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Native Ontological Framework Guides Causal Reasoning: Evidence from Wichi People

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Abstract

Causal cognition – how we perceive, represent and reason about causal events – are fundamental to the human mind, but it has rarely been approached in its cultural specificity. Here, we investigate this core concept among Wichi people, an indigenous group living in Chaco Forest. We focus on the Wichi, because their epistemological orientations and explanatory frameworks about ecosystem differ importantly from those documented among most Western majority-culture populations. We asked participants to reason about causes of events that involve the *hunhat lheley* (inhabitants of the earth: humans, non-human animals, plants and spiritual beings) and other entities of their ecosystem (e.g., lagoon). We find a native ontological framework that encompasses three interacting organizing principles. This new evidence highlights ways in which native categories guide causal reasoning. Our research challenge long-held assumptions that dichotomies – nature-culture or natural-supernatural – are universal features of the human mind.

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Keywords

causality – causal cognition – causal reasoning – wichi

1 Introduction

There is broad agreement that causal cognition is a core process in the human mind, which allows us to perceive, represent, and reason about causal events in the world (Waldmann, 2017). Since the bulk of research addressing these phenomena support the domain-specific perspective (Wellman & Gelman, 1992), causal reasoning has often been observed in a narrow set of domains divided into physical (Carey, 2009; Spelke & Kinzler, 2007), biological (Inagaki & Hatano, 2004; 2006) and psychosocial events (Leslie, 1995; Spelke et al., 2013). Certainly, since most of the above studies have focused only on Euro-American descendants, these domains may represent a cultural framework and not universal building blocks of human cognition (Medin et al., 2013; Ojalehto & Medin, 2015; Viveiros de Castro, 2004).

Importantly for our purposes, other studies have focused on cultural factors of causal cognition (Bender & Beller, 2016; 2019; Bender et al., 2017). These studies showed differences in causal reasoning about simple physical scenarios such as launch and floatation (Bender & Beller, 2011; Bödeker, 2006; Peng & Knowles, 2003); in essentialist reasoning about biological entities (Astuti et al., 2004); and in attribution of (mental) causes of behavior (Liu et al., 2008; Wassmann et al., 2013). However, although these studies incorporate diverse populations, they are still conceptually based on 'Western' domains and categories (Bender et al., 2017). For example, regarding 'supernatural' domain (e.g. 'master' spirits of environments), many researchers would consider attributions as 'category mistakes' that mix up the core attributes of entities and processes from different domains (Carey, 1985; Keil, 1994). Others turn to this domain to contrast 'supernatural' to 'natural' causal explanations (Lindeman and Aarnio, 2006). Recent studies present compelling arguments for the coexistence and integration of 'natural' and 'supernatural' domains in causal explanations (Busch et al., 2017; Legare et al., 2012; Tucker et al., 2015). However, we wonder if the domain distinction between 'natural' and 'supernatural' causality that previous studies have stated is valid for ontology and epistemology of diverse human groups.[1] Furthermore, considering the relevance of these topics

1 We understand ontology as 'concrete expression of how a particular world is composed' (Descola, 2014) and epistemology as 'sets of (often implicit) assumptions that inform skeletal principles of reasoning' (Medin et al., 2015).

to cognitive science, it is important to know how causal cognition is expressed through native categories of each culture (Bender et al., 2017).

In the current research, we focus on the Wichi, a small scale, indigenous community from Chaco Forest, in the north of Argentina. We focus on the Wichi because this community offers the opportunity to study causal cognition on a strong native language – *Wichi lhomtes* – (Taverna, 2021; Taverna & Waxman, 2020; for a grammatical description of this language see Nercesian, 2014; Vidal & Nercesian, 2009) and a constellation of ecological experiences, to whom relations among *hunhat lheley* 'inhabitants of the earth' – humans, non-human animals, plants and spirits – take a center stage (Baiocchi, et., 2019; Fernández Ruiz et al., 2022; Palmer, 2005; Suarez, 2014; Taverna et al., 2012; 2014; 2016; 2020). To study causal cognition, we considered typical events within the Wichi ecosystem (e.g. '*carob tree grows*'; '*fish is sick*') emerged from a previous study with ethnographic techniques (Fernández Ruiz, 2021). These ecological events are rich in causal relationships, involve different types of ontological entities and are characterized by complexity, non-linear processes and emergent phenomena, linked directly with Wichi's relational epistemology.

