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## Core Folkbiological Concepts: New Evidence from *Wichí* Children and Adults

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### Abstract

We examine two core folk-biological concepts (e.g., ANIMATE, LIVING THING, where small capital letters denote concepts; quotation marks denote their names; italics denote language-specific names) in adults and children from the *Wichí* community, an indigenous group of Amerindians living in the Chaco forest in north Argentina. We provide an overview of the *Wichí* community, describing in brief their interaction with objects and events in the natural world, and the naming systems they use to describe key folkbiological concepts. We then report the results of two behavioral studies, each designed to deepen our understanding of the acquisition of the fundamental folkbiological concepts ANIMATE and LIVING THING in *Wichí* adults and children. These results converge well with evidence from other communities. *Wichí* children and adults appreciate these fundamental concepts; both are strongly aligned with the *Wichí* community-wide belief systems. This work underscores the importance of considering cultural and linguistic factors in studying the acquisition of fundamental concepts about the biological world.

### Keywords

Folkbiology, concepts, development, language, Amerindian community, *Wichí*

In recent years, considerable research attention has been devoted to the study of ‘folkbiology’, or how people in communities across the world conceptualize and reason about the natural world. Adopting a developmental and cross-cultural approach, researchers have sought to identify which concepts (if any) are represented universally and whether and how they are shaped by experience. There is a growing consensus that some fundamental folkbiological concepts, which appear early in development, may also be represented universally.

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The concept ANIMATE OBJECT serves a strong case-in-point. Infants' sensitivity to a distinction between animate and inanimate objects is evident within the first six months of life (Poulin-Dubois and Shultz, 1990; Berthenthal, 1993; Woodward et al., 1993; Gelman et al., 1995; Johnson et al., 1998; Woodward, 1999; Opfer, 2002; Kuhlmeir et al., 2004), and this distinction guides their expectations about the behaviors of objects throughout childhood (Keil, 1979, 1989; Gelman et al., 1983; Gelman, 1990; Gelman and Gottfried, 1996; Opfer and Gelman, 2001; Booth et al., 2005; Jipson and Gelman, 2007).

In contrast, other fundamental folkbiological concepts appear to emerge more slowly in development and seem to be strongly influenced by the linguistic and cultural communities in which children are raised. The overarching concept LIVING THING, which includes both the plant and animal kingdoms, appears to follow this trajectory (Piaget, 1929; Carey, 1985; Springer and Keil, 1989, 1991; Hatano and Inagaki, 1994, 1999; Inagaki and Hatano, 1996; Slaughter et al., 1999; Nguyen and Gelman, 2002; Slaughter and Lyons, 2003; Nguyen and Rosengren, 2004; Opfer and Siegler, 2004; Poling and Evans, 2004; Waxman, 2005; Leddon et al., 2008). Evidence from children across diverse linguistic and cultural communities reveals that the incorporation of plants (along with animals) into the overarching concept LIVING THING is a protracted developmental achievement (Hatano et al., 1989, 1993; Anggoro et al., 2008), and one that is strongly inflected by children's experience. Three types of experience have been implicated, including (i) language practices (e.g., whether and how key folkbiological concepts are marked in the native language (Anggoro et al., 2008)), (ii) contact with the natural world (e.g., the amount and kind of direct interaction with the biological environment (Proffitt et al., 2000; Atran et al., 2001; Ross et al., 2003; Tarlowski, 2006) and (iii) community-wide belief systems about the natural world (e.g., the range of entities that are considered to be LIVING THINGS (Astuti et al., 2004; Medin et al., 2006; Waxman and Medin, 2006; Bang et al., 2007; Waxman et al., 2007; Atran and Medin, 2008)). For example, some (but not all) communities, certain natural kinds (e.g., sun, other heavenly bodies, and rocks) are considered LIVING THINGS.

Taken together, then, recent research suggests that although some fundamental folkbiological concepts are acquired early and may be represented universally, others are acquired later and are shaped in important ways by children's experiences in the communities where they are raised. However, key questions remain concerning how peoples' appreciation of the overarching concept LIVING THING is shaped by the naming practices, language, experiences and belief systems.

Our goal in the research we present here is to pursue these questions by offering new evidence from the *Wichí*, an indigenous Amerindian community

living in the Chaco forest north of Argentina. In addition to north Argentina the *Wichí* people are located in Tarija, Bolivia. Descriptions of this population have been reported in the linguistics and anthropological literatures, but to the best of our knowledge, the current project represents the first investigation of the *Wichí* community from a psychological and developmental perspective.

