languages are defined by grammars, in particular the Chomsky Hierarchy of grammars (Chomsky 1959). Interestingly however, in a recent paper, a formal linguist in the Chomskyan tradition appears to agree (Murphy (2015)):

"It is shown that the operation Label, not Merge, constitutes the evolutionary novelty which distinguishes human language from non-human computational systems; a proposal lending weight to a Weak Continuity Hypothesis and leading to the formation of what is termed Computational Ethology."

The symbol may have resulted from associating two objects by mistake, such as a tree root confused with a serpent, or simply by regular association of one thing in the world with another object or event, as Pavlov's dog learned to associate food with the ringing of a bell. Once this connection was made, humans began to use their symbols, each one learning from the other. Since communication is an effort of the entire being, gestures, intonation, the lungs, the mouth, the tongue, the hands, body movements, and even eyebrows were marshaled for use in language, just as they are in much other animal communication. These different components of our communicative effort in language would have broken symbols down into smaller and smaller parts as they also were used to build them into larger and larger units. Speech sounds, words, sentences, grammatical affixes, and tones all emerged from the initial invention of the symbol, symbols being improved, adopted and spread over time by societal involvement, just as all other inventions are. Meaningless elements (sounds like "s," "a," and "t") "were combined to form meaningful items (such as the word "sat") and "duality of patterning" emerged along with the symbol, leading next to three types of grammars. The first kind of grammar, G_1 , is little more than symbols arranged in rows like beads on a string: "Eat. Drink. Man. Woman." Or even "I see you. You see me?" The next language type, G_2 , arranges symbols linearly (in a row), just like a G_1 grammar, but also hierarchically - combining symbols inside of other symbols, just as many modern European languages do (e.g. [[The man [with the red hair]] arrived]]. The third type of grammar, G_3 , does everything that the other types do, but with the added property of recursion, the ability to put one thing inside another thing of the same type without end, language as matryoshka doll. All three types of languages are still found in the world. All are fully functioning human languages appropriate for different cultural niches. Homo erectus communities spoke one or all of these types of grammars, in their far-flung outposts around the world.

Evidence that erectus had language is adduced in Everett (2016, 2017) from their settlement patterns, travels, sailing and transportation of tools. I won't review all that evidence again here, but the reader is referred to those works for the data.

Human languages change over time and cultures and speakers elaborate them in some places and simplify them in others. Contemporary languages are therefore different than language was two million years ago in their details. But the fact remains that two millions years ago in Africa, a Homo erectus community began to share information among its members by means of language. They were the first to say "It's over there." "I am hungry." Maybe the first to say "I love you." They achieved this by developing culture, symbols, and grammar, leading to the first cognitive and informational revolution in the history of our species.

Erectus communities were unlike sapiens communities in many ways. But all evidence suggests similarities with other societies of human beings, likely discussing, deliberating, debating, and denouncing, as they traveled the world and bequeathed to us their invention, language.

Each human alive enjoys their grammar and society because of the work, the discoveries, and the intelligence of Homo erectus, developing culture and language as the great cognitive symbiosis. Natural selection took those things that were most effective for human survival and improved the species until today humans live in the Age of Innovation, the Era of Culture, in the Kingdom of Speech.

9. Methodology and future directions

In future work, there is a need to explore the connections between dark matter of the mind and the prematurely abandoned (by many cognitivists) research program of Behaviorism, especially that version of the theory developed by Staddon (2014). This is not an abandonment of the goals of the cognitive sciences, nor of cognition more generally. Behaviorism, after all, never abandoned the goal of understanding the mind. Rather it is a recognition that external behavior, culturing and languaging for example, is our only evidence for the mind.

One reason that attempts to develop models of the role of culture in cognition often come to grief is that they lack methodological components that would enable others to test and develop them further, via additional cross-cultural and cross-linguistics research. So let me conclude by providing a list of some desiderata for understanding the components of cultures:

1. The components must be learnable from the environment (because all people have culture and cultures vary and overlap in interesting ways);
2. The components must be non-innate by hypothesis or we lose the ability to comprehend the tremendous variability among cultures;
3. The components ideally will have a clear evolutionary trajectory;
4. They should be sufficiently fine-grained so as to allow for variation in various levels;
5. They should be testable;
6. They should all us to understand how culture and cognition "link up;"
7. They should be explanatorily useful.