2 Wichi Epistemological Perspective on *Hunhat Lheley*

Anthropological and ethnobiological documentations show that ecological relations among a great deal of biological species, environments (such as '*monte*'[2]/forest, rivers and lagoons) and spiritual beings are central to the Wichi. In this way, reality in Wichi ontology is not reduced to the immediately perceptible (visible), but includes invisible beings (*nin'ola*) that interact with ecosystem. Furthermore, unlike Western perspective, Wichi people not categorically differentiate between 'natural' and 'supernatural' beings, showing an intimate relationship between 'spiritual' and biological world (Palmer, 2005; Suárez, 2014). This ecology is well captured by an overarching category – *hunhat lheley* 'inhabitants of the earth' – which is made up of humans (the Wichi as well as other ethnic groups), four distinct animal categories, one of each representing different meaningful environments (*ámbitos*) to the Wichi: *tshotoy* (animals of the forest), *tshotoy inot lheley* (animals of the water), *tshotoy fwiy'ohen* (animals of the air) and *laloy* (domestic animals). In addition, several categories of plant (e.g., *hal'o* – trees and shrubs) and 'spiritual' beings (e.g., *wekw* – master

2 The *monte* is the characteristic environment of Chaco Forest, composed mainly by herbaceous plains, interspersed with different areas dominated by scrub growth, small woody plants or palm groves.

'spirits' of environments) are included (see Suárez, 2020; Taverna et al., 2012). The rest of the ecosystem entities – inner matter, rocks, wood, etc. – is not considered *hunhat lheley*. Likewise, each *hunhat lheley* and entity is related to causes of the *ámbito*/environment to which it belongs to (e.g., deforestation in the forest – *tayhi* –; water pollution in the aquatic environments – *inot*–). In addition, all *ámbitos*, *hunhat lheley* and entities are affected by *lahwoy*, annual climate cycle that regulates rains, droughts and temperatures of Chaco ecosystem (Arenas, 2003). Thus, in the Wichi ecosystem there are different ecosystem levels interacting synergically (Fernández Ruiz, 2021).

All *hunhat lheley* are conceived within the framework of a relational epistemology organized around the native feature *husek* as an agent of vitality, socialization, and goodwill. The *husek* is a metaphysical/spiritual organ, roughly equated with what Westerners describe as the will, and possess two attributes[3] (Taverna et al., 2012). In the first instance, the *husek* invokes the

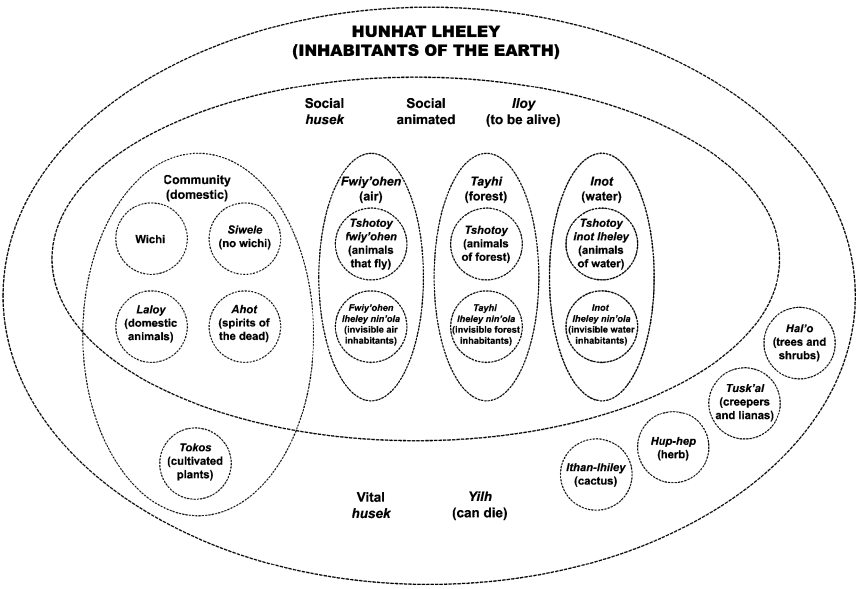

FIGURE 1 Schematic representation of *hunhat lheley*. The dotted nodes indicate the categories and environments that are the subject of our current investigations

3 Other authors consider a third attribute in the case of shamans (Palmer, 2005). However, this has not been evident in studies conducted in this community.

notion of vitality or vital will inherent in all *hunhat lheley* but which is absent in other entities (metal, stones, etc.). This vital *husek* is central to life processes as important as the growth, decay and death (*yilh*). In addition, the *husek* also invokes the notion of socialization, social will or goodwill, attributed to humans, non-human animals and spiritual beings – but not to the plant kingdom. This notion of social *husek* corresponds to the categories *iloy* (to be alive) – animate and is central to socialization processes in the Wichi community (Fernández Ruiz et al., 2022; Taverna et al., 2012, 2020) (see Figure 1). In the frame of this relational epistemology, we seek to illuminate how Wichi people represent and attribute causality when they reason about their ecosystem.

3 Current Research

The purpose of this research is to identify (1) which is the status of the dichotomy 'natural' – 'supernatural' among Wichi people, and (2) how are the causal links between *native features* of *hunhat lheley*/entities (*ámbito*; *hunhat lheley*; *husek*; *nin'ola*) and *ecosystem levels* (inhabitant; interinhabitant; environment; annual climate cycle).

