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Status of the Current Scientific Knowledge on Pirahã: What is Known and What Could be Studied in Future?

Miroslav Horák[1] – Michal Uhrin[2] – Ana Paula Amaral[3]

1 Department of Languages and Cultural Studies, Faculty of Regional Development and International Studies, Mendel University in Brno, tr. Generala Piky 7, 61300 Brno, Czech Republic,
e-mail: miros.horak@icloud.com, ORCID: https://orcid.org/0000-0001-8327-8785, web: https://bit.ly/mh-mendelu
2 Department of Archaeology and Cultural Anthropology, Faculty of Arts, Comenius University in Bratislava, Gondova 2, 811 02 Bratislava 1, Slovakia,
e-mail: michal.uhrin@uniba.sk ORCID: https://orcid.org/0000-0002-8062-5785
3 Center of Human Sciences, Letters and Arts, Federal University of Paraíba, João Pessoa, Brazil,
e-mail: paulataigy@gmail.com, ORCID: https://orcid.org/0000-0001-7898-9435

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STAV SOUČASNÝCH VĚDECKÝCH POZNATKŮ O PIRAHÃ: CO JE ZNÁMO A CO BY SE MOHLO V BUDOUCNU ZKOUMAT?

ABSTRAKT Tento článek je zaměřen na stav současných vědeckých poznatků o Pirahã, izolované brazilské etnické skupině. Cílem článku je předložit návrhy na budoucí výzkum, který by mohl přispět k rozšíření znalostí o Pirahã, a poukázat na související etické otázky. Z tohoto důvodu byl provedena systematická literární rešerše odborných článků publikovaných v letech 2018 až 2023, které jsou indexovány na Web of Science. Tímto způsobem bylo nalezeno 26 relevantních článků. Dále byla v programu Atlas.ti provedena obsahová analýza 17 vědeckých článků vybraných podle vyřazovacích kritérií. Vytvořené kategorie (celkem 4), spojené s publikacemi interpretovanými v tomto textu, se obecně týkají jazyka a společnosti Pirahã, specificky pak numerické kognice a rekurze. Tyto kategorie odkazují na nejdiskutovanější témata v současných vědeckých publikacích o Pirahã a představují témata pro budoucí výzkum.

KLÍČOVÁ SLOVA Pirahã; Brazílie; Amazonie; jazyk; společnost; numerická kognice; rekurze

ABSTRACT This paper is focused on the status of the current scientific knowledge on Pirahã, an isolated Brazilian ethnic group. The aim of this article is to raise suggestions for future research that may help to extend the knowledge on Pirahã, as well as to point out ethical issues involved. For this reason, a systematic literature review of journal articles published between 2018 and 2023 and indexed in Web of Science was performed. This way, 26 relevant articles were found. Furthermore, the content analysis of 17 scientific papers selected according to the exclusion criteria was done in Atlas.ti. Created categories (4 in total), linked to quotations of articles interpreted in this article, comprise generally the Pirahã language and society. Particularly, they are related to the numeral cognition and recursion. These categories refer to the most discussed topics in the current scientific articles on Pirahã and represent research topics for future studies.

KEY WORDS Pirahã; Brazil; Amazon; language; society; numerical cognition; recursion

In memory of František Vrhel

INTRODUCTION

In Brazil, the Legal Amazon comprises an area of approximately 5 million km², which corresponds to 59% of the Brazilian territory, encompassing the extension of 8 states in the country (i.e., Acre, Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, Tocantins), as well as part of Maranhão state. This geographic organization, created in the 1950s, considers not only the biome and the characteristics of the ecosystem in this region, but also the density of the indigenous population (IPEA 2008). 56% of the Brazilian indigenous population live in this area (Ibid.). This number may increase, since 5 areas are in the approval and regularization phase (Fellows *et al.* 2023).