We focus on the *Wichí* because they offer us an opportunity to consider the acquisition of fundamental biological concepts within a strong native language-speaking community with a constellation of experiences and belief systems that differs in important ways from the ones held by participants in most prior empirical work. First, unlike in the majority of the Amerindian populations studied to date, the *Wichí* language is very much alive. As the primary language within the family and the community as a whole, *Wichí* is acquired naturally and spontaneously by infants and young children. Second, for children as well as adults, daily life in the *Wichí* community involves extensive and varied direct contact with plants, animals and natural inanimates. Third, as we shall see, *Wichí* belief systems pertaining to the natural world appear to be distinctive.

In what follows, we provide an overview of the *Wichí* community, describing in brief their contact with and beliefs about the natural world and the naming systems that they use to describe key folkbiological concepts. Whenever possible, we supplement the existing evidence with insights from native adult informants from our target community. Armed with this descriptive information, we go on to report the results of two empirical studies, each designed to deepen our understanding of the acquisition of the fundamental folkbiological concepts ANIMATE and LIVING THING in *Wichí* adults and children.

### Descriptive Information

The *Wichí* people, formerly known as the “*Mataco*”, are an indigenous population living in the Chaco forest in the South American Lowlands of Argentina. The Chaco forest spans 1 000 000 square kilometers; its terrain is characterized primarily by grassy plains, interspersed with distinct areas dominated by scrub growth, small woody plants, or palm groves. The *Wichí* depend economically on traditional activities, including hunting, fishing, gathering, and seasonal “slash-and-burn” horticultural practices. Textile weaving, pottery, and, to a lesser extent, ranching and farming are also key economic practices.

The nutritional, symbolic, economic, medicinal uses and significance of both plants and animals in the *Wichí* community is well-documented (e.g., Wilbert and Somoneau, 1982; Maranta, 1987; Alvarsson 1988; Koschitsky, 1992; Arenas and Giberti, 1993; Palmer, 1995, 2005; Arenas, 2003; Suárez,

2009; 2010, 2011a,b; Suárez and Montani, 2010). Both women and men are engaged directly with plants and animals, but their activities reflect a strongly gender-based differentiation of labor and expertise. Men are responsible for hunting, fishing, horticulture, and manufacturing wooden handicrafts. Women are responsible for housework, child-rearing, and manufacturing textile handicrafts. Women are also responsible for gathering fruit, wood and other plants, a task that typically requires full-day expeditions deep into the Chaco forest, in which they are accompanied by their children.

The *Wichí* peoples' beliefs about relations among entities in the natural world differ from those in most Western, technologically-saturated communities, but bear strong commonalities with the beliefs held in several other native Amerindian communities (see Wilbert and Simoneau, 1982; Palmer, 2005; Braunstein, 1983 for more extensive descriptions). We focus here on only two beliefs. First, in the *Wichí* tradition, humans descend from non-human animals; this origin story reveals a close affinity between human and non-human animals. Second, in addition to the plant and animal kingdoms, the *Wichí* recognize other kind of world beings or spirits (in *Wichí*, 'ahot': the terms *ahot* and *wichí* also refer to opposite dimensions: *ahot* represents the danger and the damage and *wichí* the vitality and prosperity (see Braustein, 1983; Barúa, 2007 for a extensive treatment about the relation between the *Wichí* people and the spiritual world)) whose members interact permanently with the natural world.

### *The Wichí Language*

In sharp contrast with many Amerindian communities studied to date, the *Wichí* language (*Wichi-Lhamtes*, or 'the words of the people') is the first language in the family and primary language in the community. *Wichí* is classified as a member of the Mataco-Mataguayan language family (Tovar, 1964). Several distinct regional dialects have been reported. Taken together, there are approximately 40 000 native speakers of *Wichí* in Argentina and Bolivia. Nonetheless, because *Wichí* is considered an endangered language, language documentation is currently underway (Golluscio, 1993; Vidal and Nercesian, 2005, 2009; Terraza, 2009).

In this paper, we focus on the *Wichí* population living at Laguna Yema, Formosa, Argentina, where the dialect known as *del Teuco* o *Bermejo* is spoken (Gerzenstein, 2003). Beginning at roughly six years of age, all children from Laguna Yema are enrolled in a public school (The *Wichí Lako* School Number 421: this school is attended only by children and adolescents of this ethnic group and this institution is under the direction of the Intercultural Bilingual Education program implemented in 1984 in Argentina); the students in this school are exclusively native-speaking *Wichí* children from our target com-

munity. Although instruction is considered to be bilingual and although Spanish is introduced gradually for some subject areas, children are not fluent, and their use of Spanish is restricted to certain classroom settings.

