

The Language of Teotihuacan Writing

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The culture that thrived at Teotihuacan in the Classic period has a unique place in Mesoamerican history. Today, it is held as an emblem of the Mexican national past and is one of the most visited archaeological sites in the Americas. Nevertheless, curious visitors are told that the ethnic and linguistic affiliation of the Teotihuacanos remains unknown. Whereas the decipherment of other Mesoamerican writing systems has provided a wealth of information about dynasties and historical events, scholars have not been able to access information about Teotihuacan society from their own written sources. Indeed, the topic of writing at Teotihuacan prompts several contentious questions. Do signs in Teotihuacan imagery constitute writing? If it is writing, how did it work? Was it meant to be read independently of language? If it did represent a specific language, then what language was it? We propose that Teotihuacan writing shared basic principles with other Mesoamerican scribal traditions, including the use of logograms according to the rebus principle, as well as a principle we term “double spelling.” Arguing that it did encode a specific and identifiable language, namely, a Uto-Aztecan language immediately ancestral to Nahuatl, Cora, and Huichol, we offer new readings of several Teotihuacan glyphs.

Online enhancements: appendix.

Teotihuacan

During its heyday in the Classic period (ca. AD 1–650), Teotihuacan was unparalleled in its influence across Mesoamerica. The city was of gargantuan proportions and remained without equal until the large urban conglomerations of the Late Post-classic Aztec, a millennium later. At its peak, Teotihuacan was not only the capital of an expansionist state but also the heart of a multiethnic and pluralistic culture in the Central Mexican highlands, whose city-states spread into the Basin of Mexico and adjoining regions (fig. 1). At its peak the urban population may have approximated 125,000 (Cowgill 2015:144; Hirth et al. 2020:7, 36), making it one of the largest conglomerations in the Western Hemisphere. Teotihuacan was not merely the capital of expansionist leaders and bellicose military orders but an urban and cosmopolitan society with the Mesoamerican world as its horizon. Yet, although the site is today held as an emblem of the Mexican national past, little is known about the people who lived there in ancient times, other than the fact that the city was ethnically diverse, with barrios of ethnic groups from many Mesoamerican regions. With millions of annual visitors, it is one of the most visited archaeological sites in the Americas, and even inquisitive tourists are told that the ethnic and linguistic affiliation of the Teotihuacanos remains a mystery, perhaps an unsolvable one. This work seeks to advance our knowledge of the Teotihuacano people, proposing new arguments in favor of an early presence in the city of a group of people speaking a language that belonged to the Uto-Aztecan (UA) language fam-

ily that was directly ancestral to the modern Nahuatl, Cora, and Huichol languages. We argue that they encoded this language in writing in the city’s colorful murals, as well as in other media. Confirming the linguistic affiliation of the Teotihuacan language, as well as identifying the correct historical stage of the language, would constitute a significant step toward a decipherment of Teotihuacan writing.

Teotihuacan Writing

Archaeological and epigraphic evidence reveals that Teotihuacan’s influence reached far and wide in Mesoamerica and beyond (e.g., Braswell 2003; García-Des Lauriers and Murakami 2021). As an urban culture and an imperial capital, it quickly became the home to a gamut of cultural groups, residing mostly on the outskirts of the metropolis, with varying degrees of integration into the heart of the city (Gómez Chávez and Abasolo Hernández 2011; Helmke 2012; Ortega Cabrera 2014; Rattray 1987, 1993). The foreign neighborhoods at Teotihuacan show the presence of peoples from Oaxaca, West Mexico, Veracruz, and the Maya area. The obviously cosmopolitan nature of the Teotihuacan polity raises the question of ethnic and linguistic continuity in Central Mexico, both with the populations preceding Teotihuacan in the Basin of Mexico and with those remaining there after its fall. Where did the original founders come from, and where did they go? In addition to the material culture and traditional funerary practices of their homelands, the founders of Teotihuacan also brought

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Figure 1. *a*, Metropolis of Teotihuacan as an archaeological site today. *b*, Maps showing the location of Teotihuacan (*inset*) and the distribution of Teotihuacan hieroglyphic writing at sites in the Central Mexican highlands. All photographs and drawings by Christophe Helmke, unless otherwise specified.

with them their languages, making Teotihuacan a multiethnic and diverse cosmopolitan city. However, what has puzzled researchers for decades is the language of the local Teotihuacan population, those who built the great pyramids before the city had taken on its truly cosmopolitan appearance. The only way to identify such a language would be to find it encoded in written form at Teotihuacan, and this raises the question of writing at Teotihuacan. Some researchers have viewed Teotihuacan as a utopian social experiment where even the features often considered fundamental for organized states, such as writing, are absent (e.g., Cowgill 1992:135–136; Pasztory 1992, 1997). Others have conceded that even if Teotihuacan culture was not literate per se, at least the capital must have relied on something resembling a notational system to account for the many tasks that such an urban center would have required (Langley 1986, 2002; Valdez Bubnova 2012).

One of the possible forays into the question of language is the writing system itself (fig. 2), but research into Teotihuacan writing has not drawn the attention of many specialists, owing to the small corpus of very brief texts. To provide context for the present proposal, we first review the most salient epigraphic progress and efforts at decipherment (a full review and the current status of the field are provided in the recent review by Helmke and Nielsen [2021]).

The history of the decipherment of Teotihuacan writing begins with the work of José María Arreola (1922), Hermann Beyer (1922), and Alfonso Caso (1937, 1959, 1967), all of whom proceeded from the tacit assumption that the signs that could be isolated in Teotihuacan imagery were a form of writing. Although they did not themselves propose phonetic readings, they did draw comparisons to the writing system of the later Aztec, at times pointing out equivalences between signs



Figure 2. Example of a linear text in Teotihuacan writing painted in three columns on the floor of the Plaza de los Glifos in the La Ventilla sector.

and thereby suggesting corresponding meanings (especially for numerals and calendrical signs). Clara Millon (1973:311) explicitly compared the writing system of Teotihuacan to other Mesoamerican writing systems, stating that “the writing system of the Teotihuacanos may not have been so completely different from other Middle American writing systems, as superficially it appears to be.”

In ensuing decades, James Langley (1986) set out to create a complete signary or sign catalog, but in his later work, there is a note of disillusionment, as he writes of glyphic signs as “notational elements” and sees the system described as a type of “symbolic notation” and sign clusters as “emblems” (Langley 1991, 1992). Surprisingly, Langley (1991:285) even went on to state that “no evidence of writing in the form of inscriptions or documentary records has been found at Teotihuacan.” Similarly, in a recent synthesis of the archaeology of Teotihuacan, George Cowgill (2015:213–214), who had himself earlier proposed potential readings of Teotihuacan signs, now describes these as “standardized signs” that do not constitute “writing in the strict sense.”

This ambiguity has proved a fertile ground for speculation. Even epigrapher Pierre Robert Colas identified some signs as probable logograms but also went on to suggest that the writing system represents a combination of so-called semasiographic principles with true glottographic writing (Colas 2011; see also Nielsen 2014). Even more recently, López Corral (2021) has proposed entirely nonlinguistic readings that assign purely mathematical values to various iconographic elements, seeing Teotihuacan images as complex calendrical and astronomical

computations. These interpretations represent an entirely different approach to Teotihuacan writing than the tradition represented by the proposals of Thomas Barthel (1987), who suggested that the glyphs in speech scrolls recorded an early form of Nahuatl, and the influential study by Karl Taube (2000) wherein he outlines all the features that define Teotihuacan writing as a typical Mesoamerican writing system.

To be sure, to the modern observer, the Maya writing system, with its orderly columns of highly stylized signs and relatively clear separation between text and image, may appear much more akin to writing, in a European sense, than the seemingly haphazard juxtapositions of highly figurative elements found at Teotihuacan (although cf. Salazar Lama and Valencia Rivera 2017 and Taube 2000; also Domenici 2023). This aspect and the difficulties of clearly tying Teotihuacan signs to language have made some scholars reluctant to describe these signs as “writing,” contributing to the notion of Teotihuacan as a society without writing (see Marcus 1992a:3, 17; Nichols 2016:37–38). Following the decipherment of the Maya script, recent decades have also seen significant advances in our understanding of Aztec writing (by which we specifically mean Aztec hieroglyphic writing, also known as *escritura náhuatl* in Spanish; e.g., Davletshin 2021a; Lacadena 2008; Valencia Rivera 2021; Velásquez García 2019; Whittaker 2009, 2021; Zender 2008b), which, much like Teotihuacan writing, was formerly considered to be something other than “true writing.” Now that these writing systems have been deciphered, no scholars would argue that these are not a form of glottographic or logophonetic writing (Lacadena 2019; Whittaker 2021).

A Way Forward

As scholars gradually accept that Teotihuacan must have had some form of writing, we see a growing realization that it is more comparable to that of other contemporaneous Mesoamerican societies and later cultures in Central Mexico. In our opinion, the most promising advances toward a decipherment have been those that seek to identify the function of signs in the writing system, to account for their contexts and the parts of speech that these likely record. Precisely this type of semantic decipherment has proved particularly promising and has been advocated by epigraphers for the past two decades. It has enabled the identification of calendrical signs, place names, and titles, as well as the isolation of probable names, both anthroponyms of historical figures and theonyms, and has even led to the identification of likely verbal expressions (e.g., Domenici 2017, 2023; Helmke and Nielsen 2014*b*, 2021; Millon 1988; Nielsen and Helmke 2014, 2020; Taube 2000, 2011). A further step in actual phonetic decipherment is to match up signs with words and meanings in potential candidate languages, assessing the probability and plausibility of such matches. This, however, presents the problem of deciding which language candidates are most likely encoded in Teotihuacan signs.

Given that Teotihuacan undoubtedly had a linguistically diverse population, in principle, Teotihuacan writing may represent any or all of these languages. Nonetheless, the presence of Zapotec and Maya writing at Teotihuacan suggests that foreign languages were recorded in their own scripts. That being said, logograms as word-signs are a type of sign that can be said to primarily bear and convey semantic information and thereby can be understood independently of a specific language. It is precisely this feature of logograms that has allowed semantic decipherments and epigraphic forays into the writing of Teotihuacan. Logograms, however, leave us in an ambiguous situation with regard to language, as, in theory, a purely logographic writing system could be understood by all of the inhabitants of Teotihuacan, regardless of their linguistic background (Houston 2004:277–278). If this were the case, it would be impossible to decipher the writing system and to identify the language(s) spoken by the writers. Nevertheless, it is a reasonable assumption that the city had a dominant language and that the writing system was developed for this language. From an epigraphic standpoint, this is a sound precept because all known writing systems that make use of logograms use these to cue specific words and readings and also use logograms for sound values in a specific language (e.g., Daniels and Bright 1996). Also, whereas writing systems can be adapted to fit different linguistic contexts, all known writing systems are developed within a specific linguistic matrix where the words for culturally significant things are coded to their graphic representations. In a Mesoamerican context, we can also see a close equivalence between writing systems and archaeological cultures, with little overlap between these, suggesting that writing systems were each tied to a particular language

(or at least language family) in which a given writing system was developed (Helmke and Davletshin 2010; Houston 2004: 293–308; Justeson and Mathews 1991).

At Teotihuacan, epigraphic work over the past two decades has found that a majority of the signs employed in the writing systems are logographic. This is in part because of the results of semantic decipherments (matching a sign with its probable meaning, but not to a specific linguistic form) but also because sign combinations involve exceedingly few signs, in most cases combining only two signs (see Helmke and Nielsen 2021:43–45; Taube 2000). This constitutes a significant obstacle to a phonetic decipherment of Teotihuacan writing, as, without evident phonetic signs, the logograms allow solely for semantic decipherments that match a sign with its probable meaning, but not to a specific linguistic form.

Yet the one context in which logograms can function phonetically is when these are used according to the rebus principle, where the phonetic value of a logogram is used to cue a word with a different meaning but a similar phonetic value. This is a typical scribal recourse wherein homonyms (or near homonyms) of the language allow for this kind of substitution and frequently employ signs that have clear visual referents to prompt a reading of another word that is more difficult to render graphically (see Lacadena, forthcoming; Velásquez García 2019:75–78; Whittaker 2021:78–79). All known logographic writing systems are thereby also logophonetic, as they employ the rebus principle to varying degrees. If Teotihuacanos also used rebus in their writing, we may be able to tie particular logograms to their phonetic values in a specific candidate language, and repeated pairing may enable the identification of the language recorded, allowing us to deduce the meaning of the text.

Previous Proposals

With a predominance of logograms and without a clear language candidate, the prospects of deciphering Teotihuacan writing may seem bleak. Yet, despite these obstacles, scholars have proposed different candidates for the language encoded in Teotihuacan writing, including Nahuatl, Otomí, Totonac, and an extinct and undocumented language of the Mixe-Zoquean family (see Nielsen and Helmke 2011:345–349). Because Teotihuacan is located in an area where Nahuatl is spoken, historically and currently, and because Nahuatl is known to have been a prominent language in Mesoamerica, several Nahuatl-based readings have been proposed for logograms at Teotihuacan. This also follows from the identification of sign continuities between the writing of Teotihuacan and that of the later Aztec (Beyer 1922; Helmke and Nielsen 2014*b*, 2023; Nielsen and Helmke 2011, 2014; Taube 2011). Several proposals have offered readings of logograms using phonetic values from sixteenth-century Nahuatl (Cowgill 1992; Taube 2000; Whittaker 2012, 2021) or from a reconstructed earlier form of Nahuatl (King and Gómez Chávez 2004). These are promising proposals in that they posit phonetic readings of

logograms, but we should remember that ascriptions of hypothetical values to logograms do not constitute decipherments. However, the most serious problem is that they attempt to read the glyphs in a form of Nahuatl that postdates the heyday of Teotihuacan by at least a millennium. The proposal by King and Gómez makes the reasonable attempt to try to read them in an earlier form of Nahuatl, but the proposal is weakened by the fact that it seemingly relies on ad hoc reconstructions—and that the reconstructed stage of the language is in all likelihood not early enough (as is described below). Moreover, none of the proposals have been conducted in a systematic way with a temporally appropriate form of Nahuan before it is tested for its overall fit in the corpus of Teotihuacan glyphs.