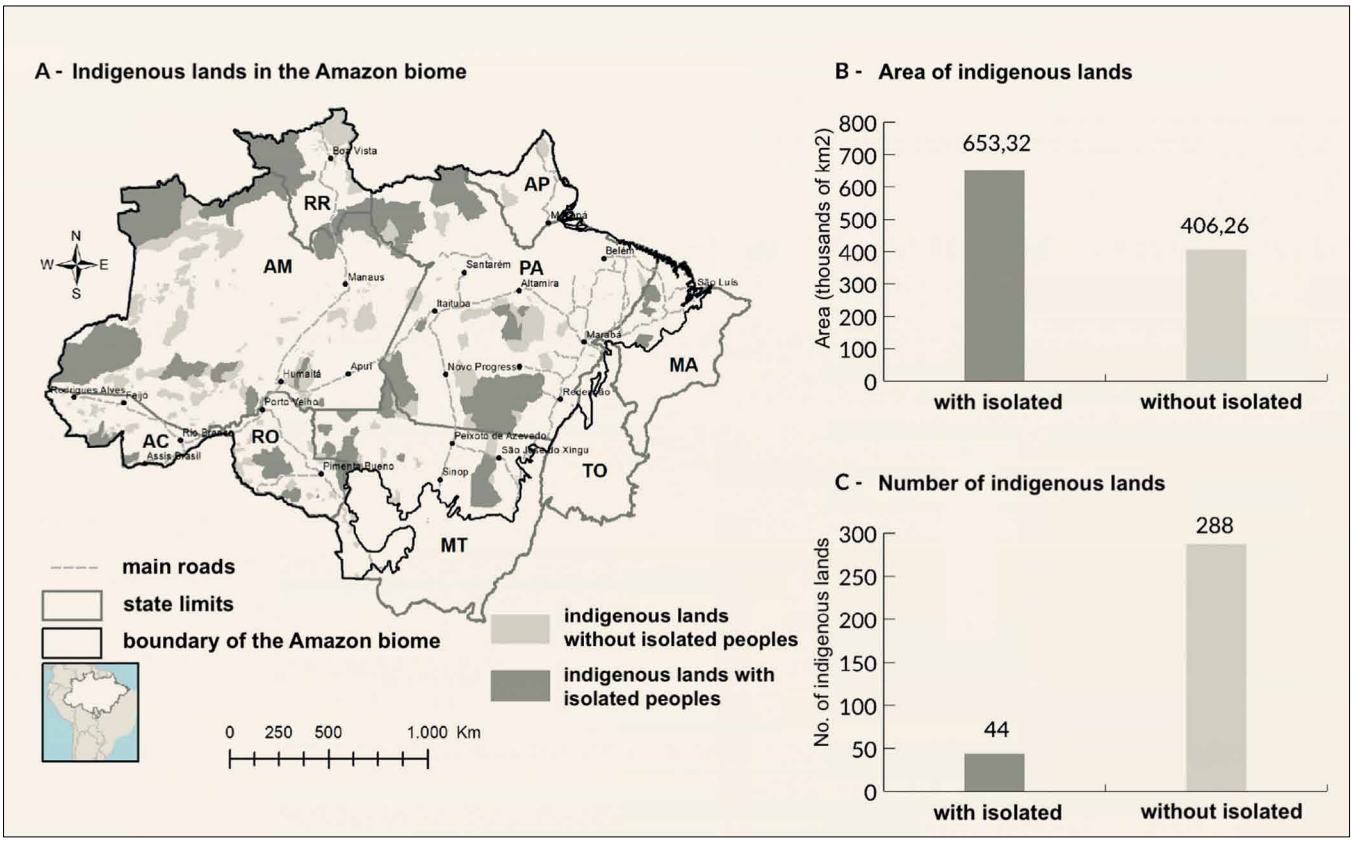

Fig. 1 Indigenous lands in the Amazon biome (source: own processing according to Fellows et al. 2023, 3).

According to the Technical Note No. 3 from January 2023 (Fellows *et al.* 2023), these lands had their administrative demarcation approved and their territory delimited. 10 more areas had been declared as indigenous lands and now are awaiting their demarcation and regularization. 28 extensions are in the process of delimitation and await of being recognized as areas of indigenous possession. In addition, in the Legal Amazon, there are 6 interdicted areas with restrictions on the entrance and transit of non-indigenous people for the protection of isolated indigenous groups (Ibid.). This restriction in some indigenous lands is necessary, as Brazil is the country with the largest number of isolated indigenous peoples in South America (IACHR 2013).

As stated by FUNAI (2021), the denomination "isolated indigenous peoples" refers specifically to indigenous groups with no permanent relations with national societies or with little frequency of interaction. In the same way, people of recent contact are considered those indigenous groups that maintain relations of permanent and/or intermediate contact with segments of the national society (regardless of the time). However, they present singularities in this interaction, selectivity in the incorporation of goods and services, as well as in maintaining autonomy from the Brazilian State.

In this context, the records about isolated indigenous are divided into 3 categories comprising: 1) groups of isolated indigenous people with whom FUNAI has been carrying out systematic follow-up work and their geographical location is defined; 2) unconfirmed records where there is a strong evidence of the existence of certain isolated indigenous groups classified in the FUNAI database (but without systematic work performed); 3) information on isolated indigenous people, but without any qualification or study by FUNAI (Ibid.).