The research was organized into two interrelated studies with a quasi-experimental design. The studies used a causal attribution task, in line with background of the topic (Bender and Beller, 2011; Legare and Gelman, 2008; Le Guen et al., 2015).

In Study 1, we focus on the dichotomy 'natural' – 'supernatural' in the causes attributed by the Wichi. In Study 2, we consider the interactions between *native features* of *hunhat lheley* / entities and *ecosystem levels*, to know the native perspective in causal reasoning.

4 Study 1: Natural vs. Supernatural Causes?

In relation to dichotomy 'natural' – 'supernatural' domains, some researchers would use these categories to indicate 'category mistakes' (Carey, 1985; Keil, 1994) or coexistence and integration of both domains (Busch et al., 2017; Legare et al., 2012; Tucker et al., 2015). However, we wonder if the distinction between 'natural' – 'supernatural' domains is valid for the diverse human groups studied. Thus, the purpose of this study is to know the status of the dichotomy 'natural' – 'supernatural' in the frame of Wichi causality. To accomplish this, we

focus on the distinction between '*natural*' – '*supernatural*' causes. We predict that the Wichi would tend to invoke more 'natural' causes (e.g., flood), than 'supernatural' ones when reasoning about the *hunhat lheley* and ecosystem entities. We further speculate they would attribute 'natural' causes to 'spiritual' inhabitants, due to the evidence presented by ethnographic documentations studies (Palmer, 2005; Suárez, 2014) and our own previous studies (Taverna, et al., 2012).

4.1 *Method*

4.1.1 Participants

In this study, nineteen bilingual Wichi-Spanish speaking adults (5 women, M_{age} = 29.95, range = 18–48 years), residents of the Wichi Lawet community (Laguna Yema, Formosa province) and El Sauzalito (Chaco province) participated. Participants were selected through accidental or convenience sampling (Clark Carter, 2002), since they were contacted by the main native collaborator. The criteria for their selection consisted of being Wichi and having Wichi as their mother tongue or first language. All of them go to the forest and the lagoon from an early age and continue to do so, the men hunt and fish, while the women go to find plants for medicinal purposes or to make handicrafts. Both men and women have a high knowledge of the forest and the surrounding aquatic areas (rivers, lagoons), having frequent interactions with the inhabitants of these environments. Eighteen out of 19 participants were literate, only 1 has received no formal education. Ten have incomplete primary studies, 4 complete primary studies, 2 secondary studies and 2 were undergraduates.

4.1.2 Design and Materials

Current research used a causal attribution task specially designed and adapted to Wichi's ontology and epistemology. This task was grounded on previous studies on causal cognition (Bender & Beller, 2011; Legare & Gelman, 2008; Le Guen et al., 2015) and a previous ethnographic study conducted in the same community in which we identified 38 relevant events in Wichi ecosystem (Fernández Ruiz, 2021; Table 1). The task comprised two phases: a) *familiarization phase*: consisted of 6 questions aimed to elicit participants' knowledge about the forest, the lagoon and the activities they carry out there; b) *causal inferences elicitation phase*: it includes 38 verbal scenarios that referred to causal events of the Wichi ecosystem (which combine various *hunhat lheley*/entities and properties), where the participants had to respond for their causes (*'lagoon is dry' why do you think this happens?*; '*wekw of forest is angry*'

why do you think this happens?) (See Table 1 for a complete list of scenarios[4]). In order to compare similar scenarios among different *hunhat lheley*/entities and to include particular scenarios to each one, one group of scenarios repeated the event only varying the inhabitant: '*wekw of water grows*' – '*yacare caiman grows*'; a second group used homologous scenarios such as animal locomotion: '*chaco chachalaca flies*' – '*fish swims*'; and a third group made reference to particularities of each *hunhat lheley*/entity: '*carob tree bears fruits*' – '*wichi hunts*'. Additionally, to reach different possible scenarios we include counterfactuals. Thus, all the scenarios were created in two modes: presence of the event/property ('*carob tree bears fruits*') and absence of the event/property ('*carob tree doesn't bear fruits*').

TABLE 1 List of scenarios of Wichi ecosystem used in the current research

Events	
Carob tree grows	*Wekw of forest dies*
Carob tree bears fruits	*Wekw of water grows*
Carob tree is sick	*Wekw of water is angry*
Carob tree is dry	*Wekw of water is sick*
Chaco chachalaca grows	*Wekw of water dies*
Chaco chachalaca flies	*Wichi cuts a carob tree and then grows*
Chaco chachalaca sings	*Wichi hunts*
Chaco chachalaca is sick	*Wichi drowns in lagoon*
Chaco chachalaca dies	*Wichi fishing*
Fish grows	*Wichi grows*
Fish swims	*Wichi is angry*
Fish is sick	*Wichi is sick*
Fish dies	*Wichi dies*
Fruit is delicious	*Wood floats*
Lagoon is dry	*Wood falls*
Lagoon has fish	*Yacare caiman grows*
Wekw of forest grows	*Yacare caiman swims*
Wekw of forest is angry	*Yacare caiman is sick*
Wekw of forest is sick	*Yacare caiman dies*

4 The scenarios that include 'wood' entity were not considered in analyzes because they presented problems in translation and in the task.