#### *Wichí Names for Fundamental Concepts Relative to the Natural World*

Although documentation of the *Wichí* language is currently underway (e.g., Golluscio, 1993; Vidal and Nercesian, 2005, 2009; Terraza, 2009), there is already intriguing evidence about the linguistic devices that mark the key folk-biological concepts. In this section, we describe the *Wichí* naming practices associated with these concepts. Whenever necessary, we supplement the existing evidence gathered on speakers of other dialects, with additional information that we have gleaned from interviews with native-speaking adults from Laguna Yema.

*LIVING THINGS.* The *Wichí* language, like English, Spanish, and other languages, includes no single dedicated noun to refer to all entities that are alive, that is to all LIVING THINGS. The phrasal description *hunhat-lheley* – translated as ‘inhabitants of earth’ – appears to be close in meaning to English’s LIVING THING. It can be applied to all humans, non-human animals and plants. But in addition, *hunhat-lheley* can also be applied to a broader range of entities, including spiritual beings (Vidal, personal communication) (see Figure 1).

Interestingly, although there appears to be no dedicated noun referring to LIVING THING, there are other linguistic devices whose use is restricted to entities with life status. For example, several verbs (e.g., *iloy* (to live; to be alive), *yilh* (to die)) are applied to all and only inhabitants of earth (that is, to all and only living beings).

*HUMANS.* The noun *hin’ulh* refers to humans, but is rarely used by either adults or children (Taverna, Waxman, Medin and Peralta, in prep.). Instead, humans are described either as *wichí* (applied to *Wichí* people), *siwele* (applied to *criollos* or white people) or named with a number of other nouns that are used to describe people of other ethnic groups (e.g. *Nivaklé*).

*NON-HUMAN ANIMALS.* In addition to naming distinct kinds of animals, *Wichí* also includes names for several more inclusive categories, each organized around characteristic animal habitats: *tsotoy* (animals of the forest), *tsotoyinat-lheley* (animals of the water), and *tsotoyfwiyohen* (animals of the air).

One question that remains unclear from the documentation available to date is whether *Wichí* also includes a dedicated name that encompasses all non-human animals. To address this question, we conducted detailed interviews with