The Legal Amazon territory concentrates the largest number of indigenous lands with confirmed or yet to be confirmed presence of isolated peoples. In total, there are 44 registered indigenous lands with confirmation of the presence of isolated indigenous ethnic groups. This number could be higher, since it does not include indigenous lands that are still in the process of being registered by the Brazilian government (see figure 1).

In the Amazonas state, the Pirahã indigenous lands are in the Humaitá municipality, which was homologated and registered since November 1997. It measures 348,409.03 hectares (see figure 2). The current number of indigenous people living in this territory is uncertain and varies according to the source of information (Unckel Nimuendajú 1944). In accordance with ISA (2014), there are currently 592 indigenous people living on this land, and they descend from the Mura linguistic family (Ibid.). FUNAI has records of the presence of isolated indigenous in this area, and they called them "Isolated people from the Maici River" (ISA 2019). The registration of this group is in the process of studying and data research, for confirmation and subsequent monitoring by the federal agency (Ibid.).

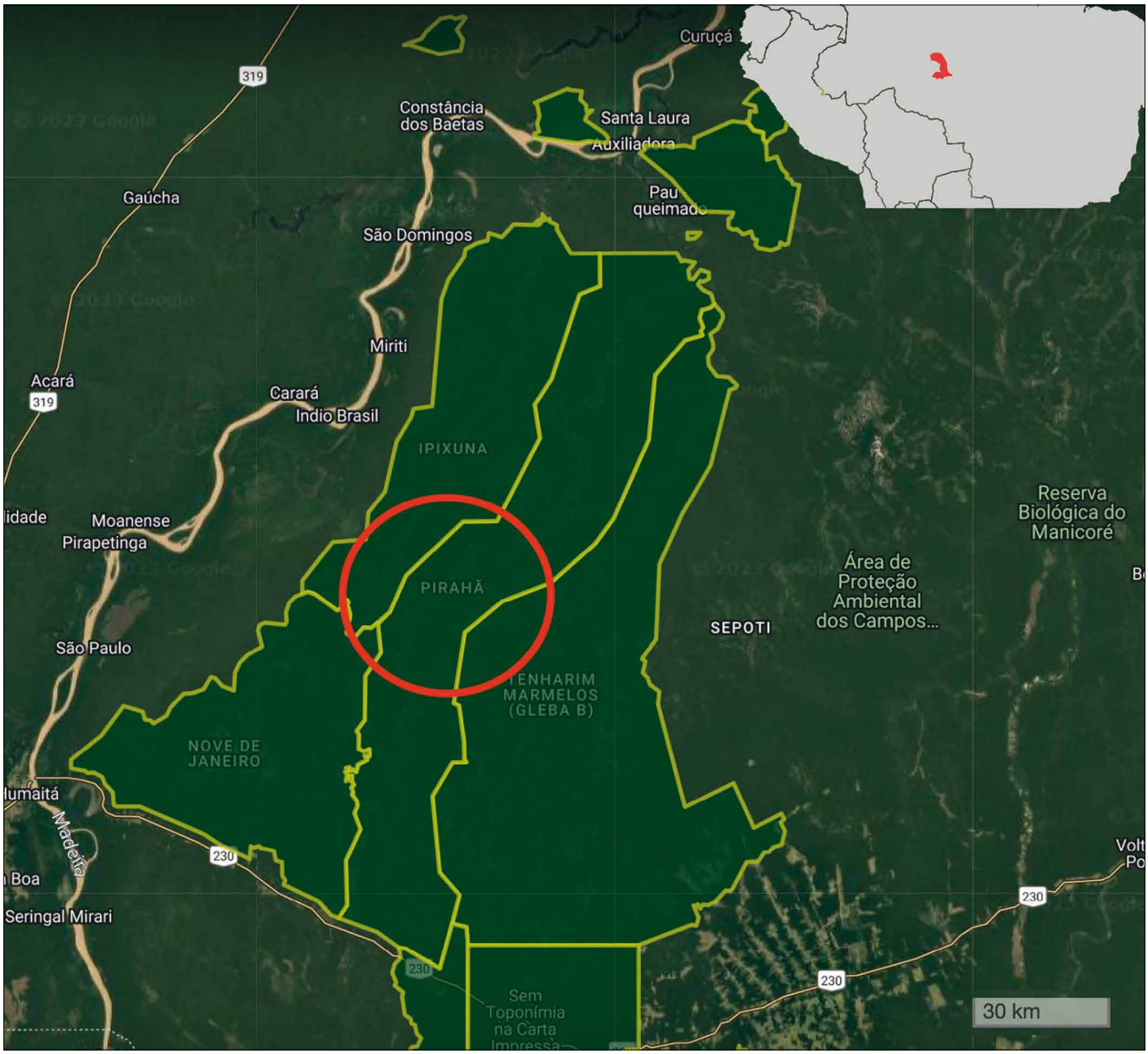

Fig. 2 Pirahã territory (source: CTI 2023; Ostler 2005, 362; Dixon & Aikhenvald 1999).