4.1.3 Procedure

Each participant was informed about the purpose of the task: 'The purpose is to ask them some questions about the forest and the lagoon and what we want to know is why they think some things happen' we explained. Second, the participant was introduced to the familiarization phase. Third, we informed the participant about the procedure of the causal inferences phase: 'I am going to tell you some situations and I would like to know why you think they happen. If you are not sure, just tell us why you think it happens, because it is important to us'. The objective of this assignment was to introduce the participant to a series of scenarios with ecosystem events. There, the scenarios in Table 1 were presented one by one, followed by the question: 'Why do you think this happens?'. The presentation of the scenarios in their two modalities (presence or absence of the event/property) was counterbalanced among participants.

The causal attribution task was administered individually and had an average duration of approximately 30–45 minutes per participant. The task was administered in the primary language of the speakers, the Wichi, by the native collaborator. Scenarios were presented in previously audio-recorded by a native speaker and accompanied with illustrations of native animals and plants extracted from the books 'Hunhat lheley' (Inhabitants of the earth), elaborated by native educators and researcher all members of our team (Pérez et al., 2017, a, b, c, d, e; 2021) (Figure 2). The responses and justifications of the participants to the task were also audio-recorded. The information obtained from the task was transcribed to Wichi and translated to Spanish by the native collaborator. Translations were reviewed by a second native speaker; the few disagreements about the material obtained were jointly resolved between the speakers.

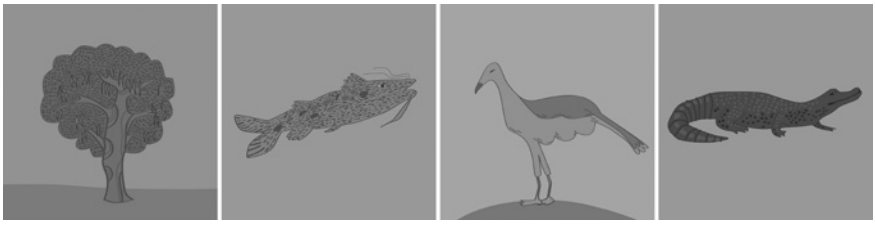

FIGURE 2 Illustrations of native animals and plants extracted from the books 'Hunhat lheley' (Inhabitants of the earth) (Pérez et al., 2017, a, b, c, d, e; 2021)

TABLE 2 Types of causes of western perspective

Type of causes	Example
'Natural' Causes related to inhabitants, entities and processes that are perceptible from western viewpoint	*'The water is going down a lot, that's why it can't find food'* *'The fruits are still immature that's why it has no taste'*
'Supernatural' Causes related to inhabitants, entities and processes that are imperceptible from a western viewpoint	*'He doesn't die because he doesn't have blood, they are only like a spirit, they are invisible'* *'It is not dry because it has a wekw'*

4.1.4 Coding and Analysis

All participants' justifications were coded according to two types of causes based on the dichotomy *natural – supernatural*, as a function of *hunhat lheley* / entities (Table 1). Additionally, two researchers coded 10% of the randomly selected justifications and then the results were compared, obtaining a 95% agreement. Then, we analyzed the incidence of the type of causes invoked by the Wichi as a function of the type of *hunhat lheley* / entities, since a normal distribution was identified ($Z(644) = .093$, $p > .05$).

4.2 *Results*

The results are reported below about the types of causes invoked by the Wichi according to the type of *hunhat lheley*/entity (Table 3).

Results showed no differences in the type of causes attributed to all *hunhat lheley* / entities, $F(8, 634) = .732$, $p = .68$. As we expected, the Wichi were more likely to assign 'natural' causes (e.g., food, drought, etc.) (99.38%), than 'supernatural' (e.g., immortality) (0.62%), to all inhabitants and entities. This remarkable difference is reflected in Figure 3. Thus, despite the great variety of *hunhat lheley* and ecological entities presented in this study, all participate in 'natural' processes – processes that are perceptible from Western viewpoint –, even those that are considered 'supernatural' from a Western perspective (e.g., *wekw* of water).