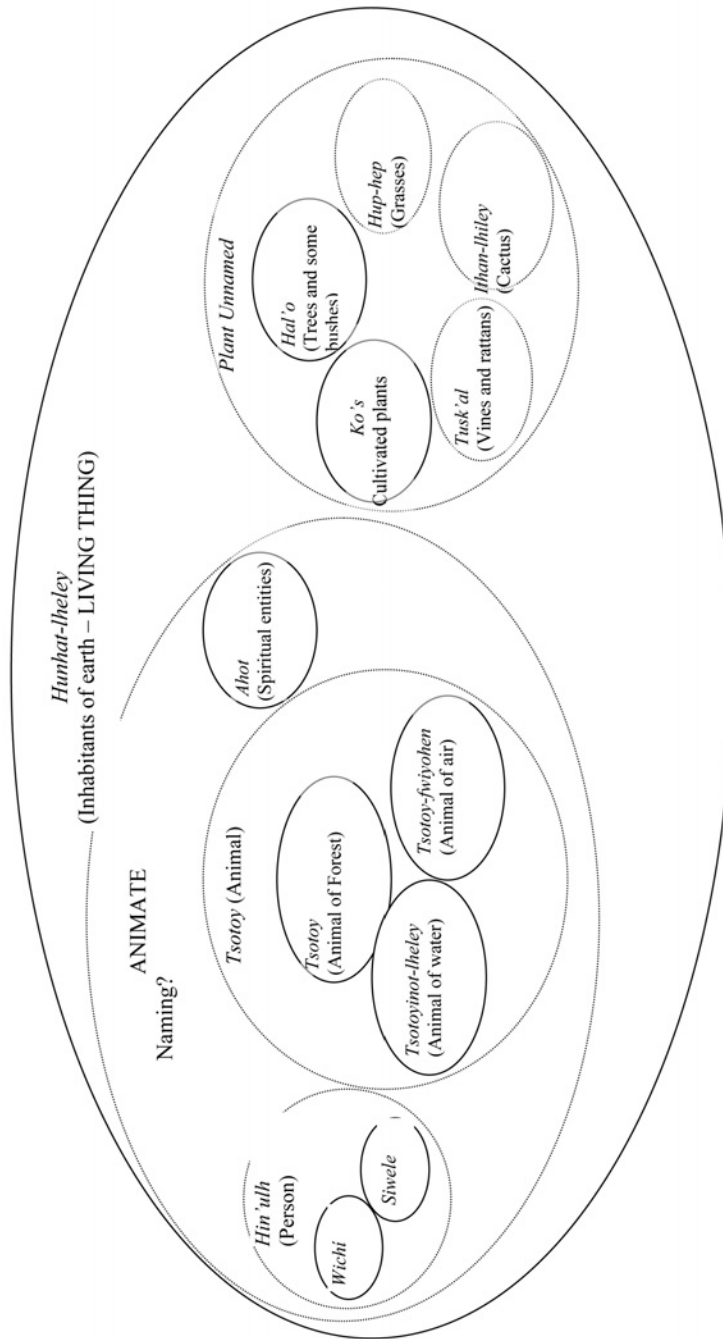


Figure 1. A schematic depiction of *Wichi* names for fundamental concepts relative to the natural world. Although the *Wichi* concept INHABITANTS OF EARTH does not mean LIVING THING, they are close in meaning. Dotted nodes indicate that terms are still under examination.

seven native-speaking adults from our target community, all of whom were teachers in the native school and therefore fluent in Spanish as a second language. The interviews were conducted in Spanish (the native language of the first author). We first asked whether the term *tsotoy* could be applied to all non-human animals. All informants ultimately but hesitantly accepted the possibility that it could be used in this way, but did so only after much deliberation. This suggests that this application of *tsotoy* is certainly not a preferred use. We then asked whether *tsotoy* could, also be applied to both humans and non-human animals (that is, to all animate beings). All seven informants rejected this possibility, and did so with little hesitation.

Next, because we know that children's interpretations do not necessarily match perfectly those of adults (Leddon et al., 2008), we interviewed 33 native *Wichí*-speaking children, ranging from 5 to 10 years of age ( $M=7.8$ ; 18 girls; 17 boys). Each child was interviewed individually in *Wichí* by a native school-teacher, in collaboration with the first author. The task was simple. Following the Angorro et al. (2008) task, the teacher presented a photograph of a human and asked "Could this be called an animal?" Children's responses were quite clear. None responded in the affirmative. This, taken together with adults' responses, strongly suggests that *Wichí* includes no dedicated noun that refers to both humans and non-human animals. Instead, as is the case in Indonesian, the concept ANIMATE OBJECT remains unnamed (Angorro et al., 2008; see Berlin, 1992 for other examples of covert or unnamed categories).

**PLANTS.** In all the documentation to date on *Wichí*, there is no evidence for a dedicated noun that encompasses the entire plant kingdom. In addition to naming distinct kinds of plants, *Wichí* includes several higher-order categories (commonly called "life forms" in ethnobiology): *hal'o* (wild trees and shrubs with woody trunks that inhabit the forest); *kos* (cultivated plants); *hup-hep* (grasses), *tusk'al* (vaines and rattans) and *ithan-lhiley* (cactus) (see Suárez, 2009, 2010, 2011a,b for detailed documentation of the species included in each category).

**SPIRITUAL BEINGS.** *Wichí* includes a term *-ahot-* to refer to spiritual beings or entities that are believed to coexist with the *Wichí*.

**Remaining questions.** The existing documentation of the *Wichí* language, supplemented with our interviews, offers intriguing insights into the naming practices for natural entities. At the same time, however, issues pertaining to two fundamental folkbiological concepts – ANIMATE and LIVING THING – remained unclear. We designed Studies 1 and 2 to delve more deeply into these concepts in *Wichí* children and adults, building upon experimental tasks

that have been productive in several other distinct cultural and linguistic communities (Stavy and Wax, 1989; Waxman and Medin, 2006; Angorro et al., 2008; Leddon et al., 2008).

### Study 1. Evidence for the ANIMATE Concept in *Wichí* Children and Adults

Our analysis of *Wichí* naming practices uncovered no evidence of a dedicated name for ANIMATE. Importantly, however, another word, *husek* (N), came up repeatedly in documentations and spontaneously in discussions with our consultants about the natural world. Roughly translated as “soul” (native speakers from our target community agreed with the translation of *husek* as soul; however, Palmer (2005) translates *husek* as “will” to avoid confusing the *Wichí* term with Western notions of soul), *husek* refers to a concept that is fundamental to the *Wichí* belief system. The importance of *husek* and its implications for the social and moral spheres of the *Wichí* world are well documented (e.g., Palmer, 2005; Barúa, 2007).

A central issue is which living entities are believed to be ‘owners’ of *husek*. Several distinct extensions of this term have been noted. According to Palmer (2005), in its primary sense, *husek* is attributed to animate or social beings (including humans, non-human animals, and *ahot*), but not to members of the plant kingdom. There is some evidence suggesting the extension of *husek* to certain species of plants with magical properties (see Suárez and Montani, 2010 for a discussion). This primary sense, which invokes notions of intentionality, will and conscience (or ‘social will’), is well-aligned with the concept ANIMATE.