The Pirahã are considered hunter-gatherers living in the close vicinity of the Maici River in Amazonas, Brazil (Nevins *et al.* 2009). They live mainly from fishing, hunting, and agriculture, as well as collecting Brazil nuts (*Bertholletia excelsa*), honey and making cassava flour (Sadlier-Brown *et al.* 2022). According to Everett (2012), there is no traditional hierarchical organization in their society, and they understand the importance of the surrounding plants and their locations, know the animal behaviors, and are able to walk into the jungle and once out after some days carrying with them nuts and fruits among other eateries.

The history of contact of Pirahã with "Western civilization" dates back to the turn of the 20th and 19th centuries (Vrhel 2009). Some Pirahã settlements are electrified and have access to television broadcasting. In one of their villages, the Brazilian government also built a health clinic, toilets, and a school where children learn Portuguese and to count (O'Neill – Wood 2012). However, in accordance with Sadlier-Brown *et al.* (2022), the Pirahã people resist receiving formal education. The adults prefer that their children learn activities related to their culture and way of life, such as fishing, hunting, canoeing, etc., following their parents in the daily life of the village. According to same authors, only Pirahã men understand and speak words in Portuguese, and some even communicate in other indigenous languages, such as Nheengatu - also known as the Amazonian General Language or Modern Tupi, an indigenous language belonging to the Tupi-Guarani family (Ibid.). On the other hand, Pirahã women are less likely to

talk to non-Pirahã indigenous, and generally avoid going outside their territory (Gonçalves 2001). Because of this, "only men (in general) talk to outsiders" and they end up having more access to items from outside the villages, e.g., tobacco, processed foods, fishing equipment, etc. (Sadlier-Brown *et al.* 2022, 734). They become the main providers of the consumer goods in their community and are more likely, though, to get involved in conflicts with outsiders (Sadlier-Brown *et al.* 2022; O'Neill – Wood 2012).

Pirahã language is, as stated by Nevins *et al.* (2009), predominantly subject - object - verb order language and possibly one of the last surviving members of the Mura language family. As claimed by Colapinto (2007), Pirahã language consists of 3 vowels and 8 consonants, and is not related to any extant language, hence known to have the simplest system of sound ever heard. Despite this, it has varying syllable lengths, array of stresses and tones enabling the speakers to hum, sing or even whistle when dispensed with the available consonants and vowels (Ibid.).

One of the key issues in the study of Pirahã people is whether their language contains recursion, a process through which sentences can be expanded infinitely, which is considered to be a common characteristic of all known languages (Chomsky 1980).[1] Grammatical recursion is a skill that allows humans to embed sentences inside another, turning the language into an instrument to express an infinity of thoughts (Futrell *et al.* 2016). In other words, it is the faculty of inserting one sentence into another, infinitely, e.g: "The man [who was standing by the door] asked [if you were at home]" (created by the authors).

In his analysis, Everett (2005) proposed that Pirahã language presents embedded meanings, but these are expressed through juxtaposed phrases, without the use of conjunctions which would allow the formation of compound sentences, either by coordination and/or subordination (i.e., without the use of recursion). This argument caused many discussions and controversies, because if recursion is not a feature that may not be systematically noticeable or present in all languages, then it could be a cultural achievement (Ibid.).[2] These two hypotheses—recursion as a property of the human mind (Chomsky 1980) vs. recursion as a cultural achievement (Everett 2005)—fed an enormous debate about the origins of syntactic rules in the evolution of human language, which cannot be resolved by looking at Pirahã alone (Kocab *et al.* 2023). It arouses curiosity, mostly in researching isolated peoples, ethnic groups which have little or almost no contact with other societies. For example, Murillo-Corchado and Nepomuceno-Fernández (2019), who consider the Pirahã case an anomaly within the framework of the Chomskian theory, used it during their logical studies of abduction, one of the fundamental problems of contemporary epistemology.

Another significant issue in the study of Pirahã is related to the absence of ordinal and cardinal numbers in their language (Gordon 2004). The language lacks words that denote numbers and, as stated by Sergeyev (2022) and Everett (2012), it works with a few concepts - one, two or many -, to refer to small or more significant amounts (Everett 2012). "For Pirahã, all quantities larger than two are just 'many' and such operations as 2 + 2 and 2 + 1 give the same result, i.e., 'many'" (Sergeyev 2022, 7).