TABLE 3 Percentages of the types of causes based on *hunhat lheley* and entities

	Type of causes	
Hunhat lheley / entity	'Natural'	'Supernatural'
Carob tree	100%	0%
Chaco chachalaca	100%	0%
Fish	100%	0%
Fruit	100%	0%
Lagoon	97,22%	2,78%
Wekw of forest	98,53%	1,47%
Wekw of water	98,63%	1,37%
Wichi	99,16%	0,84%
Yacare caiman	100%	0%

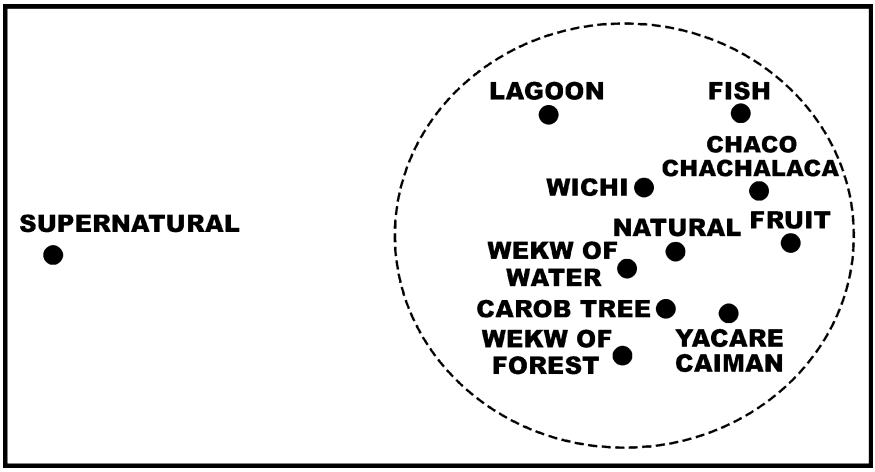

FIGURE 3 Illustration based on correspondence analysis between *hunhat lheley*/entities and type of causes

4.3 *Discussion*

In this study, we demonstrated empirically that there is no categorical differentiation between 'natural' – 'supernatural' among Wichi people. All *hunhat lheley* / entities – even inhabitants that from the Western perspective are considered 'supernatural' (e.g., *wekw of water*) – are subject to same 'natural'

causes such as alimentation, disease, drought, rain, etc. This broadens our previous outcomes (Taverna, et al., 2012, 2018) and is consistent with anthropological studies (Palmer, 2005; Suárez, 2014) which have shown that nature and 'spirits' are connected in Wichi epistemology and ontology.

This study reformulates the interpretation about the relationship between natural and so-called 'supernatural' world in cognitive studies. For example, recent studies argue the coexistence and integration of 'natural' and 'supernatural' domains in causal explanations (Legare et al., 2012; Busch et al., 2017). However, although the author's position is logical, according to our evidence we posit that among Wichi people there are not two domains that coexist and integrate, but a single domain that includes entities and events that from Western perspective would be considered 'supernatural'.

In sum, the types of causes that emphasize the 'natural' – 'supernatural' opposition turned out to be invalid and inapplicable for the human group under study. Thus, focusing on more ecologically oriented approach to the dynamics of the ecosystem is more appropriate and consistent with the Wichi ontology and epistemology. In the next study, we will delve into these ecological causes, analyzing the interaction between native features of *hunhat lheley* / entities and ecosystem levels.

5 Study 2: Native Features and Ecosystem Levels

The goal of this study is to explore what causal links emerge between the *native features* of the *hunhat lheley* / entities (*ámbito*; *hunhat lheley*; *husek*; *nin'ola*) and the *ecosystem levels* (inhabitant, interinhabitant; environment, annual climate cycle). To achieve the goal of study, we analyze the native features of *hunhat lheley*/entities based on ecosystem levels.

5.1 *Method*

The participants, materials, methods and procedures are the same as in Study 1.

5.1.1 Coding and Analysis

5.1.1.1 *Qualitative Phase*

A qualitative analysis was carried out in order to create a system of categories that are adequate to describe the phenomenon studied in its specificity. To accomplish this, we combined an ethnographic phase that surveyed anthropological antecedents (Arenas, 2003; Palmer, 2005; Suarez, 2014; Suarez & Montani, 2010) and the application of the Constant Comparative Method

(Strauss & Corbin, 1994) to the data obtained in the field (Fernández Ruiz, 2021). The Constant Comparative Method was applied to the justifications obtained in the causal attribution task. In this procedure, inductive and deductive pathways were used and the data was articulated with native categories obtained from previous studies (Arenas, 2003; Palmer, 2005; Suarez, 2014; Taverna et al. 2012). As a result, 4 *native features* of the *hunhat lheley* / entities (Table 4) and 4 *ecosystem levels* linked to the causes (Table 5).