In addition, *husek* appears to have another extension, and one that takes a broader scope. Used in this sense, *husek* is applied not only to humans and non-human animals, but also to plants. This secondary sense of *husek*, then, is aligned with LIVING THING. In Palmer’s view (2005), this secondary sense invokes a notion of vitality (or ‘vital will’) which is very different from the social will inherent in only human and non-human animals. In addition to these two senses, *husek* appears to have a third sense, the shamanistic will, which is applied only to a person who becomes a shaman. However, this sense was never brought up by our consultants.

The goal of Study 1 was to delve deeper into *Wichí*-speakers’ interpretations of *husek*. We were guided by two motivations. First, we sought evidence on how this term is used in our target community, a community that uses a dialect distinct from that in published investigations (e.g., Palmer, 2005; Suárez and Montani, 2010). Second, we were intrigued by the apparent polysemy of this term. In particular, the two extensions, one referring to all living things



and another to animate objects only, piqued our curiosity. We noticed that this kind of polysemy, involving nested concepts related to ANIMACY, is not unique to *Wichí*. Notice, for example, that English, and Spanish as well, include two senses of *animal*: ANIMAL<sub>inclusive</sub> (which includes humans and non-human animals) and ANIMAL<sub>contrastive</sub> (which includes only non-human animals, excluding humans). There is evidence that nested meanings like this have interesting consequences on our construal of the relation among humans, non-human animals and even plants (Waxman, 2005; Angorro et al., 2008, 2010; Leddon et al., 2008).

### Participants

Participants were 17 native *Wichí*-speaking adults (13 women; 4 men) (since village life during the day is marked by the divisions of labor according to sex, women are the ones who are at home so were more available for testing), ranging from 15 to 52 years of age ( $M=29.3$ ). Although most had learned some Spanish as a second language, they converse almost exclusively in *Wichí*. Participants were interviewed individually in their homes. Interviews were conducted exclusively in *Wichí* by a native teacher, in collaboration with the first author.

### Materials

We developed a set of 10 cards, each with a color photograph of a single entity. Items were chosen to cover the range of living and non-living categories plants, animals, and non-living objects (see Table 1).

### Procedure

The teacher/researcher explained that we were interested in learning about the meaning of *husek*. To begin, she simply asked, “What does *husek* mean for you?” Next, to understand more precisely the extension of this term, she presented each of the 10 photographs, one at the time in random order, and asked participants to name the depicted entity and to identify whether or not it has *husek*. Participants were encouraged to discuss their reasoning throughout the task.

### Scoring

Responses to each photograph were scored as 1 (yes) or 0 (no). We tabulated participants’ responses to ascertain the range of entities to which they attributed *husek*.

Table 1  
Proportion of *husek* attribution for each entity

Test item	<i>M</i>
Human	.94
Jaguar	.82
Dog	.82
Snake	.82
<i>Vinchuca</i> ( <i>Triatomainfestans</i> )	.76
Mosquito	.82
Bottle Tree	.29
<i>Cháguar</i> ( <i>Bromelia sp.</i> ) <sup>a</sup>	.17
Sun	.05
Chair	0

*Triatomainfestans*, commonly called “vinchuca” in Argentina, “barbeiro” in Brazil and also known as “kissing bug” in English, is a blood-sucking bug (like all the members of its subfamily Triatominae) and the most important vector of Trypanosomacruzi, which can lead to Chagas disease very common in the region of the Chaco forest

<sup>a</sup> In the region, *cháguar* is the common name of two related species (*Bromelia inermis* and *Bromelia urbaniana*) of South American plants of the Bromeliaceae family which are non-woody forest plants with sword-shaped evergreen leaves. These plants are extensively employed by *Wichí* people; they provide a durable fiber that can be woven to make a large variety of textile products: bags and purses, ponchos, skirts, fishing nets, string, ropes, hammocks, mats, covers and clothing.

### Results

Results were straightforward. All participants knew the term *husek*, noting that it refers to a soul or a kind of spiritual entity. Most of them attributed *husek* only to humans and non-human animals, and denied that it could be attributed to plants, natural kinds and artifacts. This suggests that within our target community, *husek* is extended to animals and humans being indeed aligned with ANIMACY. It is stated that the term *husek* also can be extended to other animates entities such as *ahot* (supernatural spirits). Our informants agreed with this extension of the term; however in this study we primarily focused on natural entities.