Nahuan Languages and Southern UA

Nahuatl is the most frequently mentioned candidate language for ancient Teotihuacan. It belongs to the widely dispersed UA language family, with languages scattered throughout northern Mexico and the American Southwest (Caballero 2011;

fig. 3). The name Nahuatl comprises a group of closely related linguistic varieties historically spoken as far north as Durango, Mexico, and as far south as Nicaragua and Costa Rica (Chapman 1960). Today, the internal diversity of the group is such that it warrants speaking of a group of Nahuan (or Aztecán) languages, rather than a single Nahuatl language. These languages must descend from a single Proto-Nahua (PN) language, which can be reconstructed using the historical comparative method. PN has been reconstructed by Karen Dakin (1982), but subsequent advances in our understanding of the historical development of Nahuan languages allow for more fine-tuned and refined reconstructions. Comparative work has now established that Nahuan languages are grouped into two main branches, an Eastern and a Western branch (Canger and Dakin 1985; Dakin 2021). Eastern Nahua extends from the Huasteca region and along the Gulf Coast and southward into El Salvador. Western Nahua centers in the Basin of Mexico and adjoining states, reaching northwest all the way to Durango. Campbell and Langacker (1978) considered the extinct Pochutec language of Oaxaca to be a separate third branch,

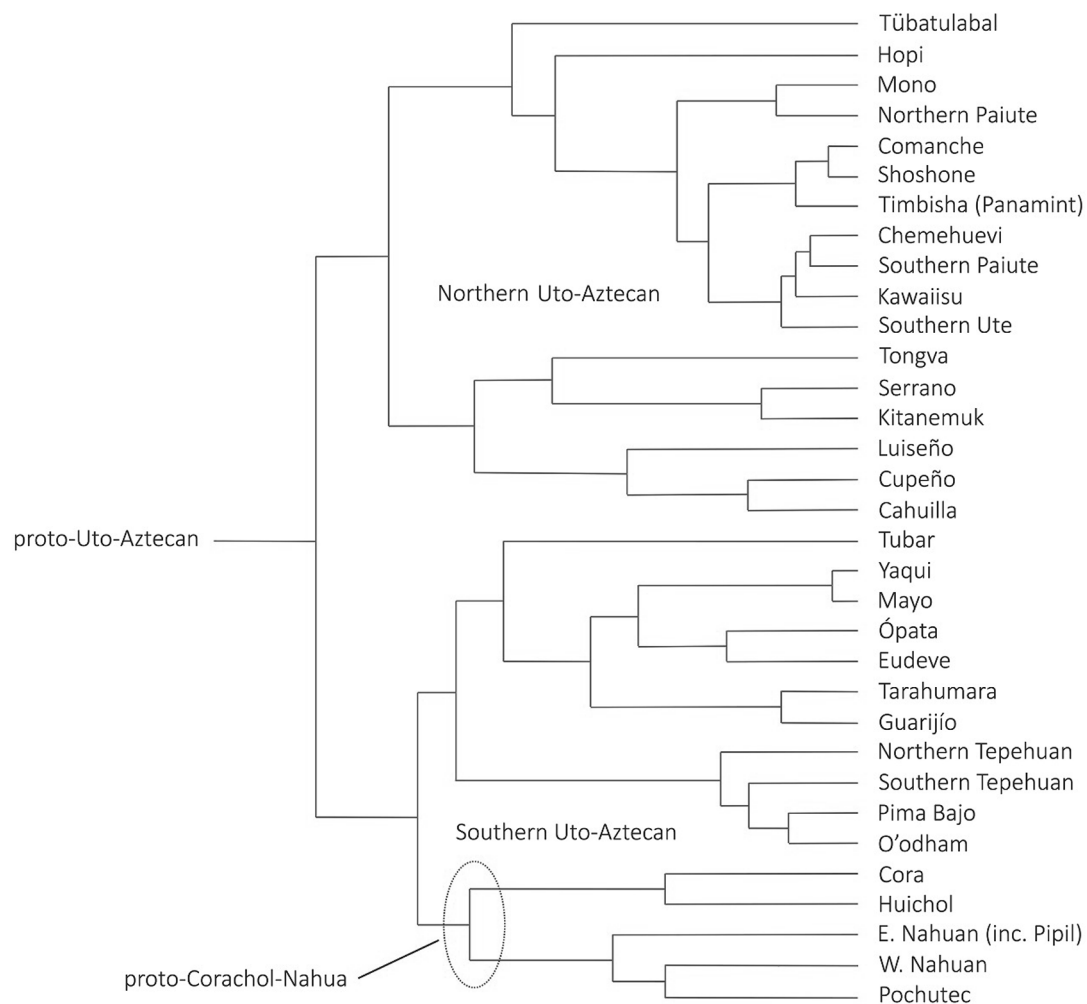


Figure 3. Genealogical tree of Uto-Aztecan languages based on lexicostatistical analyses (adapted after fig. 2 in Greenhill et al. 2023). E. = Eastern; W. = Western.

possibly a sister language of PN, but Dakin (1983) demonstrated that it can be derived from within the Western branch of PN. This means that the idea of King and Gómez Chávez (2004) that “Nahua-Pochuteco” is older than PN itself is erroneous and that their reconstructions represent a language more likely spoken in the early Postclassic, but not that spoken a millennium earlier, during the Classic period. However, an even earlier stage of Nahuatl can be reconstructed by comparing PN to the languages with which it is most closely related.

The UA language family itself is now established as having two main groups: Northern UA and Southern UA (SUA; Greenhill et al. 2023). Nahuatl is part of the southern group of languages, but its potential relations to other SUA languages have also been a matter of debate. Campbell and Langacker (1978) argued that Nahuatl (which they called Aztecan) forms a group with the two Coracholan languages Cora (or Náayeri) and Huichol (or Wixárika) and that several shared phonological innovations between Coracholan and Nahuatl suggest that they descend from a single intermediate ancestor language—which would have been the southernmost variety within an early SUA dialect continuum. Given that Corachol and Nahuatl are the southernmost UA languages, this is a reasonable starting hypothesis. Other scholars, however, have argued that Corachol and Nahuatl descend through separate branches and that the similarities demonstrated by Campbell and Langacker are due to early contact between speakers of Proto-Corachol (PCC) and PN (Dakin 2017; Kaufman and Justeson 2007:195, 2009:225). Systematic comparative work on Corachol and PN by Pharo Hansen (2020) further supports Corachol-Nahua as a valid phylogenetic grouping, which is also supported by recent lexicostatistical analysis by Greenhill et al. (2023). The present proposal uses a database of some 300 lexical items reconstructed for Proto-Corachol-Nahua (PCN) and SUA by Pharo Hansen (2024). The full database is not included here, but the parts that are directly relevant for the present proposal are included in the appendix (available online). It is important to note that the reconstructions have been prepared independently of the proposed readings presented here.

Another important question, however, is where and when PN and its ancestor PCN were spoken. Following debates over the past two decades, scholars of UA nowadays place the UA homeland in the American Southwest or Southern California (Greenhill et al. 2023; J. Hill 2011; Shaul 2014), although it may also have extended into northwest Mexico. Nahua ethnohistorical sources from the colonial period also describe the Nahuatl-speaking peoples as having arrived to Central Mexico from the north (Smith 1984). Kaufman and Justeson (2009) have argued that PN was spoken in contact with speakers of Totonac, Mixe-Zoque, and Huastec and argue that the most likely location for the PN homeland is to the northeast of the Basin of Mexico. Others have found it more likely that Nahua speakers arrived in Central Mexico from the northwest (Beekman and Christensen 2003) and that they were in contact primarily with speakers of Cora and Huichol (Dakin 2017). Ad-

ditionally, there are historical reasons to believe that Cora, Huichol, and Nahuatl and other closely related UA languages were spoken in a much larger area of western and Central Mexico at the time of earliest European colonization (Miller 1983). If Nahuatl and Corachol are indeed offspring of a single ancestral SUA variety, then this variety may have formed a dialect continuum from the Pacific coast of Nayarit in the west and eastward into the Central Mexican highlands, possibly extending to the Valley of Mexico. When that dialect continuum eventually disintegrated, the southeasternmost dialect became the earliest form of PN, while the western PCN dialect became the PCC language (Pharo Hansen 2020).

There is also no consensus on the question of when early Nahua speakers arrived in Central Mexico, and hence whether they could have been present at Teotihuacan. Some linguists have proposed that UA linguistic influence may have spread from Teotihuacan to other areas of Mesoamerica (Dakin and Wichmann 2000; Macri andLooper 2003; Wichmann 1998), while others have rejected this idea, seeing Nahua speakers as newcomers in the Postclassic period (Kaufman and Justeson 2007, 2009).

It is significant that the form of PN that can be established by comparative reconstruction within the Nahuatl subgroup already bears all the signs of having become fully assimilated to the Mesoamerican linguistic area (Campbell, Kaufman, and Smith-Stark 1986). This implies that, for its grammatical profile to have become fully assimilated to its Mesoamerican neighbors, PN had coexisted with Mesoamerican languages for a considerable period of time, which the latecomer hypothesis hardly allows. The Corachol languages, located on the northern edge of Mesoamerica, in turn exhibit only a lesser degree of assimilation to the Mesoamerican linguistic area. These are much more conservative than Nahuatl and, therefore, more similar to the other SUA languages of northern Mexico. Comparison of Corachol and PN therefore permits us to reconstruct an early stage of PN that represents the stage of the language before it was influenced by Mesoamerican languages. If the split of PN into the Eastern and Western branches can be dated to the juncture between the Epiclassic and Early Postclassic migrations (ca. AD 600–1100), as suggested by Dakin (2021:2180), then the assimilation of Nahua to the Mesoamerican language area must have taken place during the Classic period. Therefore, if an early form of Nahua was present at Teotihuacan, then the best candidate would be early PN (pre-Nahua) or even earlier PCN (see the chronological model for the development of PCN in the appendix). The basic hypothesis that a UA language ancestral to Nahuatl was spoken at Teotihuacan has been proposed or even assumed in previous proposals. This article seeks to test this hypothesis by using a list of reconstructed vocabulary in the earliest direct ancestor of Nahuatl to read the glyphs at Teotihuacan, focusing on finding possible phonetic readings that are motivated by the rebus principle or by use of phonetic complementation.

The motivation for testing PCN as a candidate occurred by happenstance, when Helmke, who was working on Teotihuacan

writing, showed a glyphic sign compound from Tetitla to Pharao Hansen, who was working on the reconstruction of PCN. The sign in question renders a human face with nopal cactus pads affixed to the ears. At this, Pharao Hansen immediately remarked that the words for “ear” and for “nopal” are near homonyms in Corachol. The use of homonymy to prompt a phonetic reading of a logogram is, of course, based on the rebus principle, which ties logograms to readings in a specific language. This observation of homonymy opened the way for us to explore the reconstructed PCN language as a candidate language for that encoded in Teotihuacan writing. In the following, we present a series of proposals of phonetic readings of Teotihuacan signs that support the premise that the language encoded in Teotihuacan writing belongs to the SUA family, similar to the PCN reconstructed by Pharao Hansen.

Ears of Nopal

The rich array of polychromatic murals of the Tetitla compound at Teotihuacan are punctuated by large emblematic glyphs (de la Fuente 1995:259–311; Miller 1973:119–156). The murals span over the walls of several buildings and form an imposing thematic tableau. The murals that decorate the buildings facing onto Patio 1 cover the walls of rooms and spill out onto porticos, forming a single great narrative that spans from north to south (Miller 1973:120–124). In these, we can see a procession of priestly figures performing scattering rituals. Only the lower halves of these figures are preserved, but large emblematic glyphs are displayed in front of these individuals (fig. 4). One such glyphic compound represents what is called an “enclosure sign,” in front of which is a pair of disembodied hands in the act of scattering, and it thereby provides a verbal reference to the ritual actions that these priests are conducting (Helmke and Nielsen 2021:45–46; fig. 4a). On another partly preserved mural, we can just discern a glyph for “mountain” that is modified by a speech scroll qualified by a flower, which, on the basis of comparisons to Aztec glyphic writing and Nahuatl, has been interpreted as a toponym for “singing mountain,” quite possibly commemorating an important pilgrimage to this locality (Helmke and Nielsen 2014b:91, 93–94; fig. 4d). Among the remaining glyphs is what appears to be a shield that is crossed by the so-called four-element group, a set of linear elements that are symbolically related to fire (Langley 1991: 291–292, fig. 15; von Winning 1987: vol. 2, 15–23; fig. 4b). At Tetitla, this combination likely represents an anthroponym naming one of the individuals depicted as “fire shield” (Helmke and Nielsen 2021:53, fig. 13b). The last well-preserved emblematic glyph represents a face that has frequently been interpreted as that of a woman whose ears are adorned by flowering pads of the nopal cactus (*Opuntia* spp.; fig. 4c). This stunning combination quite probably records another name, and it is here that an interesting conjunction becomes apparent, as the words for “ear” and “nopal” are near homonyms in the Cora and Huichol languages and are also reconstructed as such for PCN (table 1).

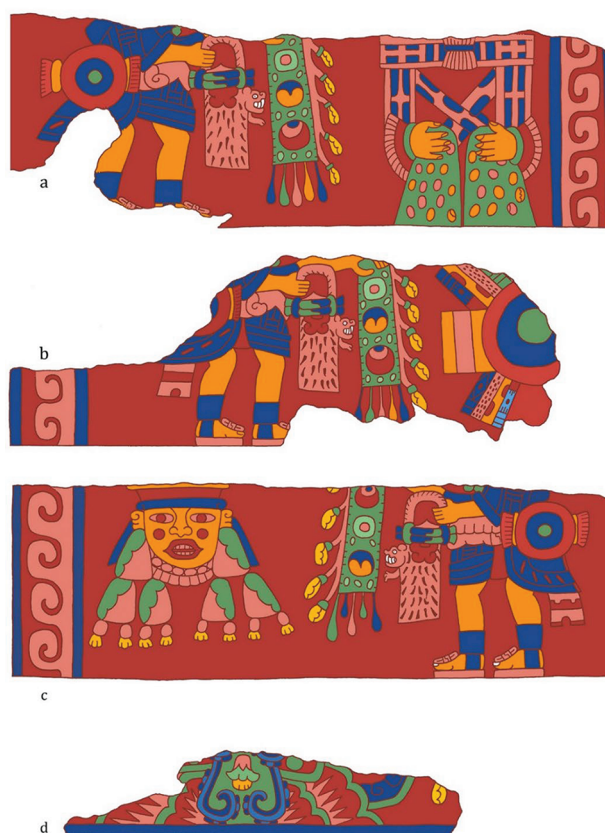


Figure 4. Murals of Patio 1 at Tetitla, showing a procession of priestly figures conducting scattering rituals, each accompanied by a large glyphic compound. *a*, “Enclosure” sign and disembodied hands scattering, forming the verb. *b*, So-called four-element group crossing behind a possible shield, as an anthroponym. *c*, Human face with ears of nopal (*Opuntia* sp.), as a likely anthroponym. *d*, Mountain emitting a florid song, as a toponym (drawings by Christophe Helmke, based on original reproductions by Felipe Dávalos in Miller 1973: figs. 231–241).

One of the scribal recourses found in Aztec writing is what has been called “redundant logographic homophones” (Lacadena, forthcoming; Velásquez García 2019:75–78), which we here refer to as “double spelling.” In this type of spelling, the reading of a logogram is reinforced by writing an additional logogram with a similar pronunciation. In these cases, one of the logograms encodes the desired semantic value as well as the corresponding word in the language, whereas the other is represented merely to ensure the proper reading. Such spellings form a particular class of phonetic complementation. Many examples of this writing convention are known from Aztec codices, particularly those of the so-called Tenochtitlan-Tlatelolco school, where emphasis is given to the use of logograms (Lacadena 2008:12–13).

An illustrative example of double spelling in Aztec writing concerns the settlement named <Quaguacan> mentioned in the Codex Mendoza (Berdan and Anawalt 1992:200), where the place name *Kʷawaʹkan* is written in glyphs with a full-figure

Table 1. Proto-Corachol-Nahua (PCN) word, gloss, language, and attested form

PCN	Gloss	Language and attested form
* <i>Nakása</i>	Ear	Huichol: <i>naaká</i> ; Cora: <i>nasaíh</i> ; Nahuatl: <i>nakas-</i>
* <i>Nakári</i>	Nopal	Huichol: <i>nakári</i> ; Cora: <i>naká</i> ; Nahuatl: <i>naka-</i> (“meat”)

eagle standing in front of a tree, which together provides the sign compound **K^WAW-K^WAW** (see Peñafiel [1897:71] for his comparable reading as Cuahuacan-Cuauhtla; fig. 5a). When one examines the glyphic spelling, the meaning may be unclear, but the reading of the root is reinforced by the double spelling, leaving the reader to reconstruct the toponymic *-tla:n* suffix (Berdan and Anawalt 1992:200; Peñafiel 1897:71). Another particularly illustrative example (Berdan and Anawalt 1992:181) represents the place name <Coyuacan>, now a district of Mexico City. In this case, the primary logogram represents a full-figure coyote, for **KOYO**, which is infixed by a small circular perforation that is likewise a logogram for **KOYO**, from *koyoktli* (“perforated”), *koyoktli* (“hole”; Berdan and Anawalt 1992:181). This pairing is thereby another instance of double spelling, here for the toponym *koyo[wa’kan]* (see Domenici 2017:54; Helmke and Nielsen 2014b:100). A comparable toponym may also be represented at Teotihuacan in the murals of the White Patio at Atetelco, where a row of coyotes is represented, each with a circular sign (see Taube 1992) embedded into their chests (de la Fuente 1995:203–205, lámina 6; Domenici 2017:54, fig. 3.1a; fig. 5c). The graphic correspondences are so close to the later Aztec examples that we cannot help but wonder whether these are not spellings where the embedded sign (see Taube 1992) serves as a double spelling.