This characteristic/property of the Pirahã culture is quite interesting, because, as some authors claim, recursion is a condition both for language and for numbers and, consequently, for arithmetic functions (Overmann 2021). Therefore, this combination - supposed absence of language recursion and absence of words denoting numbers and quantification - would not be a coincidence. In the words of Overmann (2021, 542): "In mathematics, recursion is often considered the mechanism whereby the successor function (n + 1) generates new numbers".

Sergeyev (2022) also emphasizes that Pirahã's numerical system is not unique, there are other isolated peoples with similar ways of counting, for example, the Warlpiri people - aborigines that live in the Northern Territory of Australia -, which use the same counting system as well (one, two and many to refer to numerical quantities).

Faced with these facts, especially after the publication of Everett's work (2005, 2008, 2009), the scientific interest in studying the indigenous group of Pirahã has increased, especially due to the particularities of their language and culture. And although the peak of scientific publications related to this ethnic group occurred in the first decade of the 2000s (see figure 3), recent publications focused on some aspect of the culture or language of the Pirahã—especially concerning the absence of recursion or reduced numeracy—can be found (Kocab *et al.* 2023).

As the fieldwork in the Pirahã territory is currently not possible, the objective of the present work is to perform a systematic review of articles published in the last five years (2018-2023) found in the database of the Web of Science (WOS) that cover or mention, in some aspect, the Pirahã people. Based on the analyzed studies, our aim is to reflect on the current debate and theoretical, methodological, and ethical questions concerning scientific research involving isolated native peoples.

METHODS

For the above-mentioned reasons, both quantitative and qualitative systematic literature review (SLR) of the peer-reviewed scientific papers that deal with Pirahã was carried out (Xiao – Watson 2019; Pati – Lorusso 2018). In the quantitative part, Google Ngram Viewer was firstly used to identify the period in which scientific papers on Pirahã were published. In this case, an English corpus has been revised from 1900 to 2019. Furthermore, references of up-to-date articles were collected at top academic research databases, in Scopus and Web of Science (WOS). To perform the literature search, "Pirahã" AND

1 For a general critique of Chomsky see Knight 2004, 2016a, 2016b, Knight & Power 2011.

2 For critique of Everett's work see for example Nevins *et al.* 2009; Reboul 2012, 2017; Rodrigues 2017; Vrhel 2009.

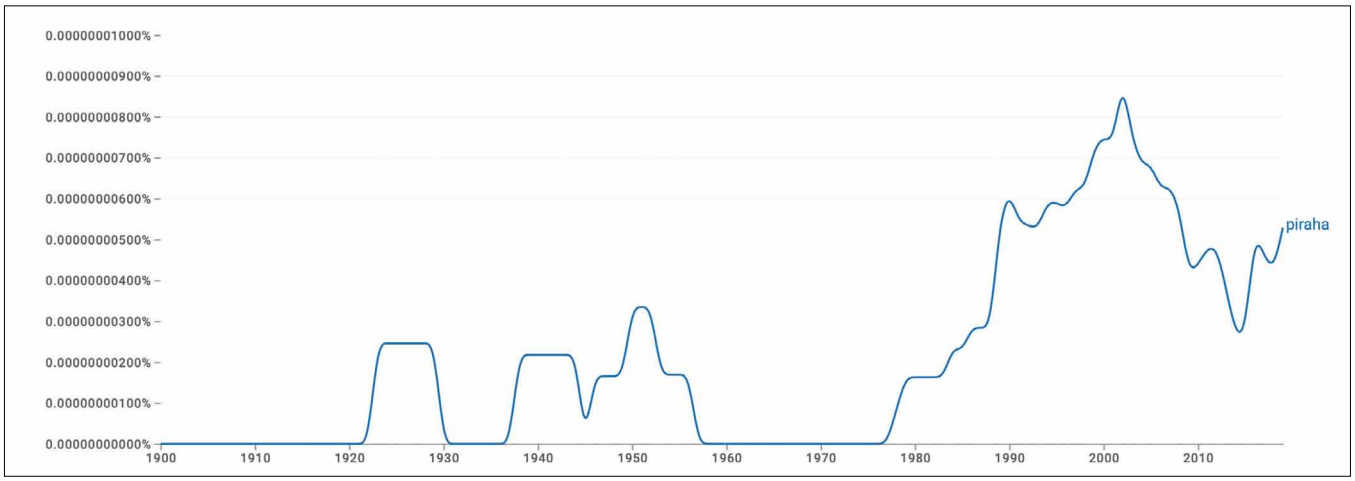

Fig. 3 Publications about the Pirahã since 1900 (source: Google Ngram 2023).