These results mirror the primary meaning of *husek* (social will) in the documentations published to date (Palmer, 2005). This strong pattern of interpretation was evident not only in adults’ yes/no responses, but also in their justifications. Most of the adults’ spontaneously discussed characteristics (e.g.,

autonomous motion, goal-directed behavior) that highlight the distinction between humans and non-human animals on the one hand, and plants on the other. Notice that these same characteristics figure largely in infants' and English-speaking children's ANIMATE concept (e.g., Gelman, 1990; Berthenthal, 1993; Gelman and Gottfried, 1996; Opfer and Gelman, 2001). Thus, although *Wichí* speakers have no dedicated name for ANIMATE OBJECT, their attribution of *husek* reveals their sensitivity to this fundamental concept.

## Study 2. Evidence for LIVING THING and ANIMATE in *Wichí* children and adults

The goal of Study 2 was to consider the developmental trajectory underlying the concepts of LIVING THING, and ANIMATE in *Wichí*-speaking children and adults. At issue is whether, and at what developmental point, *Wichí* individuals come to include plants along with humans and non-human animals as constituents of the fundamental concept LIVING THING. We considered two alternatives. On the one hand, because plants have such strong cultural and spiritual significance in the *Wichí* community and because children and adults have such extensive experience gathering and working with plants, perhaps the *Wichí* will include plants (along with human and non-human animals) as LIVING THINGS relatively early in development, as compared to their counterparts in, for example, the United States and Jakarta, Indonesia. On the other hand, because the ANIMATE concept is so salient in this community (in *husek*, in the origin story), perhaps *Wichí* children, like their US and Indonesian counterparts, will only gradually come to grant plants status as LIVING THINGS.

To address this question, we built upon a sorting task designed by Medin, Waxman and their colleagues (Angorro et al., 2008; Leddon et al., 2008) to tap into this overarching concept in young children and in adults from a range of cultures. The procedure involves bringing attention to some property or basis of classification and then asking informants to sort the cards according to whether or not they have this property. In the present case we asked individuals to sort the cards twice, once to identify which were “alive” (*iloy*), and then to identify which could “die” (*yilb*). Responses to this task provide insight into the scope of their concept LIVING THING.

### Participants

A total of 59 *Wichí*-speaking individuals participated: 16 5-year-olds (mean age=5.6); 13 7-year-olds (mean age=7.0), 16 10-year-olds (mean age=10.3), and 14 adults (ranging from 18 to 40 years of age (mean age=29.3). All adults,

Table 2  
Test items used in Experiment 2

People	Animal	Plant	Non-living natural kind	Artifact
Person(man)	Bee	Carob tree	Water	Bicycle
	Jaguar	Acacia	Sun	Pencil
	Swallow-tailed kite	<i>Cháguar</i> ( <i>Bromelia</i> sp.)	Cloud	
	Armadillo		Rock	
	Piranha			
	Rattlesnake			

and most of the children, also participated in Experiment 1, three weeks earlier: 10 at age 5; 11 at age 7; 12 at age 10. All the children attended the *Wichí Lako* School 421, where they were interviewed individually in a quiet room. Adults were interviewed their homes. All interviews were conducted exclusively in *Wichí* by a native teacher, in collaboration with the first author.

#### Materials

With the assistance of native teachers, we developed a set of 16 cards, each depicting a color photograph of a single living or not living entity familiar to the *Wichí* (Table 2).

#### Procedure

To begin, the teacher/researcher and participant named the entity depicted on each card. The researcher then shuffled the cards and initiated the sorting task by presenting the cards one at a time. Participants were asked to “put the ones that are “alive” here (indicating one side of the table) and “the ones that are not ‘alive’ here” (indicating the other side of the table). Once this initial sort was completed, the experimenter re-shuffled the cards and asked the participant to sort them again, this time on the basis of the predicate “die” (e.g., “put the ones that can “die” here, and the ones that do not “die” here”). Because each of these subtasks taps into a property of all living things, we reasoned that performance on this sorting task would reflect the content of this concept.

#### Scoring

For each sort, the experimenter took note of the participant’s responses (1 for ‘yes’; 0 for ‘no’). We tabulated participant’s responses to ascertain the range of