Everett (2016) is a sustained attempt to realize these desiderata and to provide a model for investing cognition cross-culturally. Not everyone of course will agree with the approach that I suggest in that book. But one hopes that whatever model is assumed, developed, or criticized, more research on the role of culture in cognition will occur. In fact, there is evidence that this is a promising new

line of research. Gibson, et. al. (2017) argues that color-naming is inherently a cultural phenomenon, at least partially inspired by the work of Everett (2005).

10. Conclusion

In this overview paper, I have presented evidence that human cognition, from language to memory to perception, is profoundly affected by human culture. I offered definitions of culture and its underlying engine, dark matter of the mind, that accord with ongoing research of mine, reported on in particular in Everett (2012, 2016, and 2017). Humans are cultural creatures. We cannot understand ourselves in the absence of a clear concept of culture and how this is underwritten by individuals.

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¹ An "apperception" is the mental process by which a person makes sense of an idea by assimilating it to the body of ideas he or she already possesses.

² They can also help us to better situate and evaluate important work from at least two major research programs, that of "Dual Inheritance Theory" (Boyd and Richerson (1998)) and of the "Cultural Attractor Theory" of Sperber and Hirschfield (2004). The former is the idea that culture (in a way nearly identical to the so-called "Baldwin effect") can lead to changes in biological evolution, even as biological evolution underwrites culture and cognition. The latter, simplifying, is the idea that certain behaviors and ideas wind up being more widespread and thus successful than others.

³ This experiment was not our primary research focus, but simply a prolegomena to an exploration of other aspects of Pirahã cognition.

⁴ The Pirahã language is a member of the Mura linguistic family, all other languages now extinct, so it has become a language isolate. The villages of the people are located along the Maici river, a tributary of the Marmelos, which is a tributary of the Madeira, a tributary of the Amazon, about 800 miles southwest of the city of Manaus, in the Brazilian state of Amazonas. When I began work there in 1977, there were estimated to be about 110 speakers. Today estimates are as high as 1,000.

⁵ "For the syllable span task, we created five sequences of consonant-vowel syllables at each length from two to eight syllables. To create the syllables, we used all possible combinations of the three vowels (i, a, u) and seven consonants (p, b, t, k, g, h, and a glottal stop)² in the Pirahã language (Everett, 1988). All of these phonemes are present in the English language, too, and so the syllables should be equally familiar to the two populations. We ensured that no syllables or adjacent collocations of syllables formed words in Pirahã (to the best of DE's knowledge of the language) or English. For the Corsi block task, we followed the arrangement of blocks used in previous work (Kessels et al., 2000). We created two sequences of taps at each length between two and nine taps. In the course of testing, two additional sequences at span-level 2 were created to allow for extra training trials at the shortest length for the Pirahã participants." Fedorenko, et. al. (2011, 5ff)

⁶ The Pirahãs are almost exclusively monolingual, by which I mean that no one in the community would be able to carry on a normal conversation in any language but their own, although many men do know large numbers of Portuguese nouns and a few verbs.

⁷ These are both idealizations. Our understanding of "phonetics" seen, for example, in something so erstwhile objective or etic as the International Phonetic Alphabet, is shaped by our emic perspectives and most "etic" categories are themselves idealized (affected by researchers' experience with emic categories) in cultural ways. So there is no truly objective vantage point, just ones less contaminated in ways we know of.

⁸ The standard convention in linguistics is that //s are used to enclose phonemic sounds and []s to enclose phonetic sounds.

⁹ Pike's (1967) book in which these ideas are developed examines emic vs. etic perspectives of American football games and a wide variety of other behaviors, both public and private, for example.

¹⁰ Much of this section is drawn from Everett (2016, chapter four).

¹¹ This process of "putting together" an interpretation of raw perception was first explained in detail by C.S. Peirce in his metaphysics, wherein the raw perception was a "firstness" and the final interpretation was a "thirdness." Firstness, secondness and thirdness run throughout Peirce's philosophy and offer insights into a number of aspects of human cognition and logic (Everett (forthcoming)).

¹² "Following the Gestalt school, we use the terms "perceptual organization" and "perceptual reorganization" to emphasize the process by which local image features are appropriately integrated ('grouped') or segregated in order to arrive at a meaningful interpretation of the image—a "gestalt" (Kohler, 1929)."