Returning to Tetitla, the juxtaposition of the nopal pad (**nakári*) and the ears (**nakása*) strongly suggests that the scribe was intending to prompt a phonetic reading as *nakasa* + *nakari*, focusing on the shared initial syllables *naka*. This enables the reading of the nopal ear as a double logogram with the logographic value **NAKA**. By simultaneously using both of the logograms that can produce the phonetic value **NAKA**, the scribe provided a double spelling as **NAKA-NAKA**. We suggest that the nopal-ear double spelling is likely meant as a personal reference to the individual depicted. Coincidentally, a name that includes the root *naka*—is that of the great founding fertility and earth goddess of the Huichol, *Nakawé* (Pharao Hansen 2021), demonstrating the possible onomastic value of the root *naka*. We suggest that *naka* here may encode a comparable theonym, but it bears remembering that theonyms in Mesoamerica are frequently used as the base for theophoric personal names. At present, this is the sole example of this glyphic compound, and it is, therefore, not altogether ideal to posit a reading based on just one instance. But given the small size of the Teotihuacan corpus, this is a basic premise for any attempt at decipherment. Possibly, in the future, additional attestations may corroborate or contradict this proposal.

The Shallow Basin

Among the signs of Teotihuacan writing is one that is known as the “shallow basin” (Taube 2000:9, 20, 23; see also Langley 1986:299, glyph 266). The same sign continued to be used in the ensuing writing system of the Epiclassic and is found at sites such as Cacaxtla and Xochicalco (Berlo 1989:32; Helmke and Nielsen 2011:20–22). The sign appears to represent a stylized dish or shallow bowl or at least a hollow or depression. In the context of writing, the sign is used as a type of container into which other signs are placed, wherein the shallow basin is generally the lower sign in a compound. Combinations can be simple, as, for instance, on a polychromatic tripod vessel wherein a series of atlatl dart butts are placed within the “dish” (von Winning 1987: vol. 2, chap. 8, fig. 3d) or in other examples at Acanceh where the sign for “cattail reed” is nestled within the basin (Stuart 2000:502–504; fig. 6b–6d). In these cases, the shallow basin appears to serve as a type of locative marker, but in other instances, we can see that calendrical notations are also placed within the shallow basin, as is the case on the so-called Ixtapaluca plaque (originally from the vicinity of Chalco), where the date “7 Reed” is set within a shallow basin (Helmke and Nielsen 2011:21; fig. 6a). The same type of usage is also documented in later Epiclassic writing, where the

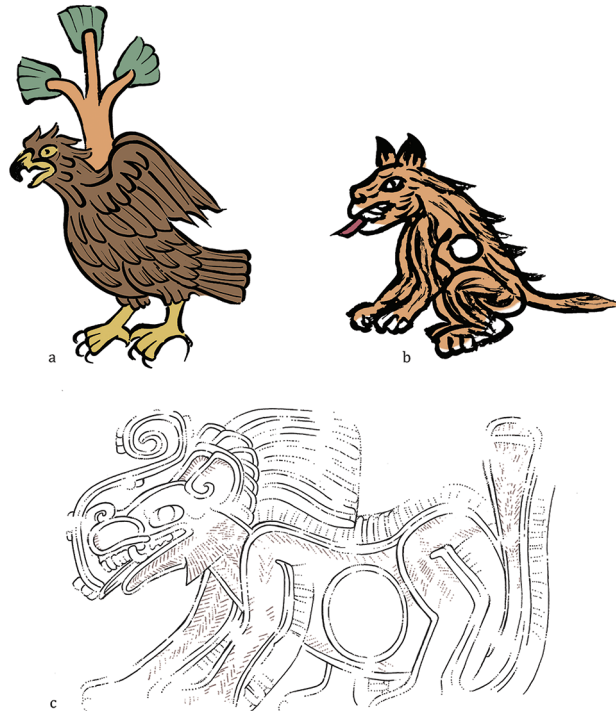


Figure 5. Examples of double spelling involving two homophonous logograms in Aztec writing. a, **K^WAW-K^WAW** for <Quaguacan>. b, **[KOYO]KOYO** for <Coyuacan> (Codex Mendoza, fol. 5v). c, Coyote with eroded circular sign on its abdomen in the murals of Atetelco (drawn from photographs and inspection of the original).

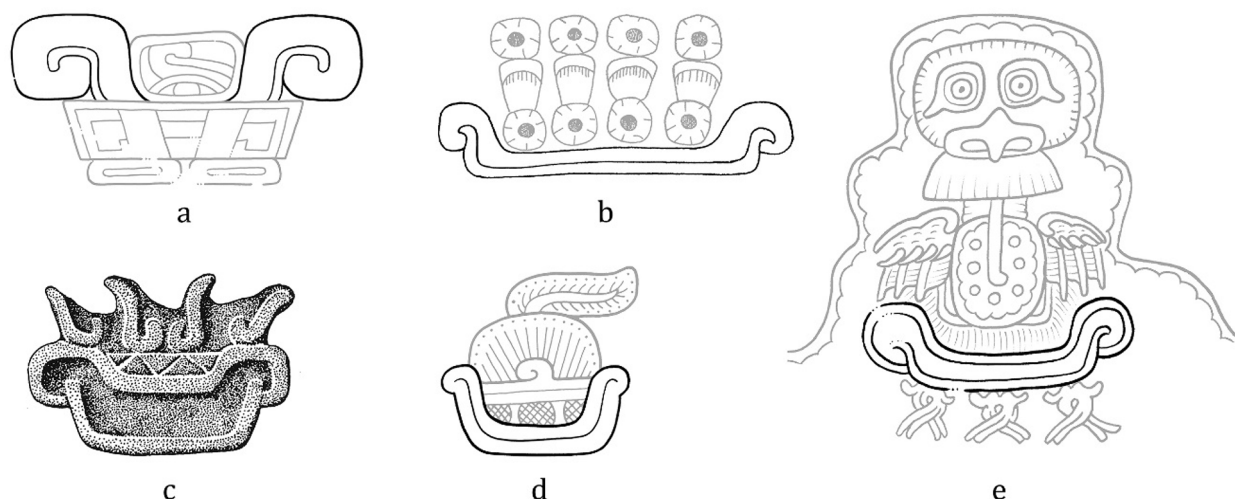


Figure 6. Examples of the “shallow basin” sign in Teotihuacan writing (bold). Uses with calendrical notations: *a*, Date “7 Reed” written with a “Reptile Eye” glyph (detail of the Ixtapaluca plaque). Uses in toponyms: *b*, Four atlatl dart butts as qualifying elements (after von Winning 1987: vol. 2, chap. 8, fig. 3*d*). *c*, Flames (after von Winning 1987: vol. 2, chap. 2, fig. 22*k*). *d*, “Reptile Eye” glyph for “reed” (detail of the stucco facade of Acanceh). *e*, Name of a mountain combining the shallow basin and twisted root signs (Atetelco murals).

shallow basin sign is equally used in both toponymic and calendrical notations (Helmke and Nielsen 2011:20–22). On the basis of these calendrical examples, we surmise that the shallow basin also serves as a temporal marker. Given these contexts, it is unlikely that the sign is meant to be understood in a literal fashion, but it more likely functions as a rebus for a homophonous suffix that is used in both locative and temporal constructions (Helmke and Nielsen 2011:20).

In Nahuatl, a basic word for a ceramic vessel is *komitl*, where the *-mi* part may be a collective suffix that describes things that occur in groups (Laughlin 2014). Pharao Hansen reconstructs the root **ko* in PCN with the meaning “hollow,” from which words were derived designating containers of this form (*komitl* [“jar,” “olla”], *komalli* [“griddle”]) as well as features of the landscape, such as hollows and basin-shaped depressions (*komo:lli* [“depression,” “hollow”] and also *koyo:ni* [“make a hole”]). At the same time, *-ko* is a locative and temporal postpositional suffix in Nahuatl with cognates in other UA languages. We therefore hypothesize that the shallow basin sign may function as the logogram **KO**. This reading is further supported by the fact that in later Aztec writing, a similar sign depicting a small stylized olla, or ceramic jar, functions as the phonogram *ko* (Aubin 1849:35; Lacadena 2008:9–10). In Aztec writing, this logogram is frequently used to write the locative suffix *-ko*, which is used to form toponyms but also for general locative expressions that also describe temporal relations (Karttunen 1992:36)—for example, in Nahuatl phrases such as *tonal-ko* (“in the dry season”) and *teotlak-ko* (“in the evening”). This suggests a linguistic and scribal continuity from Teotihuacan to Aztec times in using the depiction of a ceramic vessel to write the syllable **KO** in the function of the locative suffix, and it explains why the suffix also occurs with day signs.

Roots and Places

A sign that has a relatively high incidence at Teotihuacan is the so-called twisted root sign (Langley 1992: fig. 6*a*; Nielsen and Helmke 2008:461; Taube 2000:9). In the depiction of plants, Teotihuacan conventions follow those of related Central Mexican cultures in representing not just the part of the plant that appears above the earth but also the whole plant, including the roots (see Berrin 1988; Sahagún 1950–1982: vol. 11, figs. 479–615). This is most clear in the murals of Techinantitla, where large, writhing, feathered serpents soar in the skies above flowering orchards as these disgorge streams of life-giving water. The trees and bushes are represented with broad stems and ample roots. Distinguishing the trees are the stylized flowers on each branch, as well as the glyphic sign combinations that mark the stems. Many of the associated glyphs are repeated in regular sequences, suggesting that these could name particular plants. Cowgill (1992:237–239) was the first to suggest identifications for two of these plants that provide rather convincing correlations to known Aztec names for plants, including the *tlapalomixochitl* (i.e., “red bone flower,” also known as the *omixochitl*, *Polianthes tuberosa*) and the *tlapaluacalxochitl* (“red basket flower,”¹ possibly the same as the *uacalxochitl*, *Phyllodendrum affine*; see Sahagún 1950–1982: vol. 11, 198, 209; fig. 7*a*, 7*b*). It is compelling to consider that these represent Nahuatl words that include the exact elements represented—but as Cowgill himself acknowledged, there is in fact no indication

1. In this, Cowgill translates *uacal* as “basket,” perhaps because this is what seems to be depicted in the glyphs. Other, more literal translations would be “gourd” or “crate,” but in this context it should probably be understood more generally as “container.”

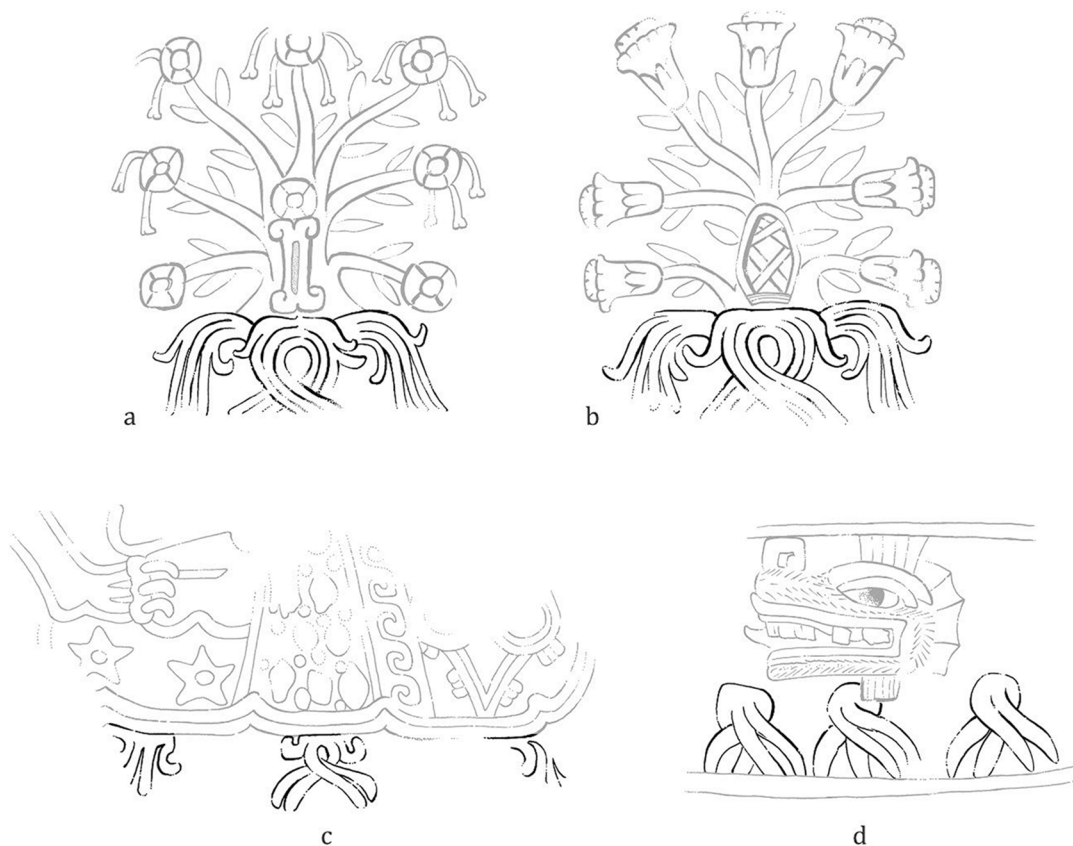


Figure 7. Examples of the “twisted root” sign in Teotihuacan writing (bold). *a*, “Red bone flower” tree (Techinantitla murals). *b*, “Red basket flower” tree (Techinantitla murals). *c*, Basal register of a mythological scene (Zona 5A, Portico 3, Mural 2). *d*, Detail of a stucco-painted cylindrical tripod vase (drawing by Christophe Helmke, based on a photograph in Berrin 1988: fig. VI.28).

that the logograms are being used phonetically. Following a suggestion by Lyle Campbell, Cowgill (1992:242) notes that in Totonac, there is also a plant called “bone flower,” suggesting that the logogram could also be read in other languages. Thus, whereas the signs may help us identify the plants represented, these do not identify the language in which these glyphs were meant to be read.

However, when segregated from plants, the same twisted root sign is used as part of sign combinations that appear to be toponymic in function (Taube 2000:9). For instance, the twisted root sign demarcates the lowest portion of the basal register of a large supernatural scene (de la Fuente 1995:71, fig. 6.7; Miller 1973: figs. 114, 115) in a context where we can expect toponymic references, or notations pertaining to place. The twisted root sign is also found several times in the carved panels of the site of Las Parotas, where these serve to designate a named mountain place (Valdez Bubnova and Rivera Guzmán 2017). The same sign not only is used in Teotihuacan writing but also continued to be used in the writing system of the ensuing Epiclassic (Helmke and Nielsen 2023).

Taube (2000) suggests that the twisted root sign is a locative marker and ventures a reading based on a clue from colonial Nahuatl. He suggests that the sign could be read as the Nahuatl

word for “root” (*tlanelwatl*), which he further suggests could represent the locative suffix *-tlan:n*. This reading, however, is faulty, as it is based on an erroneous segmentation of the Nahuatl word. The word does mean “root” in Nahuatl, as the lexical root of the word is not **tlan* but *nelwa*. Being the name of a part of a plant, the word *nelwa* is inherently possessed in Nahuatl, and when it needs to be represented in an unpossessed form, it takes the dummy possessor prefix *tila-*. However, we do believe that Taube was correct in identifying the sign as a locative sign with the meaning “root,” and it does have a potential locative reading in PCN.