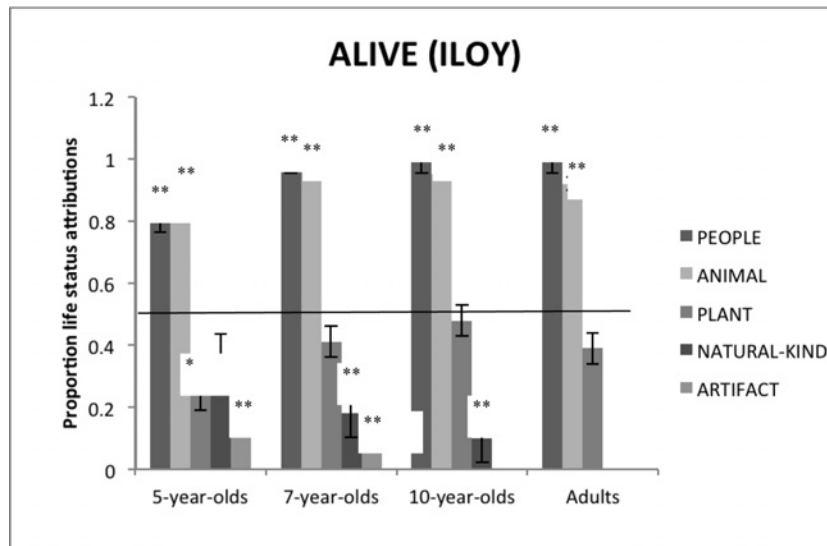


Figure 2. Proportion of life status attributions for each category as a function of age. Asterisks indicate different from chance (\* $p < 0.05$ , \*\* $p < 0.001$ ).

entities that they included when sorting on the basis of “alive” and “die”. For each sort, we then calculated each participant’s mean response for the People, Animal, Plant, Natural-kind and Artifact targets.

### Results

The results were striking and revealed strong convergences across language and cultural communities in children’s interpretations of “alive” and “die”. *Wichí* children’s and adults’ appreciation of the overarching LIVING THING concept is evident in their performance when sorting on basis of *die*. But when sorting on the basis of *alive*, both children and adults exhibited a different pattern, one that includes humans and non-human animals (but not plants) and that is aligned with ANIMATE (see Figures 2 and 3).

For each sort we conducted an analysis of variance (ANOVA) using category (5: people, animal, plant, natural-kind, artifacts; preliminary analyses revealed no differences within animals, within plants, within natural-kinds or within artifacts and, therefore, we collapsed across these to test our hypotheses) as a within-participants factor, age (3: 5 years, 7 years, 10 years, adults) as a between-participants factor, and participant’s responses as a dependent variable.

*ALIVE*. The ANOVA revealed a main effect for category  $F(4, 54)=162.4$ ,  $p < 0.001$ . There were no other main effects or interactions. Participants at all

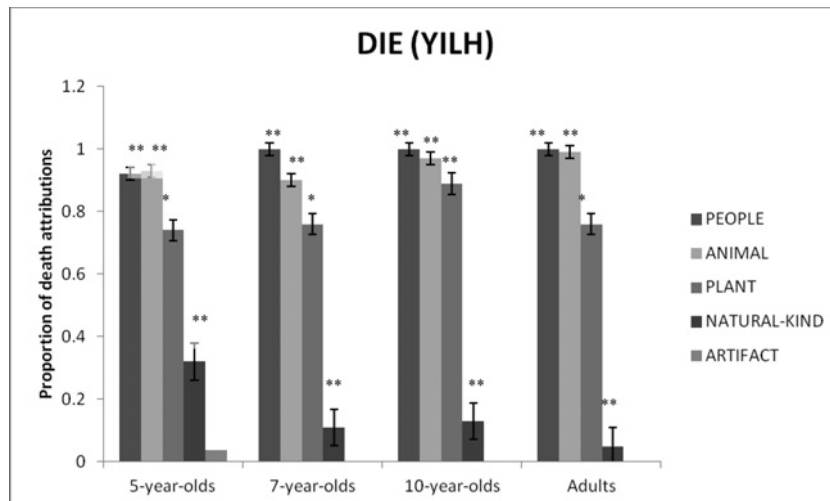


Figure 3. Proportion of death attributions for each category as a function of age. Asterisks indicate a significant difference from chance (\* $p < 0.05$ , \*\* $p < 0.001$ ).

ages were more likely to attribute life status to people and non-human animals than to plants ( $p < 0.001$ ) and were more likely to attribute life status to plants than to natural-kinds ( $p < 0.01$ ) or to artifacts ( $p < 0.001$ ). Figure 2 shows a developmental progression: Five-year-olds denied life status to plants, but at all other ages, performance was at chance levels. Thus, even adults did not reliably include plants when sorting on the basis of *alive*.

In essence, then, despite their extensive daily contact with the natural world, *Wichí* people tend to deny that plants are “alive” (*iloy*). This suggests that life status is aligned strongly with animate objects.

*DIE*. These same participants exhibited a very different pattern when sorting these cards on the basis of the predicate “die”. An ANOVA revealed only a main effect for category,  $F(4, 54) = 215.2$ ,  $p < 0.001$ . Importantly, however, for this predicate, participants at all ages were more likely to include humans and non-human animals than plants ( $p < 0.01$ ), but were also more likely to include plants than either natural-kinds or artifacts ( $p < 0.001$ ).