TABLE 4 Native features of *hunhat lheley* / entities

Native feature	Description	Subcategories
Ámbito	Ecological environments such as forest, river, lagoons, etc.	Community Air Forest Water
Hunhat lheley	Animals, humans, plants and spiritual beings possessing vital *husek* and / or social *husek*	Inhabitant Entity
Husek	Will that invoke vitality, socialization and goodwill	Social *husek* Vital *husek* Without *husek*
Nin'ola	Susceptibility not to be seen by humans	Visible Invisible

TABLE 5 Ecosystem levels linked to the causes

Ecosystem levels	Examples
Lahwoy / *Annual climate cycle* (1) Level that refers to causes from the annual climate cycle and affects all the environments and inhabitants/entities	*'When it rains a lot, it grows and bears fruit'* *'The lagoon has no fish because it is the dry season'*
Ámbito / *Environment* (0,66) Level that refers to causes from a particular ecological environment and affects their inhabitants/entities	*'He doesn't sick because there's no pollution in lagoon'* *'When there's nothing in the forest, he dies'*

TABLE 5 Ecosystem levels linked to the causes (*cont.*)

Ecosystem levels	Examples
Inter-Hunhat lheley / *Interinhabitant* (0, 33) Level that refers to causes from interactions between inhabitants or entities	*'If someone else bites him, he stays sick'* *'We water it and it's grows'*
Hunhat lheley / *Inhabitant* (0) Level that refers to causes from vital processes or something that happens to inhabitants or entities	*'He doesn't eat much, that's why he doesn't grow'* *'When they are little, pigeons, they no fly'*

5.1.1.2 *Quantitative Phase*

All participants' justifications were coded according to four ecosystem levels (see Table 5), which are aligned with the Wichi's relational epistemology. From this set of ecosystem levels, a continuous variable was created with four values within a range between 0 and 1. Where '0' the lowest value, represents the degree coinciding with inhabitant level and '1' the highest value, is the degree of the 'highest' level of the ecosystem, annual climate cycle.

Two researchers coded 10% of the randomly selected justifications and then the results were compared, obtaining a 95% agreement. Since a normal distribution was identified (Z (640) = .093, $p > .05$), we analyze the incidence of ecosystem levels based on the native features.

5.2 *Results*

The results are reported below about the interaction between native features and ecosystem levels linked to the causes (Table 6).

In regarding the native feature '*ámbito*', the ecosystem levels to explain the events of their environment differ among the 4 habitats community, air, forest and aquatic environments, F (3, 636) = 13,68, $p < .001$. Additionally, when the Wichi reasoned about the inhabitants of the water – *tshotoy inot lheley* – (e.g., fish) and their aquatic environments – *inot* – (e.g., lagoon) they were more likely to invoke causes inherent to the environment level (e.g., lagoon pollution) than when they reasoned about inhabitants from other environments (the forest, the air or the community), t (638) = 2.36, $p < .05$.

Considering the native feature *hunhat lheley*, the ecosystem levels differed between the inhabitants of the earth, that is, animals, plants, spirits, etc., and

TABLE 6 Average proportions of ecosystem levels for native features

		Ecosystem level	
Native feature	Subcategories	*M*	*DE*
Ámbito	Community	0,21	0,29
(Environments)	Air	0,26	0,38
	Forest	0,47	0,38
	Water	0,43	0,36
Hunhat lheley	Inhabitant	0,35	0,36
(Inhabitants of	Entity	0,59	0,37
the Earth)			
Husek	Social *husek*	0,33	0,36
(Will / Vitality)	Vital *husek*	0,53	0,36
	Without *husek*	0,59	0,37
Nin'ola	Visible	0,39	0,38
(Invisibility)	Invisible	0,35	0,34

the entities of the ecosystem such as inert matter, abiotic components, etc., t (638) = 5.46, p < .001.

Moreover, regarding the native feature *husek*, the ecosystem levels varied between those *hunhat lheley* that have social *husek* (e.g., animals, spiritual beings) and *hunhat lheley* / entities that lack social *husek* because they only have vital *husek* (e.g., plants) or do not have *husek* at all (e.g., lagoon), t (638) = 7.05, p < .001. Wichi were more likely to invoke inhabitant level causes (e.g., mood) to *hunhat lheley* with social *husek*, and annual climate cycle level causes (e.g., rains) to *hunhat lheley* / entities without social *husek*. Finally, regarding the feature *nin'ola* (invisibility to human perception), the ecosystem levels did not vary between the inhabitants and entities considered visible and invisible – or imperceptible to the human eye –, t (638) = 1.24, p = .22, suggesting that this native feature is not relevant to causal organization.

A correspondence analysis allowed establishing more precise relationships between *native features* (*ámbito*; *hunhat lheley*; *husek*; *nin'ola*) and *ecosystem levels* (*inhabitant, interinhabitant; environment, annual climate cycle*) (Fig. 4).