Nahuatl shares with Corachol a lexeme that can be reconstructed as **neriwa* (“edible root”; this gives Nahua *nelwa*, Huichol *ínieri*, and Cora *ínee*), but there is evidence to suggest that PCN also had another general word for “root” that can be reconstructed as **nawa*. In Huichol, the general word for “root” is *naná*, in Yaqui it is *naáwa*, and in Wariho *nawá*. Pharaoh Hansen proposes that the PCN lexeme **nawa* (“root”) is a cognate of the Nahuatl locative suffix *-naawa-k*, meaning “near, adjacent to.” The final *-k* in *-naawak* is the same locative suffix *-ko* mentioned in the preceding section, which is regularly reduced to *-k* in late PN when appearing after a syllable ending in a vowel. The full postpositional expression would then originally have been *-naawa-ko* and would have had the

meaning “at the root of X.” This way of forming locatives by conceptualizing a spatial relation through a metaphor of inherently possessed parts is typically Mesoamerican (Bohnenmeyer et al. 2015). In this way, a root may metaphorically denominate a place where something is anchored or originates. In Nahuatl, these body-part metaphors generally combine a part of the body with one of the postpositional locative suffixes.

Indeed, several examples of the twisted root glyph co-occur with the shallow basin glyph (e.g., at Atetelco, Tetitla, Zona 5A, Techinantitla; fig. 6e). In the murals of Atetelco, the twisted root is used as a type of suffix below the shallow basin sign, here containing an owl within a mountain range topped by large obsidian blades. The glyphic combination within the peak, here named with an owl, followed by a shallow basin and the twisted root, likely names a particular peak within that mountain range (Helmke and Nielsen 2014b:101, fig. 13g, 13h; Nielsen and Helmke 2008). Reading the glyphs with the values **TEKO-NAWA-KO** proposed above, this toponym can be understood as “at the root of the owl/lord” (adding **teko* [“owl”]; see Pharao Hansen, forthcoming b, forthcoming d). Here we gloss **TEKO** as either “owl” or “lord,” as **teko* can be reconstructed in SUA as “lord,” with *teko-yawi* as both “raptorial bird” and essentially “warlord” (see sec. 2 in the appendix, glyph 15; Pharao Hansen 2022).

Another related example is rendered on a polychromatically decorated stucco tripod where the head of what may be a bat is suffixed by a series of three twisted roots (Berrin 1988:209; Conides 2018; Taube 2000: fig. 17c; fig. 7d). Drawing on the reconstruction of the term “bat” as **tsi-naka* in PCN, this compound may have had the intended reading of *tsinaka-nawa[ko]*, for “at the bat place.”

The Stone Series

Building on findings made by Marc Zender (2008a), Helmke and Nielsen (2014b:81–83) have demonstrated the underlying coherence of sign formation processes in a set of Mesoamerican logograms. In particular, this concerns what can be called the “stone series,” where in Aztec writing the small lateral scrolls that are the diagnostic elements of the logogram for “stone” are repeated in the logograms for “mountain” and “cave” (fig. 8a). This underlying graphic logic suggests a significant degree of coherence and continuity in Mesoamerican writing systems, even though these were each developed in their own linguistic contexts, drawing on the representational conventions in use in that particular culture. That this system extends to Teotihuacan has already been demonstrated (Helmke and Nielsen 2014b:81–83), showing that the diagnostic

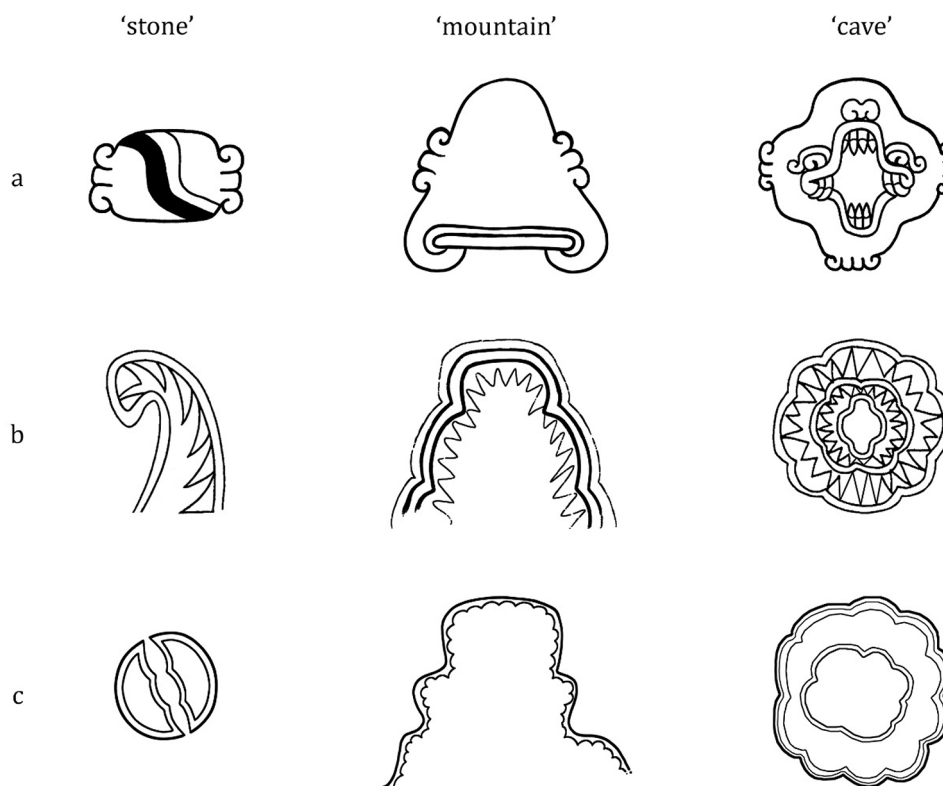


Figure 8. Diagnostic elements shared by the logograms for “stone,” “mountain,” and “cave” in two different Mesoamerican writing systems. *a*, Note the lateral scrolls in the Aztec logograms for *te[tl]*, *tepee[tl]*, and *ostoo[tl]*. Note the triangular serrations (*b*) and lunate crenellations (*c*) in the Teotihuacan logograms for **TE**, **TEPE**, and **TESO** (after Helmke and Nielsen 2014b: fig. 5). *a*, Codex Mendoza. *b*, From Atetelco, Zona 5A, and polychromatic olla. *c*, From Gran Conjunto, Atetelco, and Tepantitla.

elements of “stone” are the triangular serrations that are found within signs such as those representing obsidian blades. The same serrations are equally present on the interior of the logogram for “mountain” as well as for “cave” (fig. 8*b*), following the same structures as those seen in Aztec writing. A graphic variant is evident in later glyphs at Teotihuacan where the sharp, pointed serrations have been reduced to duller lunate crenellations (fig. 8*c*). It is important to remark that these pointed serrations are not always present, and in about a third of the examples, mountain signs are represented without these (see Helmke and Nielsen 2014*b*). This behavior suggests that these serrations are optional in their usage and supply secondary information.

The graphic elaboration of the logograms for “mountain” and “cave” repeats the graphic features of the sign for “stone.” This in turn may suggest that we are looking at a series of signs that add nonlinguistic information related to the material substance (as an iconic marker) or assist in identifying the semantic class of particular logograms (things related to “rock” and “stone”). However, the reconstructions of PCN reveal that the words referring to the three elements in the stone series (“stone,” “mountain,” and “cave”) in fact shared the initial syllable **te* in all three of the protoforms (**te* [“stone”], **tepe* [“mountain”], and **teso* [“cave”]). This suggests the possibility that these scribal additions may not have been merely iconic, as has otherwise been assumed, but could have served in a phonetic capacity, cueing readings for speakers of PCN (table 2).

These reconstructions show that in SUA languages, the words of the stone series all begin with *te-* (which reflects the PUA root **ti-* [“stone”]). However, it also shows that, if the serrated-edge sign in the stone series was also used as a phonetic complement (as is suggested by its optional usage), then it could have been phonetically motivated only in an SUA language but, crucially, not in PN. In PN, the original pre-Nahua form *tesó* had been transformed—first by syncope (**tesó* to **itso*), then by metathesis (**itso* to **isto*), and finally by vowel assimilation, to *osto-* (see the appendix).

To conclusively demonstrate that the serrated sign has a phonetic function, we would expect to find it in a spelling of the syllable **TE** in a context not related to stone. As long as we have not identified such a sign combination, we feel that it is warranted to consider the function of the serrated sign as a

phonetic complement or as a semantic determinative, indicating either the syllable *te-* or the semantic content of “stone.” With the antecedents of Teotihuacan writing, the stone sign would continue to be used, but only as an iconic marker or semantic determinative in the later writing systems from the Epiclassic onward (see Helmke and Nielsen 2014*a*:25). In this way, the stone series provides another indication that the language at Teotihuacan was a Nahuatl language, but such an early form that it more closely resembled its SUA predecessor.

Correspondences

Having now proposed readings of Teotihuacan logograms using the reconstructed PCN lexicon, we now turn to consider two lexical items that appear in Classic Maya writing in cultural contexts related to Teotihuacan. These terms have long been identified as highly promising lexical items of Teotihuacan language, as these cannot be etymologized in Mayan languages and may function as loanwords that refer to objects that are likewise foreign to Maya material culture (Nielsen and Helmke 2011:346–348).

The first is a glyphic compound recorded on the side of the famed Stela 31 of Tikal that portrays the local ruler, Siyah Chan K’awil II, in AD 445, flanked on either side by what may be emissaries from Central Mexico (Beliaev 2019; Stuart 2000: fig. 15.2, 469, 481–482; fig. 9*a*). The segment in question is couched in the caption above one of the emissaries and includes three phonograms above what appears to be a woven mat throne, known as an *ikpalli* in Nahuatl, which is a typical symbol of Central Mexican rulership (Davletshin 2023; de Sahagún 1950–1982: vol. 6, 68). The phonetic sequence above the throne can be transliterated as **ko-sa-ka** (as first identified by David Stuart), which bears a significant resemblance to the Nahuatl *kooskatl* (“necklace,” “collar”; Karttunen 1992:43; fig. 9*b*). This term has previously been analyzed as either an early Nahuatl term (see Boot 2010:154–155) or an early PN form (Nielsen and Helmke 2011:347). Now, on the basis of the reconstructions for PCN, we can propose the following: that the word for “necklace” can be reconstructed as **koosaka*, which then, after a syncope of the unstressed vowel, becomes **ko:ska* in PN and Corachol, becoming *kúka* in Huichol, as the *s* is elided before *k* to avoid a consonant cluster (table 3).

Table 2. Protoform, gloss, language, and attested form

Protoform	Gloss	Language and attested form
<i>*Te</i>	Stone	Nahuatl: <i>te-</i> ; Huichol: <i>teté</i> (“stone,” “ <i>piedra</i> ”); Cora: <i>teté</i> (“stone,” “ <i>piedra</i> ”)
<i>*Tesaka</i>	Obsidian, flint	Cora: <i>tehka</i> (“obsidian,” “ <i>obsidiana</i> ”); Huichol: <i>téka</i> (“vitreous stone,” “ <i>piedra vidriosa</i> ”); Nahuatl: <i>teska</i> (“obsidian mirror”)
<i>*Tékà-pari</i>	Flint, knife	Nahuatl: <i>tepatl</i> (“flint”)
<i>*Tepe</i>	Earth, mountain	Nahuatl: <i>tepe:tl</i> (“mountain”); Tübar: <i>tepe</i> (“elevation,” “hill,” “ <i>alto</i> ,” “ <i>cerro</i> ”; Lionnet 1978:66); Ópata: <i>tepe téve</i> (“earth”; Stubbs 2011: no. 757)
<i>*Teso</i>	Cave	Nahuatl: <i>osto</i> ; Cora: <i>tastaa</i> (from <i>*teso-taa</i>); Yaqui: <i>teéso</i> ; Wariño: <i>tesó</i> ; Hopi: <i>tíiso</i> < <i>tíiusö</i> >
<i>*Tesoní</i>	<i>Tezontle</i>	Nahuatl: <i>teson-</i> ; Huichol: <i>texuni</i>

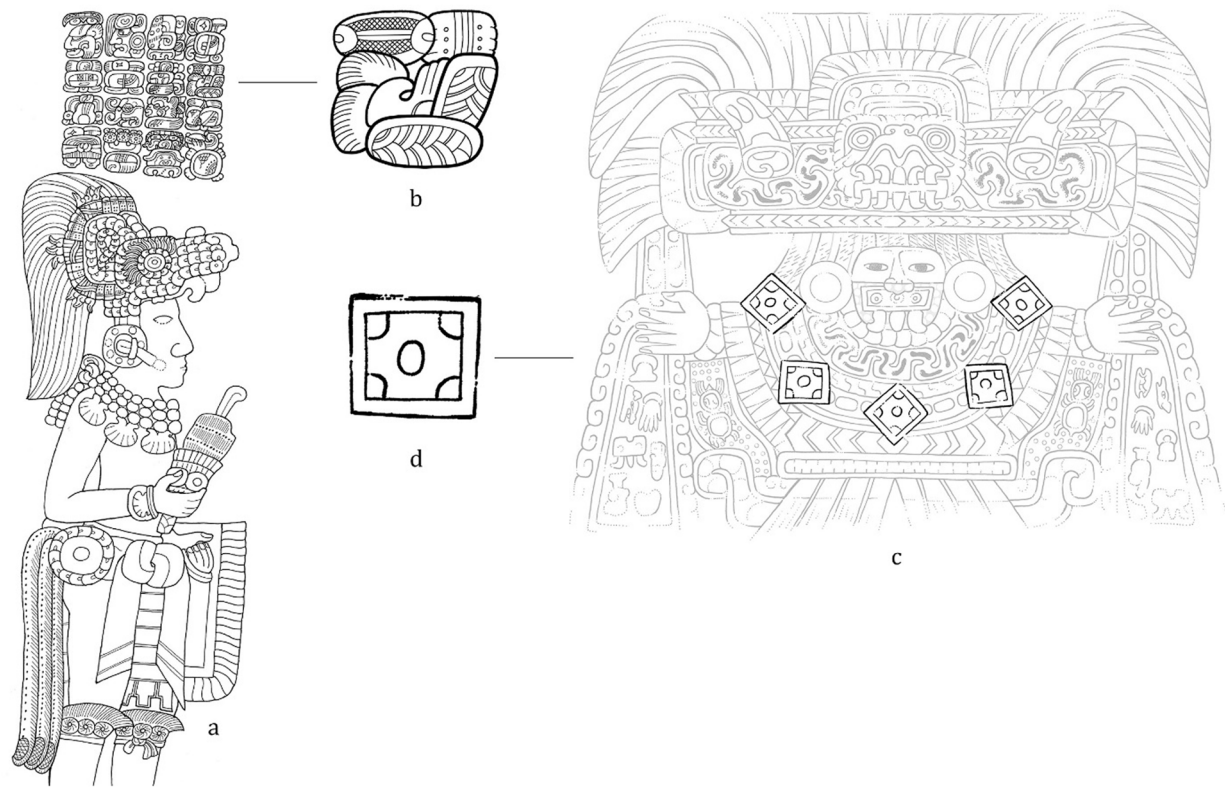


Figure 9. Correspondences to Classic Maya hieroglyphic writing. *a*, Left side of Stela 31, at Tikal (Guatemala), showing a foreign emissary in Teotihuacan attire (drawing by Linda Schele; © David Schele, courtesy of the Los Angeles County Museum of Art). *b*, Glyphic sequence **ko-sa-ka** and the woven mat throne in the glyphic text on the side of Stela 31. *c*, Detail of a Teotihuacan mural showing a glyphic compound dominated by a funerary bundle, dressed in opulent attire, including a necklace decorated with quincross glyphs (*d*), for which we propose the logographic value **KOSA**.