This analysis suggests that *Wichí*-speaking children and adults appreciate the concept ANIMATE, as witnessed by their sorting on the basis of the predicate “alive”. In addition, they appreciate the LIVING THING concept, as witnessed by their sorting on the basis of the predicate “die”. Each of these

different patterns is in line with their belief system. Under the “alive” term (*iloy*), *Wichí* children and adults included animals and people. This is aligned with the preferred extension of *husek* which was attributed to animate beings (humans and animals) with autonomous motion or goal-directed behavior and denied to plants because they are inert entities (Palmer, 2005; Experiment 1 in this paper). However, note that *Wichí* people consider plants along with animals and humans owners of a vital sense (vital will) responsible of the biological process such as growth or decomposition, processes that are common for the three categories (Palmer, 2005). We suggest that the “die” (*ybil*) term as a biological process, may have activated animals, people and also plants making the way to include all living things. These alignments (“alive” – ANIMATE; “die” – LIVING THING) have also been observed in other populations, including urban and rural English-speaking adults and children (from both European- and Native-American communities) and urban Indonesian-speaking children (Waxman and Medin, 2006; Angorro et al., 2008; Leddon et al., 2008).

In designing this experiment, we offered several reasons to suspect that when sorting on the basis of “alive”, *Wichí* children might attribute life status to plants in early childhood. More specifically, we noted the cultural significance of plants in *Wichí* culture, *Wichí* children’s extensive contact with plants in their daily lives, and the fact that in *Wichí* (as in Indonesian) the ANIMATE concept is unnamed (Angorro et al., 2008). However, the current experiment offers no evidence that *Wichí* children attribute life status to plants in early childhood. Instead, their performance is consistent with the notion that the representation of certain core folkbiological concepts such ANIMATE are universal, even in the face of striking cross-cultural and cross-linguistic variation in experience. At all ages, *Wichí*’s predominant response pattern converged on the concept ANIMATE. This concept, which is acquired early (e.g., Gelman, 1990; Berthenthal, 1993; Gelman and Gottfried, 1996; Opfer and Gelman, 2001), is strongly aligned with the primary extension of *husek* and with the *Wichí* origin myth (Wilbert and Somoneau, 1982; Palmer, 2005). According to Palmer’s version of the myth, *criollos* also come from animals but one from a different kind- the bull- an animal species introduced by Spanish people during the colonization. Even nowadays, it is said that the bull have a negative connotation for *Wichí* people. This suggests an intriguing hypothesis: that the influence of the *Wichí* culture and belief system are sufficiently strong to maintain access to the ANIMATE interpretation of “alive” across development. It is worth noting, for example, that the adults who participated in our experiments have limited Western-orientated education, little contact with Spanish language and culture, and little contact with non-*Wichí* people. This constellation of factors may work together to support and preserve community-wide beliefs.

### General Discussion

The present results constitute the first empirical evidence about folkbiological concepts in *Wichí* adults and children. More specifically, we considered the acquisition of two fundamental biological concepts – LIVING THING and its powerful constituent ANIMATE BEING – within an indigenous community with a constellation of linguistic and cultural experiences that differ importantly from the ones held by participants in most folkbiology psychological research. Like people from other communities studied to date, *Wichí* children and adults represent the ANIMATE concept. Study 1 reveals that this concept is aligned well with the extension of the primary interpretation of *husek* and with the predicate “alive”. Study 2 reveals that *Wichí* children and adults also represent the LIVING THING concept, and that this concept is aligned with the secondary extension of the term *husek* and with the predicate “die”.

These results open several avenues for more extended investigation. For example, it will be important to gain further insight into how the *Wichí* construe the relation between agency, animacy and life status. Another goal for future investigations is to examine whether and how *Wichí* understanding of the natural world varies as a function of gender. Recall that most of the adult participants in the current investigation were women. It will be important to see whether men and women share the same intuitions about the phenomena that we have investigated here, and to identify the specialized knowledge that *Wichí* men and women have about plants and animals. Further, working with younger *Wichí* children and even infants will allow us to identify which of these concepts (if any) are available from the start.

Another goal will be to examine the other native populations of the Chaco Forest. For example, The *Pilagá* people, who live nearby and have also preserved their native language (*Pilagá*), differ from the *Wichí* in many of their beliefs, especially those pertaining to the spiritual world (Vidal, personal communication). Comparing *Wichí* and *Pilagá* will permit a more fine-grained analysis of the contribution of cultural beliefs to the acquisition of folkbiological concepts.

The current paper underscores the importance of considering the relation between folkbiological concepts and the belief systems in which those concepts are embedded, especially if our goal is to discover how cultural models shape this relationship. This work may have implications for science education. Understanding the notions that children bring with them to the classroom may be essential for designing a curriculum that while improving their understanding of science preserves their knowledge about the natural world.



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