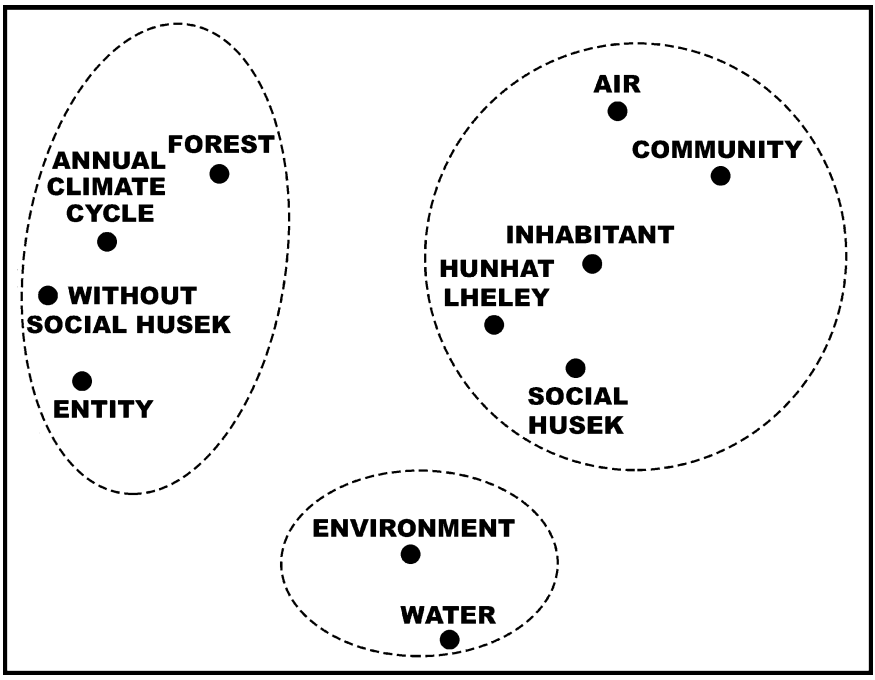

FIGURE 4 Illustration based on correspondence analysis between *native features* and ecosystem levels

5.3 *Discussion*

This study provides important findings regarding the Wichi causal organization of the ecosystem they inhabit. In the first instance, the results showed a substantial difference between *hunhat lheley* and entities; and then between its native features (with the exception of the visibility feature). The latter would indicate that the native features of Wichi epistemology reflect underlying causal differences between the different *hunhat lheley* and entities. Again, as was stated in Study 1, there were no distinctions between the perceptible and non-perceptible inhabitants, confirming the non-hierarchization between visible and invisible inhabitants.

Regarding the native feature *ámbito*, it is possible to visualize the relationship between the more 'domestic' environments – community and air – with the inhabitant level and the interaction between the less 'domestic' environment and the 'higher' ecosystem levels as environment and annual cycle. Additionally, the results emphasize an intriguing opposition between forest

and aquatic environments. The main causes that affect the forest and their inhabitants come from the annual climatic cycle, while the causes that affect aquatic life come mainly from environment itself. This suggests that the aquatic environments could differ from the rest, being the environment that most causally conditions their inhabitants and entities.

In relation to the native feature *husek*, we can identify the centrality of the social *husek*, as a feature that divides *hunhat lheley* with animation and socialization capacities (e.g., *wekw* of forest, wichi, fish) from those *hunhat lheley* / entities that do not possess this feature and capacities (e.g., lagoon, fruit). This ontological distinction highlights the relevance of this native category in Wichi epistemology and converges with anthropological analyzes (Palmer, 2005). Also connects with our previous studies where the social *husek* is linked to the attribution of life status (*iloy*, *yilh*) to the *hunhat lheley* (Taverna, et al., 2012) and categorization of the *tshotoy* – inhabitants of forest – (Baiocchi, et al., 2019). Here reemerges in causal reasoning, as a relevant factor for causal explanation of ecosystem events, giving it even greater robustness.

In particular, it is relevant to highlight what happens with the group of aquatic *hunhat lheley* that have social *husek* (fish and *wekw* of water). When both features come into competition, it would seem that the animation and socialization capacities would 'yield' to the causal 'pressure' of aquatic environments, being more affected by causes exclusive to their environment than by their own causes (characteristic of animated and social *hunhat lheley*). This would reinforce the idea of aquatic environments as different environments from the rest, where their *hunhat lheley* and entities would be more causally determined by the environment in which they live.

The combination of these two native categories – social *husek* and *inot* – configures the causal organization of the *hunhat lheley* in three ontological groupings that reflect underlying causal differences. First, the *inanimate non-aquatic grouping*, in which the inhabitant carob tree and the entity fruit would be subject to causes that come mainly from processes that occur in the annual climate cycle (e.g., droughts). Second, the *animated-social non-aquatic grouping* where the non-aquatic *hunhat lheley – chaco chachalaca, wekw* of forest, Wichi and *yacare caiman* – would be related to causes that come mainly from their vital processes and situations that happens them, directly affecting them (e.g., mood). Third, *aquatic grouping*, in which the aquatic inhabitants – (e.g. fish and *wekw* of water) and entities (e.g. lagoon) would be subject to causes that come mainly from their aquatic environment, affecting them in particular and the environment as a whole (e.g., downspout of the lagoon).