This reconstruction fits the attested lexeme on Tikal Stela 31 perfectly and shows that this is a term of considerable antiquity, possibly serving as part of a poetic pairing when juxtaposed with the woven mat throne (Helmke 2023:41–44). In this and other contexts, the poetic pairing thereby combines a reference to “jewel” and “throne” to yield a metaphor for royal authority. It is significant that the etymology of **koosa-ka* builds on the root **koosa*, which both can be reconstructed to mean “yellow” and also appears in reflexes for “rainbow.” The original reference to the iridescent appearance of mother-of-pearl seems to be the origin for both “yellow” (*koostik*) and “rainbow” (*koo-samalotl*) in Nahuatl (table 4).

This same conceptual overlap is found in the imagery of Teotihuacan, not least since the very emissaries represented on the side of Stela 31 precisely wear necklaces of seashells. Furthermore, in the murals of Portico 11 at Tetitla that are typically described as representing “the Great Goddess” (see Berlo 1992; Paulinyi 2006) but are now thought to represent a glyphic

compound dominated by a masked and elaborately attired mortuary bundle (Ruiz Gallut 2003:74–80, 174–184), the figures wear a series of necklaces qualified by five square glyphic signs (fig. 9c). The constituent signs are referred to as “quincross” signs in the Teotihuacan literature (Langley 1986:23, 2002:301). These are identical to the logogram for “yellow” as used in other Mesoamerican writing systems (Worm Danbo 2019:141–144), and at Teotihuacan they function to qualify one of the aspects of the Teotihuacan Storm God that is tied to the cardinal direction associated with that color (Langley 1992:249–253; Wrem Andersen and Helmke 2013:177–189, fig. 10f). In this context, the logogram can be attributed the value of **KOSA** and read as *koosa* (“yellow,” “nacreous”) or *koosa[ka]* (“necklace”)—in the first case qualifying the necklace by its material or color and in the other serving as a phonetic cue for “necklace.” The Nahuatl word for necklace (*kooskatl*) seems derived from the adjectival root *koosa* with the nominal derivational suffix *-ka* (see Dakin 2004). A cohesive picture thereby emerges from the

Table 3. Protoform, gloss, language, and attested form

Protoform	Gloss	Language and attested form
<i>*Koosa-ka</i>	Shell, bead, necklace	Nahuatl: <i>koska-</i> ; Huichol: <i>kúka</i> (“ <i>chaquira</i> ,” “ <i>cuello de chaquira</i> ”); Yaqui: <i>koóka</i> (“necklace”)

Table 4. Protoform, gloss, language, and attested form

Protoform	Gloss	Language and attested form
* <i>Koosa</i>	Yellow, rainbow	Nahuatl: <i>koos-tik</i> ("yellow"), <i>koosa-maloo</i> ("rainbow"); Cora: <i>kú'usa'a</i> ("rainbow")

close integration of the glyphic evidence and the imagery and their overlap with these various lexical entries.

The other lexical item connected to Teotihuacan culture is the word for a shell-platelet helmet, the typical protective gear of warriors from the Central Mexican metropolis. Good examples of figures wearing these helmets are found on the sides of Tikal Stela 31 and also on a plano-impressed bowl found at Las Colinas, near Calpulalpan in Tlaxcala, that represents three high-standing warriors in a file behind another figure with a Tasseled Headdress, each labeled with their own glyphic caption (see Linné 1942: fig. 128; Millon 1988; Taube 2000:10–12, fig. 8; fig. 10a). A plano-relief sherd originally in the collection of Hasso von Winning shows one such helmet as part of an accession ceremony, where the headgear and a seashell necklace are handed over to the person who is acceding to the corresponding office (Nielsen and Helmke 2020:326, fig. 8d; von Winning 1981; fig. 10b). In Classic Maya inscriptions, references are made to these helmets, often as a complete logogram, sometimes suffixed by a phonetic complement, *-wa*, and at other times these are specifically named as *ko-o-ha-wa*, for *ko'haw* (see Nielsen and Helmke 2011:347–348). This has been interpreted in a variety of ways, either as a term related to the PN **k'a:-h* (Macri and Looper 2003:290–291)—and it should also be remarked that certain colonial entries for headgear build on the same root (Boot 2010:148; Dakin 1982:146, 188n)—or as building on a Mixe-Zoquean root involving **ko'*, for "items pertaining to the head" (Kaufman and Justeson 2008:57). The Nahuatl root for "head" (*k'aa-*) is reconstructed as coming from a PCN root, **kopa* (or **kipa*, where *i* becomes *o* before a labial consonant). In the development from **kopa* to *k'aa*, the medial *p* is weakened to *h* in the unstressed syllable, yielding **koha*. In later developments, the *h* fuses with the *a* to

make a long vowel, *aa*, and *o* becomes a labialization of the preceding *k*—developments that were already described by Edward Sapir (1915). So at some point in the development from PCN to PN, the word for "head" must have been **koha*. The final *w*, expressed as the syllabogram *wa* in the term used by the Maya for the helmet, corresponds perfectly with one of two PCN possessive suffixes. The suffix *-ya* or *-yi* describes inherent possession and is used with body parts (this gives the Nahuatl word for "head," *k'aa-yi-tl*), and the *-wa* suffix describes alienable possession and is used in possessive constructions. Consequently, the word **koha-wa* in PCN would have had the meaning "alienably possessed head" or "removable head"—a good fit for the meaning of a large helmet.

Conclusions

In this article, we have proposed that some logograms of Teotihuacan writing can be read by using values from a reconstructed protolanguage ancestral to Cora, Huichol, and Nahuatl and identifying the use of the rebus principle to prompt phonetic readings. We have proposed readings for a selection of logograms, including **NAKA** ("ear," "nopal"), **KO** ("basin," "hole," locative suffix), **NAWA** ("root," locative suffix), **TE** (used in the words for "stone," "mountain," and "cave," all of which begin with the syllable */te/* in PCN), and **KOSA** ("yellow," "nacreous," "necklace"). We have also proposed that the two words *kosaka* and *ko'haw* recorded in Maya writing in Teotihuacan-related contexts can also be analyzed as lexical items in the PCN language. We do have other potential readings of logograms and refer the interested reader to the appendix and to future work in which we plan to describe some of these readings in further detail.



Figure 10. Teotihuacan-style shell-platelet helmet referred to as a *ko'haw*. a, Two Teotihuacan warriors with shell-platelet helmets (bold) separated by a nomino-titular glyph; detail of the Las Colinas bowl. b, Presentation of the helmet at an accession ceremony (after von Winning 1981: fig. 5b).

This is by no means a full decipherment of the writing of Teotihuacan, but it provides a strong lead for continuing work using this method and drawing on this candidate language. Two techniques have proved useful: One is identifying logograms with their potential meanings in the writing and looking for their possible readings in the reconstructed PCN vocabulary. The other is to consider homophonous roots in the reconstructed lexicon and see whether these words could be represented as logograms in the writing in ways that suggest that rebus is at play.

Although new in its substance, the argument is not without prior foundations. Its underlying thrust has been proposed by many others before: that the language of Teotihuacan was likely related to Nahuatl. The readings proposed herein are thereby not incompatible with other proposals made by King and Gómez Chávez (2004) or Whittaker (2021:174–193). However, we show that the language in which motivated readings can be proposed is not Nahuatl as it is known from the colonial sources, but a language that is substantially older, by approximately a millennium. Logograms such as those for “ear”/“nopal” or that for “cave” cannot be read using values from colonial Nahuatl or even PN as reconstructed by Dakin (1982)—but using only an even older variety, from a time when it was much more similar to the other SUA languages, Cora, Huichol, Yaqui-Mayo, Tubar, Tepehuán, and Ópata.

We believe that several elements of our proposal make it stronger than previous similar proposals. First, all of our phonetic readings are motivated by corroborating elements outside of the semantic content of the logogram itself, through (1) the identification of the rebus principle, in which a logogram stands for something other than what it depicts (**NAKA**, **KOSA**, **NAWA**, **KO**); (2) the use of phonetic complementation that works only in the candidate language (**TE** series), (3) reading the words written in another script with known phonetic values (**KOSA**), and/or (4) corroborations of the expected parts of speech. Second, the candidate language has the appropriate time depth and has been systematically reconstructed, independently of the process of decipherment, so that candidate words are not reconstructed on an ad hoc basis to fit the proposed readings. Third, there are not only nominal roots among our readings, but also other parts of speech, such as verbs and examples of postpositional suffixes that are combined in a way that is grammatically correct in the candidate language.

We also show significant continuities from Teotihuacan writing to later Epiclassic and eventually Aztec writing, both in terms of the principles and mechanisms (a focus on logograms, the use of rebus, and double spelling) of writing and also even in the phonetic readings of some logograms (the “stone” logogram with the value **TE**, the ceramic jar spelling of **KO**, and even the mountain sign read as **TEPE**). Interestingly, the logogram for the color yellow and for necklace is identical to other Mesoamerican logograms with the same meaning—but using a different phonetic value in each language. This confirms that certain signs were already shared by different Mesoamerican writing systems in the first centuries of the first

millennium, undoubtedly as shared retentions from ancestral writing systems (Helmke and Davletshin 2019; Houston 2004). This continuity of language and writing also suggests a significant ethnolinguistic continuity between the Teotihuacanos of the Classic and the subsequent Nahuatl peoples who inhabited the surrounding valleys in the Postclassic.

We should also remember that the proposal that speakers of UA were present at Teotihuacan from its earliest phases does not mean that there were not also speakers of other languages, including, perhaps, Totonac, Otomí-Mazahua, and, of course, Zapotec and Maya. As such, continued work will also have to address these other language groups and their interactions at Teotihuacan. Despite this diversity, it appears that the SUA peoples had a significant role in establishing and developing the great Mesoamerican city and that it was there, through the interaction with other Mesoamerican peoples, that the Nahuatl language took on its familiar shape and completed its adaptation to the Mesoamerican linguistic area.

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Comments

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Pharao Hansen and Helmke (P&H) hypothesize that the language of Teotihuacan and Teotihuacan writing can be identified as ancestral to Nahuatl, Cora, and Huichol. Their proposal is interesting. I will try to explain why it is unconvincing.

Insufficient attention is paid to the other proposals for the ethnolinguistic identity of Teotihuacan. P&H say, “The only way to identify such a language would be to find it encoded in written form at Teotihuacan.” However, evidence can also come from loanwords, geography, semantic content, and ethnohistory.

Ethnohistorical accounts say that Totonacs built Teotihuacan. Totonac loanwords in other Mesoamerican languages lend support (Campbell 2024; Justeson et al. 1985; Kaufman 2003, 2020). Cholan and Yucatecan borrowed the Totonac *pu* (*k*)*sik’al* (“heart,” “soul”; *pu*- [locative] + *siku?lan* [“holy”]), reflecting the sacrificial cutting out of hearts, documented in Classic El Tajín, the Totonac capital. Nahuatl borrowed

numerous Totonac words—for example, “medicine,” “cure,” “gourd bowl,” “dish, plate,” “ceiba,” “avocado species,” “cork tree,” “harvest,” “chicle,” “fish species,” *-tsi:n* (diminutive [reverential] suffix), and the phoneme /tl/. Kaufman (2003:23) argued that the Nahua verb syntax was restructured into a single word by contact with Totonac or Mixe-Zoquean.

There are problems with P&H’s interpretations of Teotihuacan writing: the difficulty of interpreting what the signs depict, speculation about both the form and meaning of signs, the small size of the corpus of signs—with “the seemingly haphazard juxtapositions of highly figurative elements”—and the infrequency of signs. Their “nopal” logographic interpretation relies on “the sole example of this glyphic compound.” On the basis of this image of what may be nopal pads attached to ears, they equate “ear,” “nopal,” and “meat.” They have **naká* (“nopal”) and **naká* (“ear”) for Proto-Southern-Uto-Aztec (PSUA). However, that homophony is not evident in Cora-Huichol and Nahua. They assume that Nahuatl shifted the meaning from “nopal” to “meat,” an unlikely semantic change. But these words do not match well phonologically, either. Nahua has *nakas-* (“ear”; compared with Huichol *naaká* and Cora *nasaiḥ* [“ear”]) but *naka* (“meat”; compared with Huichol *nakári* and Cora *naká* [“nopal”]). P&H assume that PSUA **naká* (“ear”) was extended in Proto-Corachol-Nahua (PCN) to **nakása* by addition of the unclear *-sa* and that the Proto-Cora “ear” added *-hi*, an undefined suffix, giving **nákasáhi* (“ear”; Cora *nasaiḥ*). These assumptions of ill-defined suffixes and strained semantic shifts leave this example unconvincing.

Basing readings of Teotihuacan logograms on reconstructed PCN words, P&H cite two words in Classic Maya inscriptions considered “as highly promising lexical items of Teotihuacan language.” One is spelled **ko-o-ha-wa**, interpreted as *ko’haw* (“helmet”). No such word exists in Mayan languages, although Classical Yucatec has several terms for “helmet.” They cite sixteenth-century Tzotzil *kovov* (“helmet”), although modern Tzotzil *kovov* means only “chin” and does not match *ko’haw* well phonetically. They speculate that *ko’haw* is borrowed from PCN **kopa* (or **kipa*; “head”), which becomes Proto-Nahua (PN) **kwa:-h*. However, the semantic change from “head” to “helmet” is strained, even a possessed helmet. Another problem is the alternative that they mention, that this could be from Mixe-Zoquean **ko’-*, for “items pertaining to the head.”

The other assumed Teotihuacan loan in Maya writing involves **ko-sa-ka** above a woven mat throne. This is similar to Nahuatl *ko:ska-tl* (“necklace”), as seen from PCN **koosa-ka* (comparing Nahua *ko:ska-* [“necklace”] and Huichol *kúka* [“bead”]), built on **koosa* (“yellow”), based on Nahuatl *koostik* (“yellow”; also *koosa-maloo-* [“rainbow”]) and Cora *ku’usa’a* (“rainbow”). However, it is not certain that **ko-sa-ka** referred to “necklace,” and there is a wide semantic gap between “necklace” (or “bead”) and “yellow” (or “rainbow”). Given the massive influence of Teotihuacan, if its language was based on PCN or some early version of Nahua, why are there no other loans from it in Classic Maya?

For the Teotihuacan “shallow basin” sign, P&H reconstruct PCN **ko* (“hollow”), hypothesizing “that the shallow basin sign may function as the logogram **KO**.” They say, “Words were derived designating containers of this form (*komitl* [‘jar,’ ‘olla’], *komalli* [‘griddle’]) . . . basin-shaped depressions (*komolli* [‘depression,’ ‘hollow’] and also *koyo:ni* [‘make a hole’]).” However, there is no word *ko*. Deriving it from words that have *ko* in them violates the principle of etymology that unexplained leftover pieces of words are not allowed. No explanation is offered for the leftover *ma* of *komalli*, *mo:* of *komo:lli*, or *yo* of *koyo:ni*, leaving the *ko* “hollow” interpretation in doubt. The *ko* in these words may just be part of the root.

P&H propose only a few readings of Teotihuacan signs. When and where were PCN and PN spoken? Kaufman argued in numerous publications that Nahua speakers did not arrive in Mesoamerica before 500 BCE, closer to the fall of Teotihuacan than to its rise. This roughly matches P&H’s dates, with two developments mostly in the Classic period (200–600 BCE; see appendix): (1) “Speakers of early Eastern dialect of PCN begin interactions with Mesoamericans. This initiates the breakup of Proto-Corachol-Nahua into an eastern and a Western group.” (2) “Speakers of Nahuatl . . . adopted all of the traits of the Mesoamerican Language [Linguistics] Area, and undergone all the linguistic changes that are shared by modern Nahuatl languages.”