"Brazil" were used as keywords (also considering "Pitaha" used in English written documents). The date range was set up to last 5 years.

Due to the set length of this article and the fact that Scopus contains no references of papers on Pirahã published after 2015, the qualitative data analysis was performed on articles indexed at WOS only. The selection of scientific papers was primarily based on their relevance to the topic of this article. Due to the language barrier, only the papers published in English, Spanish or Portuguese were included in the SLR, although articles on Pirahã are available in Russian too. Those texts, whose authors mentioned Pirahã only in references were kept out, as well as articles focused on other indigenous groups in different areas in the world, such as in Bolivia or China, that were erroneously included among the results of automatic literature search.

The titles and abstracts of articles from WOS were firstly revised. Then their references were grouped according to the discipline (e.g., linguistics, anthropology, psychology). To enhance validity and to interrogate different ways of understanding a research question, each of the authors performed the content analysis of journal articles separately (Corbin – Strauss 2015). The analysis of selected papers was done in Atlas.ti 9 EDU. Each author proposed their own codes for quotations related to the research questions included in the subtitle of this paper. Then the codes were merged and this way general categories were created by consensus between the authors. Finally, these categories (i.e., codes with the highest groundedness) were interpreted in the next section of this article.

RESULTS

According to Google Ngram (2023), the number of publications about the Pirahã people has increased significantly since 2000 (see figure 3). This evidence coincides with Everett's first publication about Pirahã people in which, after years living with the Pirahã people, argues that their language is void of grammatical recursion (Everett 2005).

At WOS 26 journal articles published on Pirahã between 2018 and 2023 were found in total. Table 1 contains the results of the SLR. In this case, the exclusion criteria have already been applied. Finally, the content analysis of 17 scientific papers was performed.

During the content analysis, 4 categories were created, which refer to the codes with the highest groundedness in current scientific articles on Pirahã and raise research questions for future studies. These categories generally comprise the Pirahã *language* [reference number: 4, 5, 6, 7, 8, 14, 15, 17] and *society* [RN: 1, 4, 8, 15]. Particularly, they are related to *numerical cognition* [RN: 2, 9, 10, 11, 12, 13, 16] and *recursion* [RN: 3, 4, 5, 6, 7, 10, 12, 13, 14].

In the context of *language*, authors mostly deal with controversies towards generative linguistics. Various of them suggest the necessity to continue in the studies on Pirahã and propose methodological improvements in terms of data analysis (e.g., transcriptions containing tone phonemes, vowel qualities and glottal stops; the use of similar elicitation contexts with Pirahã speakers). Nevertheless, Kocab *et al.* (2023) claim that in other contexts investigators would be in a better position to find evidence of sentence incorporation than in this case.

Sadlier-Brown *et al.* (2022) proposes to research whether social patterns of familiar variations in "the West" would also be found in the language of the Pirahã. The authors conclude that there are reasons to suspect that there is a change in progress. It is justified by cultural factors perceived in attitudes towards strangers, causing linguistic variation.

In another group of papers, various characteristics of Pirahã *society* are analyzed by researchers. The attention is mainly put here on the principle of immediate experience proposed by Everett (2009). Oesterdiekhoff (2018) for example, criticizes this principle from the perspective of developmental psychology proclaiming that Pirahã could be a people staying on lower psychological stages. Mental deficits of Pirahã are, according to his opinion, apparent from their inability of abstract thinking and achieving transcendence. The latter is clear from the absence of religion, tradition or myth telling in this ethnic group.