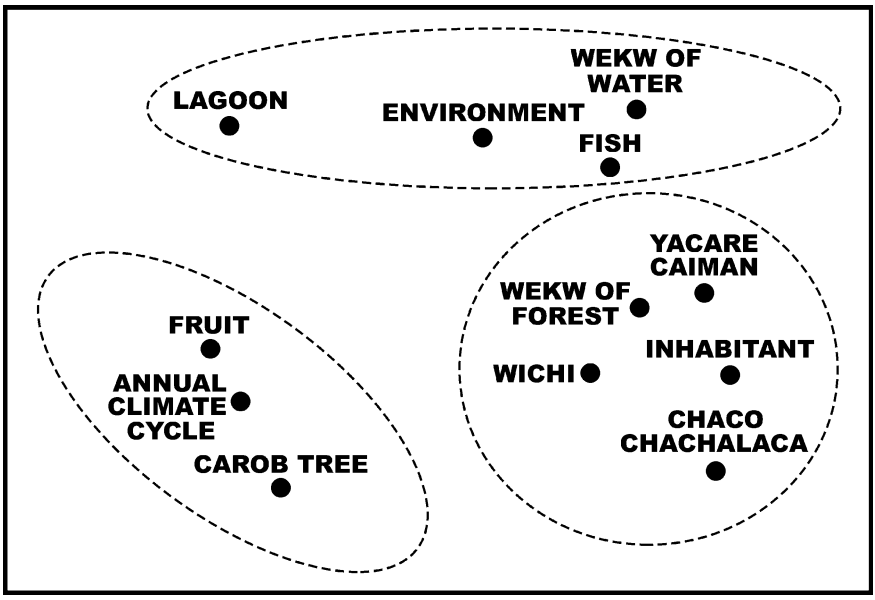

FIGURE 5 Illustration based on correspondence analysis between inhabitants, entities and ecosystem levels

6 General Discussion

The present results constitute the first empirical evidence about causal reasoning among the Wichi. More specifically, this research reveals that when Wichi people are invited to reason about the causes of their ecosystem, they organize the *hunhat lheley* and entities through a native ontological framework. This framework is made up of three interacting causal principles based on native categories, resulting in ontological continuities and discontinuities in ways unsuspected from Western perspective. First, the *relational* principle shows an ontological continuity that connects all *hunhat lheley* and entities, even those that from a Western perspective are considered 'supernatural', all being linked to ecological causes. Second, the *socioecological* principle delimits an ontological discontinuity that divides the animate-social *hunhat lheley* (social *husek*) from the inanimate *hunhat lheley* and entities. Finally, the *environmental* principle establishes an ontological discontinuity that divides the aquatic *hunhat lheley* and entities (*inot*) from the non-aquatic ones.

More generally, these results have important theoretical and epistemological-methodological implications as well. Wichi ontological framework offer

strong evidence for the relevance of native categories in causal cognition. In particular, our research show how native categories guide causal reasoning, defining a coherent way of reasoning about particular sets of events. In this sense, emergent causal principles differ substantially from principles based on supposedly universal domains. Consequently, the causal principles observed in Western, Euro-descendant, and urban populations would not be generalizable to all human groups. To the best of our knowledge, the bulk of cross-cultural research tend to use external categories to the population under study, so their conclusions could present limitations or be invalid, since as many studies have concluded this type of categories could not be used to describe internal dimensions or domains to 'non-Western' cosmologies (De León Pasquel, 2012; Descola, 2005; Rogoff, 2014; Taverna et al., 2022; Viveiros de Castro, 2002). Quite the contrary, our research underscores the relevance on use of native categories consistent with ontology and epistemology of the human group under study can result in a more in-depth understanding of their underlying representational structures, through cultural specificity and ecological validity, and in an ethical position of respect for the people with whom we work.

Admittedly, current research has limitations. For example, the size of the sample and the fact that it is not balanced by gender. Both limitations are due to migrations and other availability issues of potential participants. In addition, it will be important to gain further insight about how the Wichi reason about other 'spiritual' beings such as *wekw* of air, *wekw* of land, *ahot* (spirits of the dead), etc. Another goal for future investigations is to examine the possibility that aquatic environments and their inhabitants configure a native domain of Wichi ontology and epistemology.

In closing, this research highlights both the native cultural organization of causally relevant knowledge, concepts and categories and the importance of the native's perspective. We believe that bringing this perspective to the fore may be relevant to the study of other human groups in cross-cultural psychology as well. Importantly, then, these studies challenge long-standing assumptions that dichotomies, such as nature-culture or natural-supernatural, are universal characteristics of the human mind.

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