P&H assert that PN “already bears all the signs of having become fully assimilated to the Mesoamerican linguistic area.” They say, “This implies that, for its grammatical profile to have become fully assimilated to its Mesoamerican neighbors, PN had coexisted with Mesoamerican languages for a considerable period of time, which the latecomer hypothesis hardly allows.” For the Teotihuacan hypothesis, it hardly matters when PN was Mesoamericanized if it did not arrive until well after the establishment of Teotihuacan.

There is abundant counterevidence to the claim that PN was fully “assimilated to the Mesoamerican linguistic area.” Nahua borrowed many ecology and cultural terms diagnostic of Mesoamerica not found in drier areas to the north—for example, “cacao,” “ceiba,” “cork tree,” “avocado species,” “fish species,” and so on. This suggests adaptation to Mesoamerica after arrival there, after the establishment of Teotihuacan. Kaufman (2003:7) observed that out of 3,000 roots in Huasteca Nahuatl, there are only about 400 Uto-Aztec etymologies. A great many are borrowed. Being a heavy borrower and not a significant donor of early loanwords is hardly expected of a descendant of the language of Teotihuacan.

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The proposals made by Pharaoh Hansen and Helmke in this article are tremendously consequential for studies of precolonial

Mesoamerica, epigraphic analyses, and improving understanding of one of the iconic early cities of world history, Teotihuacan. They will surely be debated in this comment section as well as in future publications, and as an archaeologist rather than a linguist or epigrapher, I will happily be along for that ride. The lingua franca spoken at Teotihuacan and the nature of the connections between the Teotihuacanos and the Aztecs of approximately a millennium later or to the major descendant communities of the region today, the Nahuas and Otomí (Hñāhñú), represent enduring puzzles for this early city and its once influential polity.

We have four major lines of reasoning to address the issues raised by this study: (1) historical linguistics and glottochronological reconstructions, (2) the epigraphy of Teotihuacano writing based on comparison to other contemporaneous and successor writing systems in Mesoamerica, (3) the analysis of patterns in material culture that elucidate culture contacts and migration, and (4) bioarchaeological approaches to migration, particularly bone-isotope analyses and archaeogenetic research. This study engages primarily with the first two, while my own familiarity is primarily with the second two. I would view skeptically any proposal for what the dominant language was at Teotihuacan that is not grounded in two or more of these lines of reasoning, and a full resolution of this topic likely requires combining insights from all four. The emphasis of the authors on identifying glyphic double spellings and homophones, backed by comparisons to other Mesoamerican writing systems and historical linguistics, seems like the most promising avenue for future decipherments. Material culture, outside of writing, and bone chemistry or ancient DNA do not correlate directly with language, but they help clarify the centuries of migration history that characterized Teotihuacan and made it a multiethnic, polyglot metropolis. I focus mainly on how they are congruent with what the authors propose.

Because of the wealth of narratives of ethnogenesis and migration dating to the sixteenth century, a major thread in scholarship on Central Mexico has focused on sorting out where to the west/northwest Aztlán might have been located and how these narratives relate to the cultural identities of the various peoples grouped under the problematic ethnonym Aztecs, derived from this homeland. It has sometimes inflected studies of Teotihuacan with the notion that Nahuatl speakers were late arrivals to Central Mexico, perhaps migrating during the Epiclassic period (650–900 CE) following the decline of the city, and has engendered a good deal of archaeological research comparing pottery and other elements of material culture between regions of West and Central Mexico. Nevertheless, close ties between these regions in these same exact forms of material culture immediately before Teotihuacan's takeoff (ca. 200–1 BCE) have been noted for almost a century (Noguera 1935). On the basis of material ties, archaeologists have argued for West Mexican migrants at the early rival city of Cuicuilco, within the Teotihuacan Valley at the same time in what are known as Tezoyuca settlements, and, for contacts going the other way, a colony of people from Cuicuilco to the

northwest in the state of Queretaro (Saint-Charles Zetina and Fenoglio Limón 2021:192–193). A second important form of research bias with regard to Teotihuacan's origins is that scholars outside Mexico have often prioritized comparisons of the more naturalistic and figurative styles of imagery made by early cultures of eastern Mesoamerica, such as the Olmec and Maya, over the more abstracted and stylized imagery made by contemporary cultures in central and western Mesoamerica, such as the Chupícuaro style horizon.

These strong linkages with West Mexican populations during the period that Teotihuacan coalesced into a major city continued throughout its apogee of occupation. They are apparent not only in artifact styles and mortuary patterns seen at Teotihuacan but also in the now relatively robust suite of bone-isotope analyses. These document West Mexican migrants not only in ethnic enclaves within the city but also having assimilated into districts that expressed a dominant Teotihuacano identity in their material culture (Buckley et al. 2021; Gómez Chávez and Gazzola 2021). Nevertheless, at any given point in its occupation, some 25% of Teotihuacan's population had likely been born somewhere else. Many would have spoken minority languages, and some, including Maya and Zapotec migrants, wrote in their own hieroglyphic systems. My point here is that migration from and sustained ties with West Mexican groups characterized Teotihuacan from the city's rise to its fall and would have created entanglements with the Proto-Corachol-Nahua homelands proposed by Pharao Hansen and Helmke. Furthermore, although the field of archaeogenetics is still emerging and we could characterize applications at Teotihuacan as being in their infancy, the authors of one study propose that the closest genetic ties are found between ancestral Teotihuacanos and contemporary Nahua and Otomí populations (Álvarez-Sandoval et al. 2015). Again, neither genes nor material culture equates directly with language, and migration during and after Teotihuacan was common. But these lines of evidence provide other data points that are congruent with a model of Proto-Nahuas at Classic period Teotihuacan, which would have undoubtedly also had ancestral Otomame peoples given their deep history in the region.

As one closing observation, over decades of coming to the Teotihuacan Valley, I am struck by how, to my knowledge, none of the surrounding toponyms for towns, mountains, or other landscape features are in any language other than Nahuatl and Spanish. To my nonlinguist mind, if the dominant language of the Classic period city were not within a Proto-Nahua family, would one not expect some vestigial holdovers? While it is well documented that calques were common between Nahuatl and Otomí terms during the Colonial period (Wright-Carr 2015), as well as in Teotihuacano writing itself (Helmke 2023), the complete overwriting of the dominant language on the landscape of the most influential polity in a region for more than five centuries seems unusual for any world region—another possible data point. In any event, I congratulate the authors for their very provocative insights and look forward to the dialogue and future decipherments to follow.

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The people of Teotihuacan, along with Preclassic Olmecs and Post-classic Aztecs, shaped Mesoamerica as a cultural and linguistic area. The semantic decipherment of Teotihuacan writing has seen significant progress in the past three decades, mostly due to pictorial comparisons to other Mesoamerican scripts (see Helmke and Nielsen 2021; Stuart 2024; Taube 2000). Nevertheless, some basic questions remain unanswered: it is unknown whether the reading order is predominantly top to bottom, bottom to top, or free and whether Teotihuacan spellings are prone to abbreviation; it is also not known what the underlying language is. Magnus Pharaon Hansen and Christophe Helmke propose that the language of Teotihuacan writing is Proto-Corachol-Nahua, implementing this hypothesis with epigraphic data. I wholeheartedly welcome the idea because a language spoken almost 2,000 years ago should be significantly different from its descendants today. Nevertheless, I want to draw attention to some issues related to Pharaon Hansen and Helmke's interpretations.

While defending his decipherment of Maya writing, Yuri Knorozov (1956) formulated the only known method allowing us to verify reading proposals for undeciphered writing systems. It can be defined as follows: the value of a sign can be considered as proven if and only if it is supported by three or more independent contexts (Davletshin 2022). This is due to the fact that any proposal based on one example can be the subject of alternative interpretations, but erroneous reading values cannot hold in different contexts. In this respect, it is important to observe that none of the reading values suggested in the paper are attested in more than one independent context and that equally reliable phonetic readings for the day signs in the appendix can be provided in any language of Mesoamerica and in most languages of the world. The interpretation of the "basin" and "roots" signs as locative markers is not as promising as it may appear at first sight because many languages, including Classical Nahuatl, use several dozen place-name formatives (Dyckerhoff and Prem 1990) and because it is unclear whether the signs under discussion spell suffixes or prefixes.

In all writing systems, combinations of two or more signs are written apart, at least in some examples; meanwhile, phonetic complements are sometimes absent in synonymous spellings. In the paper, a unique example of a female face adorned with *Opuntia* earplugs (fig. 4c) is considered a ligature of two signs—a "female head" sign and an "*Opuntia*" sign, although nothing in the design supports this graphic segmentation. The signs "mountain" and "cave" are assumed to be phonetically complemented by the "stone" sign, although this is never written separately (fig. 8b). A straightforward interpretation is that the "stone" design indicates the material of the depicted objects, as it does in Aztec, Maya, and Mixtec writing systems. For example, the Maya signs **TUN** ("stone"), **WITZ** ("moun-

tain"), and **TOK'** ("flint") include a "stone" graphic element but share nothing in their phonetic reading values. The proposal that a necklace worn by a supernatural being conveys phonetic information (fig. 9c) is similarly problematic.

The authors compare the "quincross" design to the Maya word sign **K'AN** ("yellow") and consider it to depict shells. A similar quincross design is also attested in several Aztec and Maya signs depicting shiny objects such as (Aztec) **CHALCHIW** ("jade"), **TONAL** ("sun"), and **XIW** ("turquoise") and (Maya) **EK'** ("star"), **K'IN** ("sun"), and so on. They assume that the "shallow basin" design depicts a kind of ceramic container. A similar design is found in Aztec, Epiclassic, Mixtec, and Zapotec texts, where it functions as a locative marker and occasionally forms a part of the "reed" sign (Helmke and Nielsen 2023:58, 65). The Aztec cognate sign reads both **A** ("water") and **APAN** ("[place of] water canal"; cf. Whittaker 2021:104–105). The interpretation of the Teotihuacan sign as "water reservoir" is suggestive, also because the reed grows in water.

Pharaon Hansen and Helmke accept the widely held assumption that Aztec hieroglyphs are descendants of Teotihuacan writing, which I want to call into question. Apart from the fact that both writing systems are pictorial, I can see only one specific match among Teotihuacan, Aztec, and also Mixtec writing systems, which is the Rain God sign showing goggles and insect mandibles. This match may well be due to the shared iconographic repertoire. Even basic numerals are written differently in both systems—as bars and dots in Teotihuacan and as dots by the Aztecs (Davletshin and Lacadena 2019).

Pharaon Hansen and Helmke state that word-signs primarily bear semantic information and that a purely logographic system could be understood regardless of people's linguistic background. To the best of my knowledge, no deciphered writing system lacks phonetic signs in its inventory (Civil 2013). Word-signs encode specific lexemes, and consequently, a text written only with word-signs cannot be understood by speakers of several languages, as semantic structures of lexical meanings and syntax differ dramatically from one language to another. Open-syllable phonetic signs will undoubtedly be found when Teotihuacan writing is deciphered.

Lexico-statistical estimations give no support for Proto-Corachol-Nahua (Miller 1984) and imply that Corachol and Nahua separated more than 4,000 years ago. Pharaon Hansen and Helmke question the validity of lexico-statistics, but Bayesian methods (Greenhill et al. 2023:91, 94) give weak support for this subgroup, too (probability of 0.65, with values of about 0.80 considered well supported). Four phonological innovations postulated for Proto-Corachol-Nahua are problematic because of their different reflexes in two branches and their recurrent attestation in the world's languages. Pharaon Hansen (2022) presented some specific lexical and grammatical matches among the Cora, Huichol, and Nahua languages, although these were not shown to be innovations replacing the corresponding Proto-Uto-Aztecan items. These matches suggest that the Corachol-Nahua subgroup is valid, but a

well-argued reconstruction of Proto-Corachol-Nahua vocabulary based on regular sound correspondences will take us a tremendous amount of work. I doubt that **naka* (“meat”) can originate from “ear”; it may be related to the word for “mountain sheep” in Numic languages (K. Hill 2011). Intriguingly, the presented distribution of the words for “prickly pear cactus” speaks against the Corachol-Nahua subgroup because Nahua languages preserve the Proto-Uto-Aztecan root **naput* in **nooch-tli* (“opuntia fruits”) and **nohpal-li* (“opuntia plant”); meanwhile, Cora, Huichol, Tepehuano, and Tubar share the lexical innovation **naka*.

The little that is known about the language of Teotihuacan comes from Maya texts commissioned by Teotihuacanos in Tikal—in particular from their personal names, written with syllabic signs. These names show both glottalized and plain consonants syllable initially, which is suggestive of Proto-Otomíán (Davletshin 2024). Glottalized consonants have never been reconstructed for Proto-Uto-Aztecan, Proto-Corachol-Nahua, or Proto-Nahua. Teotihuacan names are recorded in both Maya and Teotihuacan writing on Tikal Stela 31, and thus, the Uto-Aztecan affiliation of the Teotihuacan language will remain contentious until these glottalized consonants have been explained. In summary, the proposal under discussion is interesting, but it does not receive support from epigraphic data, and it contradicts the phonetic spellings of Teotihuacan names in Maya texts.

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Pharao Hansen and Helmke’s paper takes the debate on the Teotihuacan writing system to a new level by attempting to apply the correct historical stage of an Uto-Aztecan language, using independently reconstructed terms of Proto-Corachol-Nahua (PCN) or an early form of Proto-Nahua. The possible identification of rebuses or “double spellings” is also an important step forward in demonstrating that the glottographic records of Teotihuacan were based on such a language. Most of their proposals seem convincing, such as the reading of the “quincunx” sign as **KOSA**, for **koosa* (“yellow,” “nacreous,” “jewel”) and **koosaka* (“necklace”)—the latter a reconstructed term that fits perfectly with the Maya phonetic record on Tikal Stela 31—or the reconstructed term **kóha-wa* (“removable head”) as the name of the Teotihuacan shell-platelet headdress mentioned in various Maya inscriptions. Equally persuasive are the proposed reading **NAWA** for the “twisted root” sign and the interpretation of a Tetitla mural as the “double spelling” **NAKA-NAKA**, based on the near homonymy between the PCN terms for “ear” and “nopal.”

Other proposals raise some questions, at least as far as some of the details are concerned. If the **TE** reading for the lunated

crenellations/polylobate shapes seen in mountains and caves seems sound, I am less convinced by their equation with the triangular serrations, which the authors claim to be the original form of the sign. Indeed, I see no clear evidence to support this chronological primacy of the triangular serrations, and I cannot recall any depictions of mountains or caves where the serrations are not paired with polylobate shapes—the only contexts where the two motifs are not paired being the curved obsidian blades. This very specific occurrence, together with the fact that the serrations may be iconic representations of a flaked surface, as well as their consistent use in the Nahuatl writing system as the logogram **ITZ** (for *itz-tli* [“obsidian”], an alternative sign being the curved shape of a blade), suggests that they may have already had a similar specific function at Teotihuacan, meaning “obsidian” rather than a more general “stone.” As such, they may have been used both as iconic markers (as in the curved blades) and as glyphic qualifiers in toponymic compounds recording names such as “Obsidian Mountain” or “Obsidian Cave.”