Reference number	Authors and publication year	Title
1	Oesterdiekhoff (2018)	Evolution of Mind and Language Learning From the Piraha Case
2	de Almeida (2019)	Is There Mathematics in the Forest?
3	Dékány (2019)	Foundations of Generative Linguistics
4	Everett & Gibson (2019)	Recursion Across Domains
5	Huybregts (2019)	Infinite Generation of Language Unreachable From a Stepwise Approach
6	Leivada et al. (2019)	Eliciting Big Data From Small, Young, or Non-standard Languages: 10 Experimental Challenges
7	Mendívil-Giró (2019)	Why Don't Languages Adapt to Their Environment?
8	Hashimoto (2020)	The Emergent Constructive Approach to Evolinguistics: Considering Hierarchy and Intention Sharing in Linguistic Communication
9	Rothstein & Lima (2020)	Quantity Evaluations in Yudja: Judgements, Language and Cultural Practice
10	Wu (2020)	A Refutation of a Refutation of Universal Grammar
11	dos Santos (2021)	Enculturation and the Historical Origins of Number Words and Concepts
12	Overmann (2021)	Numerical Origins: The Critical Questions
13	Abner et al. (2022)	Emergent Morphology in Child Homesign: Evidence From Number Language
14	Johnson-Laird et al. (2022)	Recursion in Programs, Thought, and Language
15	Sadlier-Brown et al. (2022)	Exploring Variation and Change in a Small-Scale Indigenous Society: The Case of (s) In Piraha Ok
16	Sergeyev (2022)	Some Paradoxes of Infinity Revisited
17	Kocab et al. (2023)	Potentially Recursive Structures Emerge Quickly When a New Language Community Forms

Tab. 1 Results of the SLR of scientific papers on Pirahã from 2018-2023 indexed in WOS (N = 17) (source: own processing).

The lack of ordinal and cardinal numbers in Pirahã is discussed in articles related to the last category called *numerical cognition*. The research in these articles is generally related to the question if the creation of numbers, an innate human ability, or a cultural achievement, is gained by the accumulation of knowledge, and if it is likely to be developed by language users of Pirahã in the next generations.

For example, Sergeyev (2022) studied the Pirahã and Munduruku numerical systems and analyzed the idea/paradox of infinity and infinitesimals. According to the author, the numerical systems of these indigenous ethnic groups led to a new point of view on the idea of infinity. Thus, arithmetic precision varies depending on the numerical system used. In the case of Pirahã, accuracy is low due to the lack of words denoting numbers and precise quantities (Ibid.). For the same reason, Pirahã people also do not track age (Sadlier-Brown *et al.* 2022). Abner *et al.* (2022) claims that humans are not the only species with the ability to detect, conceptually represent, and reason about quantity. The basic drive to perceive a parceled world may be a cognitive primitive.[3] However, the quantities we distinguish and the rationality we develop with these quantities are mediated by our cultural experiences. The authors also state that no language is known that is entirely without number. Nevertheless, they cite an observation in the footnote, mentioning a counterexample (that would be an exception to this rule) evidenced by Everett (2005). It is the case of the Pirahã, which "have been alleged to have no words for exact quantities and grammaticalize no distinction in morphological number" (Abner *et al.* 2022, 17). Finally, the authors also point out that Gordon (2004) and Frank *et al.* (2008) demonstrate that, in contrast to what has been declared, i.e., linguistic expressions for relative or approximate numbers can be perceived in Pirahã. It is noteworthy that this is the only moment in the article, in addition to the references, where the Pirahã are mentioned.

The last group of articles links to the category called *recursion*. Some authors of the papers in this group attempt to show that—contrary to Everett's claim—Pirahã does have recursive syntactic structures and the proposal on the cultural constraints in the Pirahã language is considered by them statistically insignificant. In any case, if we choose not to deny the exceptionality of the Pirahã case, it was empirically supported "that there is no correlation between the structural diversity of languages and the cultural diversity of speakers" (Mendívil-Giró 2019, 6).

3 Scientific evidence that number perception is present in ne borns was published by Izard *et al.* (2009).

DISCUSSION

The qualitative analysis of scientific papers uncovered the criticism of colonial perspectives on Amerindian peoples and raised various questions surrounding the Pirahã. Among the most urgent is if it is correct to do the fieldwork and organize missionary activities in isolated ethnic groups, because it brings irreversible changes in their lifestyle and culture. What are the positive and negative externalities of such activities? Have Pirahã started to use recursion in their language due to the contact with teachers and missionaries speaking Portuguese?

In this sense, Octavio and Azanha (2009, 1-2) problematize the way of seeing indigenous peoples as "primitive", as if the linear evolutionary logics proposed by rational scientific thinking would be the only possible path. These authors argue that indigenous ethnic groups are mistakenly considered "primitive" because according to some proponents of neocolonialism they represent a stage which other societies (such as those in the "West") have already crossed over. Such conception of "Neolithic relics", however, puts indigenous people in an unequal condition of "inferiority" (Hall 2018). Sooner or later, their cultures could succumb to modernization, a unique way of cultural interaction and evolution. The final consequence of this process would be the "acculturation" of the indigenous people and their "incorporation" or "integration" into a national society (Ibid.).