¹³ The methodology employed was as follows:

"Participants included adult members of the Pirahã tribe (n=9, mean estimated age = 30y) and as controls tested with the same stimuli, Stanford University students, faculty, and staff (n=8, mean age = 26y). An additional control task with additional stimuli was tested on Stanford students (n=10, mean age = 19y). The visual acuity of the Pirahã population was tested by DE and others some years earlier as part of a basic screen for medical services; the population was on the whole normal, with no cataracts and a small incidence of nearsightedness... Ten two-tone images were created in Photoshop by blurring and posterizing (reducing the number of distinct gray scale values in this case to two: black and white) grayscale photographs of animals and individuals found in the Pirahã participants' everyday environment (Figure 1). The amount of blur and the black/white threshold points were set independently for each photograph based on a repeated trial and error procedure until we were satisfied with the subjective impressions that the two-tone was (a) hard to recognize without first seeing the photograph from which it was derived ("uncued") and (b) easy to see after seeing the photograph ("cued"). This stimulus creation and selection were guided by the perceptual judgment of the experimenters. Images were printed onto 12x12cm cards... Two other image pairs were created which did not include two-tones and for which the correspondence was easier to see... These served as warm-up items and to ensure participants understood the task."

"Each trial proceeded in three stages. In stage 1, participants were shown a two-tone image and asked to indicate their recognition by pointing to the location of the eye or Pirahã person in the picture... Responses were marked by placing a sticker at the indicated locations. Trials in which the target was not initially identified were considered "candidate reorganization trials." These trials were of particular interest as they provided a test of whether an initially unrecognized two-tone image could be successfully reinterpreted after seeing the corresponding photo. These trials proceeded to stages 2 and 3. In stage 2, participants were shown the corresponding photograph alone and asked to point to the location of the eye or the Pirahã person. In stage 3, the two-tone image and photograph were shown side-by-side. The experimenter then pointed back and forth between the two images using the Pirahã word for "same" to convey the correspondence between photo and two-tone. After this instruction, the subject was again asked to point to the location of the eyes or person in the two-tone image."

"We additionally tested Stanford students on an alignment manipulation task. This task controlled for the possibility that U.S. participants' performance on the task was not due to recognizing the two-tone images, but merely locating the point on the two-tone card in the same location in the corresponding point in the photograph."

¹⁴ In personal correspondence, the leading field research on the Maniq culture, Helmut Lukacs, has strongly disputed the claims of Wnuk and Majid. I am preparing a paper evaluating these claims, based on Lukacs' field notes.

¹⁵ Alternations with /t/s or involving different values for [continuant] or [voicing] are unattested.

¹⁶ In a new volume (Amaral, et. al.), Sauerland and several authors criticize my analysis of Pirahã based on supposedly new data. However, as I point out in Everett (forthcoming), these criticisms are based on a combination of questionable data (since none of the critics speaks Pirahã at all and had no access, therefore, to native speakers) and a misconception, arising from Chomskyan theory's inability to account for intersentential syntactic phenomena, as opposed to intrasentential syntax). More specifically, Sauerland claims that truth conditions that emerge from his experiments demonstrate the existence of clausal embedding in Pirahã. Two others have to do with "self-embedding" in noun phrases and prepositional phrases. However, although this book is new these particular claims are not. I have answered them all in detail. See Everett (to appear), Everett 2016 (<http://ling.auf.net/lingbuzz/002857>) for why semantics cannot diagnose syntax and why truth conditions are not reliant on embedding, and Everett 2017 (<https://daneverettbooks.com/a-discussion-of-understanding-recursion-and-looking-for-self-embedding-in-Pirahã/>) for a discussion of the claims that there are "self-embedding" structures in Pirahã.

¹⁷ Ironically Nevins, Pesetsky, and Rodrigues's (2009) paper is an attempt to refute me using my own earlier analysis and data. Replying to them is like having a debate with myself – the Dan Everett of 30 years of field experience among the Pirahãs vs. the Dan Everett of 14 months of field experience, writing a PhD dissertation.

¹⁸ I use Role and Reference Grammar here because to my mind it most effectively blends structural and functional-semantic principles into a theory of grammar. Nothing crucial hangs on this, however, and other theories might be compatible with the analysis offered here.