In other cases, one perceives an indeterminacy about which parts of an image are to be read, a challenge we often face when searching for written texts in the Teotihuacan visual corpus since Teotihuacan scribes had a clear preference for large and visually “excessive” logograms, akin to Maya full-figure glyphs (Houston 2021; Houston and Stauder 2020), often presented in a deceptively “mimetic” or “emblematic” manner that makes them resemble purely iconographic representations (Domenici 2017, 2023; Taube 2000, 2011). Moreover, they are often inserted in larger iconographic compositions, creating complex multimodal assemblages in which text and image merge seamlessly. An experienced Teotihuacan reader would have appreciated such artful and semantically dense compositions, but our inexperienced eyes struggle to perceive the salience of the writing signs and thus to separate them from the imagery in which they are embedded. In one of the discussed examples of the use of the “twisted root” sign (Zona 5A, Portico 3, Mural 2), for example, the authors omitted from their drawing the “polylobate mountain” signs that alternate with the twisted root (Miller 1973: figs. 114, 115). It is difficult to say what the inner circular qualifier means (a *chalchihuitl*?), but I still think that the mountain sign should be read and that the conjoined signs could be interpreted as **?-TEPE-NAWA**, possibly a toponymic context for the adjacent mythological scene (cf. the current Nahuatl toponym San Juan Tepenahuac and the personal name <Tepenahuacatl>; *Matrícula de Huexotzinco* 1560: 486v, 648v, 733v). A similar case concerns the proposed reading of the “armed owl” as **TEKO-YAWI** (“warlord”) since it overlooks the fact that in Teotihuacan the glyphic compound almost invariably includes a “hand” sign (sometimes depicted as the bird’s hand but more often as a disembodied hand), which clearly needs to be considered. I cannot see how a **MA** (from PCN **ma* [“hand”]) reading for the hand glyph would fit with the **TEKO-YAWI** proposal.

The extensive usage of logograms also poses a challenge to understanding what a sign represents because it requires a

profound knowledge of the broader visual culture shared by the original interpretive community (Martin 2006). For example, the persuasive reading of the “shallow basin” as the locative/temporal suffix *-ko* is based in part on its identification as a ceramic bowl, a dubious interpretation since no Teotihuacan pottery type exhibits the “curled” rim that is typical of the shallow basin. Rather, the sign may represent an earthen matrix or cavity, as suggested by the similar shape of the openings in mountains and matrixes of water bodies (sometimes equipped with the fangs of the earth’s mouth) and as depicted in Late Postclassic and Early Colonial codices (e.g., Codex Cospi 3, 6; Codex Laud 15; Vaticanus B 6, 9; Codex Nuttall 16, 18, 19, 20, 22, 23; Codex Mendoza 25r <Atlatlahucan>—significantly often used in Nahuatl script as locative markers (APAN). Such an interpretation, which would also explain the use of the same inverted sign as the upper “lip” of the Storm God or as the basal cave in the famous Tepantitla mural, is not at all in contrast with the *-ko* reading since the original Proto-Uto-Aztecan (PUA) meaning of **ko* was “hollow” or “hole,” but it would induce more caution in establishing a direct genealogical “ceramic-related” relationship with the pottery olla (*komi-tl*) used as the phonogram *ko* in Nahuatl writing.

Recent advances in semantic decipherments that led to the identification of toponyms, titles, anthroponyms, and calendrical notations have made it clear that the Teotihuacan script was at the origin of a long Central Mexican writing tradition that, through the mediation of Epiclassic and Early Postclassic manifestations, culminated in the Late Postclassic and Early Colonial Nahuatl writing system (Domenici 2017, 2023; Helmke and Nielsen 2011, 2021, 2023; Helmke, Nielsen, and Rivera Guzmán 2019; Taube 2000, 2011). The strong formal continuity seen in this tradition also suggests a parallel linguistic continuity within the Southern branch of the Uto-Aztecan family, a scenario that fits with Pharaoh Hansen and Helmke’s proposal, whose analysis of linguistic change also accounts for some discontinuities. This is the case, for example, with the transformation of PUA **nawa* (“root”) into Nahuatl *nelwa*, a change that may have required sixteenth-century scribes to devise different rebuses to record the *-nawa-k* suffix using a speech scroll (*nawa-tl* [“speech”]) or four strokes (*nawi* [“four”]).

The article by Pharaoh Hansen and Helmke represents an important advance toward the identification of the (main) language(s) recorded by the Teotihuacan script, even if the question cannot be said to be completely resolved. Curiously, Mayan phonetic transcriptions of Teotihuacan names on Tikal Stela 31 seem to offer arguments in favor of both an Uto-Aztecan language (see the discussion of **koosaka*) and an Otomanguean one (Davletshin 2024). Debates will certainly continue on this aspect, as well as on other key issues such as the nature of the sociopolitical messages conveyed by Teotihuacan texts; there is no doubt, however, that Pharaoh Hansen and Helmke’s article will become an inevitable reference in any future discussion of the fascinating Teotihuacan script.

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While the purpose of Pharaoh Hansen and Helmke’s paper is to establish that Teotihuacan hieroglyphs were written in an ancestral Uto-Aztecan language, the implications of this essay engage long-standing and contentious debates that have characterized Teotihuacan scholarship. In so doing, their contribution goes beyond linguistics to suggest the most productive trajectories of future research on the city. Teotihuacan has long suffered from perceptions that it was a unique entity, oddly separated from the cultural and political traditions of the rest of Mesoamerica. By identifying the language as one related to later Nahuatl, Cora, and Huichol, the authors establish that the city profoundly participated in Mesoamerica, thereby rejecting the exceptionalism with which it has sometimes been viewed, even as its sheer size and international reach reveal its immense impact.

Many scholars (Kubler 1967; Millon 1992; Pasztory 1997) have argued against using later Aztec art and ritual to inform their interpretations, as they rejected Edward Seler’s (1915) direct identification of Teotihuacan motifs with Aztec terminology. Yet with Pharaoh Hansen and Helmke’s convincing suggestion of linguistic ancestral relationships, arguments like the ones that trace the origins of Tenochtitlan’s New Fire Ceremony to Teotihuacan’s Sun Pyramid seem all the more plausible (Fash, Tokovinine, and Fash 2009; von Winning 1979). Similarly, the use of Aztec rituals to interpret events depicted in Teotihuacan murals and the suggestion that sociopolitical groups like Mexica military orders existed in an earlier form at Teotihuacan are ever more likely, as the linguistic heritage that this essay presents justifies cultural and social continuities as well (Headrick 2007; Millon 1988).

One of the more contentious issues ensuing from this legacy of disavowing Teotihuacan’s participation in greater Mesoamerican practices—and, in particular, its legacy in the later periods of Central Mexico—concerns whether Teotihuacan was a city where power was ever invested in individual leaders (Carballo 2020; Pasztory 1997). While the multiethnic nature of its population has long been recognized, there has been a troubling inclination to view Teotihuacan as a utopian collective that developed without the guidance or control of one particular group. Pharaoh Hansen and Helmke recognize that the logographic qualities of many Teotihuacan glyphs allowed for legibility by speakers of various languages, but they unequivocally argue that the use of logograms for their phonetic value to cue a word with a different meaning indicates that Teotihuacanos wrote in a specific language. Many of their hieroglyphic examples are in public or semipublic locations, and a logical extension is that there was a particular language used by the elites who shaped the trajectory of the city, especially because the authors establish that Uto-Aztecan speakers were early inhabitants of the city. In other words, people

with a unified linguistic identity founded and directed the city, and governance was not built solely on a concept of cooperative diversity.

To address whether persons from this Uto-Aztecan-speaking group rose to wield individual power as leaders, the proposed reading for the long-debated Spearthrower Owl hieroglyph as *teko-yawi* (“warlord”) is of critical importance. The term “warlord” does not indicate a personal name, but in an earlier publication, one of the authors (Nielsen and Helmke 2008) acknowledged hieroglyphic data from the Maya region where Spearthrower Owl emerges as a historic ruler from Teotihuacan. They went on to propose that Spearthrower Owl may have been the name of a place or deity that was adopted as a personal name of a ruler at Teotihuacan. In crafting this argument, comparisons were made to the Aztec deity of Huitzilopochtli, who functioned as a war god, but they also noted that some Aztec leaders had names that were variations of Huitzilopochtli. In a recent book, David Stuart (2024) assembles years of extensive research on the historic figure of Spearthrower Owl and his interactions with the Maya world. Stuart resoundingly asserts that Spearthrower Owl was a Teotihuacan ruler and that his name was quite bellicose, akin to the *teko-yawi* proposed for the Teotihuacan hieroglyph. With the newly proposed reading for the Teotihuacan version, it will be interesting to see how the two writing systems specifically recorded the name of this historic individual, whether there were variations to account for their different languages, and whether scholars will continue to deny that such powerful people existed at Teotihuacan.

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This important paper by Pharao Hansen and Helmke seeks to answer two long-standing questions: What language did the Teotihuacanos speak? And how can we prove it? Although earlier scholars (e.g., Barthel 1987) had speculated that the Teotihuacanos spoke an early form of Nahuatl, they could not prove it. Pharao Hansen and Helmke’s new data (both linguistic and hieroglyphic) are particularly welcome because they show (1) that Teotihuacanos at AD 200–600 were speaking a language immediately ancestral to three Uto-Aztecan languages (Nahuatl, Cora, and Huichol) and (2) that Teotihuacanos were using logograms (word signs) whose sound values (logophoneticism) were the same as those used by the Aztecs a millennium later.

The attribution of phoneticism to the Teotihuacan writing system is a significant development because even the phoneticism of the Aztecs at AD 1520–1580 has been questioned. Although several scholars (e.g., Aubin 1849; Barlow and McAfee 1949; Lacadena 2008; Nicholson 1973; Zender 2008b)

had shown that some Aztec hieroglyphs were used for their sound value, they expressed uncertainty about how much of the phoneticism in Aztec writing was prehispanic and how much was due to the influence of the Spaniards.

In this paper, Pharao Hansen and Helmke make a solid case for continuity from Teotihuacan writing to Aztec writing by showing that both emphasize logograms and the rebus principle and have the same phonetic readings of some logograms (e.g., the “stone” logogram with the value **TE**, the “ceramic jar” spelling **KO**, and the “mountain sign” read as **TEPE**). Given that Pharao Hansen and Helmke have demonstrated Teotihuacan’s use of phoneticism, it seems more likely (1) that later Central Mexican writing systems (e.g., at Xochicalco, Cacaxtla, and Tula) also made use of phoneticism (Helmke and Nielsen 2023; Hirth 1989; Sáenz 1961, 1968), (2) that later (Epiclassic) central highland systems constituted the bridge from Teotihuacan’s writing tradition to that of the Aztecs, and (3) that most of the Aztecs’ use of phoneticism was prehispanic. Although it is significant that the data in this article reinforce the premise of linguistic and scribal continuity from Teotihuacan to Aztec times, we should not underestimate the input of other highlanders in Hidalgo, Tlaxcala, Oaxaca, and Morelos whose scribes postdated the Teotihuacan era but predated the Aztecs (Hirth 1989; Marcus 1992b, 2014, 2020; Smith and Berdan 2010).

Pharao Hansen and Helmke’s insights and new data require us to engage with underinvestigated topics. I can list some of them here: (1) Assessing the impact of foreigners residing at Teotihuacan, especially those (e.g., the Zapotec and Maya) who came from areas that had long traditions of writing before they relocated to Teotihuacan (Marcus 2020; Millon 1988; Millon 1992; Rattray 1993; Spence 1992). (2) Determining the subject matter of Teotihuacan’s writing, its context, and its function. (On the basis of the earlier highland Mexican scribal traditions, such as that of the Zapotec, we would expect the Teotihuacanos to have been using their writing to serve as captions to label the people and events depicted; Barthel 1982, 1987; Domenici 2023; Marcus 2020.) (3) Explaining why long hieroglyphic texts were not present at Teotihuacan. This striking lack of long hieroglyphic texts at Teotihuacan contrasts with the use of writing in Oaxaca, Veracruz, Tabasco, Chiapas, and Guatemala. (4) Discussing why Teotihuacan adopted writing later than other highland societies and chose to use it in few contexts, primarily on walls or floors. Teotihuacan’s limited use of writing is intriguing and perhaps unexpected by those scholars who had the same expectations as V. Gordon Childe (1950)—that is, that one of the hallmarks of civilization is writing. In Childe’s era, little was known about the South American states. Now we know that writing was not essential for the administration of huge cities and expansionist states; for example, the Moche, Tiwanaku, Wari, Chimú, and Inca of South America were highly effective without writing. (5) Can Pharao Hansen and Helmke’s methods advance the decipherment of Isthmian and other undeciphered Mesoamerican writing systems? Future efforts at decipherment will probably return to the Epiclassic (Helmke and Nielsen 2023) and to the

two longest Isthmian texts (carved between AD 156 and 162), which appear on (1) the Tuxtla Statuette and (2) Stela 1 from La Mojarra, Veracruz (e.g., Holmes 1907; Houston and Coe 2003; Macri and Stark 1993; Méluzin 1992; Winfield Capitaine 1988). (6) The striking contrast between Maya hieroglyphic writing and Teotihuacan writing. Given how reliant our own society is on writing and texts, it is difficult for us to understand its limited use at Teotihuacan.

Over the past few decades, much attention has been focused on the Maya as researchers moved from “semantic decipherment” to “phonetic decipherment,” but now Pharo Hansen and Helmke have turned klieg lights on the writing systems of Central Mexico.

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The unknown nature of the Teotihuacan language represents a fundamental challenge to fully understanding one of the most influential civilizations in Mesoamerica. Unlike the Maya or Zapotecs, whose writing systems have been partially deciphered thanks to codices and extensive texts, Teotihuacan left no decipherable written records. The symbols and glyphs found on murals, ceramics, and monuments are scarce and ambiguous and lack narrative context, suggesting that their writing system—if it existed—may have been limited in scope or reserved for specific uses such as rituals, administrative records, or markers of group identity.

The article presents an innovative attempt to link Teotihuacan logograms to a Proto-Uto-Aztecan (PUA) language ancestral to Cora, Huichol, and Nahuatl using the rebus principle. However, while the proposal is bold and potentially groundbreaking in reviving the debate on the possible presence of Nahuatl speakers in Teotihuacan and their role in spreading Uto-Aztecan influence, it overlooks alternative hypotheses regarding Teotihuacan’s linguistic affiliation. For instance, potential ties to Totonac (a non-Uto-Aztecan language), as suggested by iconographic similarities, or the presence of Otomanguean groups (such as Otomí or Mazahua), whose languages have deeper roots in the region, is not addressed.

The premise assumes that Teotihuacan was inhabited by speakers of a PUA language. While this hypothesis has circulated in academic circles, it still lacks sufficient interdisciplinary support. Compounding this issue is the absence of bilingual inscriptions, unambiguous lexical borrowings in neighboring languages, or genetic evidence linking Teotihuacanos to early Uto-Aztecan groups. The proposed methodology is ambitious: using reconstructed Proto-Nahuatl vocabulary to phonetically decipher Teotihuacan glyphs through the

rebus principle and phonetic complementation. However, significant challenges must be overcome to establish a reliable and accurate framework, particularly given the assumption that the underlying language is PUA.

By applying Proto-Nahuatl reconstructions to assign phonetic values to logograms via the rebus principle, other linguistic possibilities are dismissed. For example, assigning the value /te/ to the logogram for “mountain” because Proto-Nahuatl uses *tepetl* ignores the fact that if the actual language were Otomí (where “mountain” is *nzā*), the interpretation would be invalid. The use of reconstructed PUA forms to decipher Teotihuacan glyphs introduces methodological issues inherent to historical linguistics, especially since PUA reconstructions are theoretical models based on languages documented centuries later. Projecting these forms onto images from 1,500 years ago risks disregarding dialectal variations, linguistic innovations, or cultural borrowings that may have altered the original lexicon.

Furthermore, the chronological mismatch poses a problem. While PUA is dated to the first millennium BCE, its connection to Teotihuacan’s zenith (first to seventh centuries CE) is problematic. How can a language in its early phase be linked to a city in decline by the seventh century? The timeline suggests that any connection, if it existed, would likely have been marginal or late.