The questions regarding the issue of "living fossils" or "neolithic relics" have long provoked debates concerning theory, epistemology, and methodology, that transcend archeology, sociocultural anthropology, and linguistics (for further discussion see for example Currie 2016; Kelly 2013; Hayter 1994). Despite the ongoing discussions, it is important to stress that contemporary hunter-gatherer societies should not be viewed as "living fossils" in cultural, social, linguistic, biological or any other aspect. They have been undergoing cultural and biological evolution for as long as any industrialized nation. Therefore, they are not a carbon copy of the hunter-gatherer societies of times past. For this reason, caution is needed when comparing the way of life of contemporary hunter-gatherers in terms of food strategies, mating strategies, religion, rituals, and language, to those of our ancestors from several thousand years ago.

The isolated indigenous people in Brazil show that despite all the violence they suffer in their territories (e.g., due to illegal invasions) and sometimes forced contact with western society, they still resist. According to Octavio and Azanha (2009, 2), although there is a relationship of inequality and domination, "no society/culture incorporates everything from another to the detriment of what characterizes and constitutes it as a society". The annihilation of a society in its various dimensions only comes about through physical extinction. Otherwise, mechanisms of reproduction (and resistance) will always operate and incorporate new practices, habits, and technologies into the culture.

Isolated indigenous groups have a certain degree of autonomy, in their territory, over the Brazilian State, which does not interfere with their sociocultural norms and customs (Octavio – Azanha 2009). At the same time, they are considered more vulnerable. This vulnerability affects different aspects of their lives. For example, territories with the presence of isolated peoples are more likely to suffer illegal deforestation. In 2022, of the 10 most deforested indigenous lands, 6 are territories with the presence of isolated peoples (Fellows *et al.* 2023). In the epidemiological aspect, their fragility lies in the little or no resistance immunity to infectious and contagious diseases, common among Brazilian national society, e.g., flu, dengue, malaria, measles (Octavio – Azanha 2009).

Some isolated groups with low demographic density and high mortality rates were also destroyed (e.g., Aracadaini, Araraus or Tapajós in the state of Amazonas). It occurred due to voluntary or involuntary contact with non-indigenous people/national society, i.e., due to warfare and epidemics, or interethnic conflicts (OPI 2022). There are also legal, political, and territorial aspects, in which isolated indigenous people become more vulnerable. For example, since they are not politically organized, they are more likely to have their territories threatened by different political groups (e.g., land grabbers, loggers, ranchers, and drug traffickers).

The lack of environmental policies and the absence of indigenous people in the environment protection boards goes hand in hand with the negligence and slowness of the justice concerning the processes of demarcation and registration of indigenous territories. Increased exposure to these vulnerability compromises, in the medium term, the capacity for renewal of isolated ethnic groups and, in a more pessimistic scenario, may even lead to the extinction of their way of life or, worse, to their extermination.

CONCLUSIONS

Cultural anthropologists argue that language is a fundamental feature of human beings, and its research allows for a deeper understanding of human nature (Soukup 2015). The Pirahã represents a concrete case of general pattern, where it is evident that language, culture, and human biology are inevitably intertwined.

As it is outlined in this article, research into the culture and language of Pirahã has raised many questions. The majority of these relate to the work of Everett and his followers. Critics of Everett and his sympathizers have pointed out several flaws in the research on the culture and language of Pirahã.

One of the most significant criticisms has been presented by Nevins *et al.* (2009). These authors argue against multiple of Everett's claims. According to them, the existence of some of the cultural and linguistic peculiarities (the authors use the term 'inexplicable gaps'), for which existence Everett and his followers proclaim, are nonexistent, illusory, not supported by adequate evidence, and some of the supposed gaps are in fact language properties shared with other languages (Vrhel 2009).

Another important debate relates to the existence and nonexistence or absence of quantifiers in Pirahã. For example,

Reboul (2012, 2017) argues that Everett's claims about the absence of quantifiers are based on flawed argumentation and neglection of pragmatic use of language.

Finally, a pressing issue requiring further research is the issue of the contact of languages of Pirahã and Portuguese (Sakel 2012; Sakel – Stapert 2010). Interaction of different languages almost always means contact of different cultures, religions, norms, and ways of life. As we have indicated above, these interactions have many dimensions and need to be given more attention in further research.

To conclude, the Pirahã case represents various problems that originate in the clash of paradigms maintained by scientists: relativism and universalism on one side, and evolutionism, progressivism and developmentalism on the other. However, each of those brings rather more questions than answers to the issues identified in the Pirahã culture. Many of those unanswered questions and unresolved dilemmas span multiple disciplines, from linguistics and anthropology to environmental science, and remain a challenge for other researchers.

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CONFLICT OF INTEREST

No conflict of interest was identified by authors.

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