The rebus principle also requires knowledge of the underlying language to identify homophones. In this case, with the language unknown, its application remains experimental and lacks verifiable equivalents. Proposed readings (e.g., **NAKA** for “ear/prickly pear”) require broader discussion and additional evidence. Similarly, assigning the phonetic value /ko/ to a glyph depicting a “basin/hole” (based on Proto-Nahuatl *ko-*) overlooks the possibility that symbols could have ritual, ideographic, or even numeric meanings unrelated to phonetics.

The hypothesis that Maya words like *kosaka* or *ko’haw* are PUA loanwords is intriguing. However, it is essential to clarify how and why Classical Maya would have adopted PUA terms, especially considering that later Aztec Nahuatl borrowed more from Maya than vice versa. Exploring alternatives, such as loans from Zoque or Mixe languages—with whom the Maya had early contact—would also be valuable.

The article undoubtedly reflects a commendable effort to revitalize the debate on the Teotihuacan language and its potential writing system. It emphasizes the urgent need to integrate genetic, archaeological, and ethnohistorical evidence while exploring other linguistic affiliations, such as Otomanguean, Totonac-Tepehua, or even extinct languages.

Until a Mesoamerican equivalent of the Rosetta stone—a bilingual text linking Teotihuacan glyphs to a known language—is discovered, attempts at phonetic decipherment must develop interdisciplinary strategies and establish archaeological research agendas to gather complementary evidence. Teotihuacan, in its linguistic silence, continues to challenge us to rethink not only its legacy but also the limits of our tools for interpreting the past.

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18 XII 24

Can Archaeology Help Historical Linguistics?

This paper is an important contribution to long-standing debates about the language(s) of Teotihuacan. The authors' consideration of how graphic signs in the Teotihuacan murals correspond to Nahuatl concepts adds new support for Nahuatl (or Nahua) as a major language of Teotihuacan. But before we can claim to have a strong argument for the language of the city, the linguistic data need to be integrated with other types of available evidence.

Forty years ago, I argued that understanding the Aztlán migrations to Central Mexico required three types of evidence: linguistic, native history, and archaeology (Smith 1984). Later, Beekman and Christensen (2003) added bioarchaeology. Pharao Hansen and Helmke take on a related question—the language of Teotihuacan. I have no quibbles with their arguments, which look reasonable to an archaeologist. But achieving an adequate understanding of the language of Teotihuacan will require archaeology and bioarchaeology. Given that most authorities now accept a northern and likely late origin for Nahua in Central Mexico (Greenhill et al. 2023), research on this topic should include consideration of the demographic and social processes that brought Nahua immigrants to Central Mexico.

Can the arrival of Nahua speakers be documented archaeologically? For archaeologists working in Central Mexico, the migration event that has received the greatest attention centers on the users of the Coyotlatelco-style ceramics in the (post-Teotihuacan) Epiclassic period (ca. 650–900 CE). There is a long-running debate between two opposed models: local continuity versus new populations. Cowgill (2013) is probably the best summary; see also Beekman and Christensen (2003), Clayton (2016), Healan and Cobean (2019), and Ragsdale and Edgar (2018). Although I am on record as skeptical about most Mesoamerican migration accounts (Smith 2007), the evidence for the arrival of new groups in Central Mexico during the Epiclassic does appear to be strong.

These archaeological debates have been supplemented by a range of bioarchaeological analyses of skeletal remains. These paint a complex picture of Central Mexican biological populations, and some of the data have a bearing on dating the arrival of Nahua speakers. For example, biodistance measures based on both nonmetric cranial traits (Meza-Peñaloza, Zertuche, and Bautista-Martínez 2023) and dental dimensions (Beekman and Christensen 2003; Pacheco-Fores, Stojanowski, and Morehart 2023) indicate that Classic period Teotihuacan populations were genetically distinct from later Aztec (Nahuatl) populations. These results favor the new populations argument and its association with the arrival of Nahuatl speakers. If this interpretation is correct, it does not necessarily

deny the presence of Nahua at Teotihuacan, but it does weaken the authors' argument by suggesting contrary evidence that needs to be accommodated.

In comparison with long-standing debates over Coyotlatelco pottery and Epiclassic migrations, archaeologists have given less attention to potential migrations at the beginning of the Aztec period in the twelfth century CE. One of my observations in 1984 was that the start of this period saw the initiation of a group of regional styles of painted pottery throughout Central Mexico. At the time of Spanish conquest, these styles were being used by Nahuatl-speaking peoples. One interpretation is that newly arrived groups brought or started using these styles. The Aztec black-on-orange and polished redware styles are the most prominent of these; the former was used by various Nahuatl ethnic groups in the Basin of Mexico, and the latter characterized a larger area of Central Mexico. The two Aztec ethnic groups in the state of Morelos—Tlahuica in the west and Xochimilca in central and eastern Morelos—used contrasting decorated ceramic styles whose archaeological distributions match the locations of towns attributed to each of these groups (Smith 2010).

This ceramic and bioarchaeological evidence for ethnicity and migration in the Epiclassic and Aztec periods is not the only kind of archaeological data that has a bearing on the arrival of new populations. Archaeological settlement patterns can be evaluated for the degree of continuity between periods. When most sites in a region continue in occupation from one period to the next, it suggests some level of demographic or sociopolitical stability. Conversely, when most sites are abandoned while new sites are founded in distinct locations, this suggests some form of social disruption, such as the arrival of a new population that did not mix extensively with local peoples.

Figure 11 presents settlement continuity data for an archaeological survey I directed in the Yauhtepec Valley of Morelos (Smith et al. 2021). During the Classic period, this area was a province of an empire based at Teotihuacan. The disruption indicated by the low continuity value at the end of the Classic period may represent the arrival of new peoples or, more likely, disruptions caused by the withdrawal of Teotihuacan populations and administrators from the valley. The lack of an empire in the Toltec period (Smith and Montiel 2001) rules out imperial dynamics as a cause of the disjunction between the Toltec and Aztec periods. This interval of disruption in Morelos matches the concurrent disjunction of occupations in the Basin of Mexico (Sanders, Parsons, and Santley 1979) that I previously tried to link with the arrival of Nahuatl-speaking migrants from Aztlán (Smith 1984).

I am not advocating for any particular model of Nahua arrival. Perhaps Nahua speakers were present before the founding of Teotihuacan; the lack of fieldwork at Preclassic sites makes the documentation of migrations difficult for that period. Or perhaps Teotihuacan was home to a small group of literate Nahua speakers—who produced the texts analyzed by Pharao Hansen and Helmke—within a larger multilingual

Period	Dates ^a	Number of sites	Forward continuity ^a	Socio-political situation	Settlement disjunctions
Molotla	1440 - 1520 AD	178		Aztec period: City-states of Nahuatl-language groups	
Atlan	1300 - 1440 AD	157	89.8		
Pochtla	1150 - 1300 AD	113	70.8		
Epecapa	850 - 1150 AD	121	38.0	Toltec period	←
Tenayo (Epiclassic)	600 - 850 AD	94	66.0		
Late Classic	450 - 600 AD	128	31.3	Yautepec Valley was a province of the Teotihuacan empire	←
Middle Classic	300 - 450 AD	210	55.7		
Early Classic	200 - 300 AD	222	91.0		
Terminal Formative	100 BC - 200 AD	145	94.5		
Late Formative	500 - 100 BC	102	53.9		
Middle Formative	1100 - 500 BC	55	80.0	Olmec period	
Early Formative	1500 - 1100 BC	4	75.0	Initial farmers	

Key:

a) % of sites that continue to be occupied into the next period.
The lowest continuity values are highlighted.

Figure 11. Continuity of occupation across periods, Yautepec Valley. Adapted from Smith et al. (2021).

population. Neither of these scenarios is incompatible with evidence for the arrival of new populations (Nahua or other) in the Epiclassic period. Studies like the present paper are important and essential for advancing our knowledge of Teotihuacan and the ancient peoples of Central Mexico. But understanding will be held back until the various lines of research outlined above are synthesized and brought together in models that can be operationalized and tested against diverse types of evidence.

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Pharao Hansen and Helmke are to be commended for a well-researched and thought-provoking discussion of arguments relating to the identity of the language behind the writing system of the Classic period city of Teotihuacan in Central Mexico. The authors are eminently qualified for such a reassessment—Pharao Hansen is a respected specialist on Nahuatl, especially its modern dialects, while Helmke is a noted epigrapher with expertise in the fields of Classic Maya hieroglyphic writing and the iconography of Teotihuacan. Together, they build on recent advances in Teotihuacan epigraphy to argue for a Southern Uto-Aztecan (SUA) tongue as the language of the ancient capital, but an earlier one than is normally assumed.

Nonetheless, it is misleading to assert, as is done repeatedly in the present article, that this new study represents a radical

departure from—and significant advance over—previous work, although it most certainly has the potential to further the debate by virtue of its skillful integration of contextually related iconographic data and of linguistic data from SUA into the glyphic analysis. However, by and large, the article merely takes up where others have left off and proposes additional readings along the same lines, as, for example, my own research has done.

Regrettably, it is an increasing trend in academia to pay lip service to prior scholarship by parenthetically and briefly listing such authors without discussing their contributions or the extent to which they have contributed to or even furnished a foundation for their own thesis. Pharao Hansen and Helmke's proposals for readings of Teotihuacan glyphs are, like previous attempts by other scholars, including me, rather modest and involve no more than a handful of signs and reconstructed words—too few at present to clinch the argument in favor of a specific Uto-Aztecan identity, yet an encouraging indication of how fruitful further exploration in this direction could be.

Their thesis is two-pronged: on the one hand, they pursue the established path of searching for Nahua phoneticism in glyphic contexts, employing lexical material with related semantics from sixteenth-century Classical Nahuatl, and on the other, they attempt to use reconstructed Proto-Corachol lexemes to make a case for the language of Teotihuacan as having been from Proto-Corachol-Nahuan (PCN), a stage older than Proto-Nahuatl (also known as Proto-Aztecan)—that is, a language ancestral to both Nahuatl and its closest SUA relatives, Cora and Huichol. This may well turn out to be the case, but Pharao Hansen and Helmke have not, or at least not yet, succeeded in demonstrating it.

It is rather disingenuous to claim that I, like George Cowgill and Karl Taube before me, “have offered readings of logograms using phonetic values from sixteenth-century Nahuatl,” contrasting this with their own approach, which allegedly uses only data from stages far earlier than Classical Nahuatl. In actual fact, I have always argued, where possible, from reconstructed Proto-Nahuatl or, if such evidence was not (or not yet) available, from SUA, just as the present authors have done here. Examples of my methodology that have been on display repeatedly at conferences over the past decade and a half, some of them attended by Pharao Hansen and/or Helmke, can be found in my recent book *Deciphering Aztec Hieroglyphs: A Guide to Nahuatl Writing* (Whittaker 2021), in which I devote an entire chapter to the subject—none of it discussed or even mentioned, other than in a parenthetical bibliographical reference in their article.

I was a little surprised to find Pharao Hansen and Helmke promoting a parallel with Teotihuacan that I have long advanced. The authors draw attention to the fact that in sixteenth-century Aztec writing, a coyote with a small disk over its body stands for the place name Coyohuacan, asserting incorrectly that the disk “is . . . a logogram for **KOYO**, from *koyoktik* (‘perforated’), *koyoktli* (‘hole’ . . .).” While it is true that the disk can be a logogram with these values, in the context of the glyph for Coyohuacan, it is clearly a phonogram, a phonetic indicator for the pronunciation of the word for coyote, and is derived by the rebus method—as are virtually all signs in the Aztec phonetic inventory—from the logogram. The function of a sign, not its origins, determines its classification. This is the case in all writing systems, and in hieroglyphic systems phonetic signs are, as a rule, derived by rebus from logograms, unless they are loan signs from another system. Epigraphers working from a knowledge of Maya writing, which also follows this pattern, sometimes seem unaware of these basic facts.

The authors argue that a rounded element on the bodies of coyotes in murals at Teotihuacan functions in the same fashion and indicates a logogram, **KOYO**, that reinforces the iconographic depiction of coyotes. In a paper given at a Berlin conference in 2012 that was attended by Helmke, I discussed ethnohistorical and glyphic data pointing to a Nahua identity for Classic period Teotihuacan. One such example is the Teotihuacan superimposition of round-framed elements and, more convincingly, of shells on coyotes and their possible phonetic use (cf. Uto-Aztecan **koyo* [‘shell’]) in this context. Pharao Hansen and Helmke neglect to mention that I discuss this Aztec-Teotihuacan parallelism in the book cited above. Incidentally, a few years ago, I suggested to iconographer Davide Domenici that an obsidian knife (Nahuatl *itz-*) on the body of a Teotihuacan dog (Nahuatl *itzcuin-*) might be a similar phonetic indicator, an idea he has credited me with. In this particular case, SUA cognates have yet to be documented.

Fewer than a handful of graphic plays on PCN words are cited in the article, none of them as yet sufficient to clinch the argument in favor of this language as opposed to Proto-

Nahuatl or a sibling of the same. Nevertheless, the authors’ proposal that the Teotihuacan language might have been a dialect of PCN is very interesting and should be further explored.

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Some form of Nahuatl has always been a good candidate as the major language of Teotihuacan—to my mind the best (Dakin and Wichmann 2000). The kind of circumstantial evidence noted previously includes the geographical location of Teotihuacan close to the political center of the later “Aztec” empire, graphical continuities between Teotihuacan and Nahuatl writing, widespread early loanwords from Nahuatl into other Mesoamerican languages, and words of probable Nahuatl origin in Maya monumental inscriptions such as the ones discussed by Pharao Hansen and Helmke. To the last category we can add **e-je-ka**, likely reflecting a cognate of Nahuatl *ehēka-tl* (‘wind’), on Seibal Stela 13 (Lacadena 2010).

The paper under discussion takes the identification of the linguistic affiliation of Teotihuacan to a new level, not only finding evidence for a particular language at play but also detailing a particular stage of a language. The authors are justified in looking specifically to Nahuan-Corachol reconstructions for clues to phonological readings of the archaic texts since the linguistic forms must represent some stage before Classical Nahuatl and since the evidence for a Nahuan-Corachol subgroup is mounting (Pharao Hansen 2020).

The double spelling **NAKA-NAKA** provides suggestive evidence for a pre-Nahuan stage. The **KO** sign—if this is the correct interpretation of the shallow basin sign—would not be essentially different in use from the sign in Aztec writing based on the word *kōmitl*, so this at most provides possible evidence for a continuity between the writing systems. The “twisted root sign” is read as **NAWA**, said to reflect a Proto-Nahuan-Corachol lexeme, **nawa* (‘root’), but this would actually be a pre-Proto-Nahuan-Corachol form since the authors reconstruct **neri* for Proto-Nahuan-Corachol. With regard to the “stone series,” the authors admit—and I agree—that it is not necessary to assume that the triangular serrations represent a phonetic complement, so here the evidence for a language identification is at most possible. The spelling **ko-sa-ka** continues to represent good evidence for Nahuatl but can represent *koska* as well as a linguistically earlier form, *kosak*. The new observation that **ko-o-ha-wa** could derive from a form meaning “head” plus a *-wa* suffix is more striking. Even if some details still remain unexplained (the extra *o*, the absence of a possessive prefix), this suggestion does seem to shed new light on a previously mysterious form. Along with the **NAKA-NAKA** reading, I would consider this the best new evidence for an identification of the language of Teotihuacan inscriptions.

If a language stage intermediate between Proto-Nahuan-Corachol and Nahuatl is suggested by internal evidence from the inscriptions, we may ask, as the authors do in their appendix, whether linguistic dating fits the scenario. Unfortunately, the authors’ chronological model makes reference only to the earliest and latest relevant published linguistic dates, misrepresenting the latter and neglecting other recent work, so I will offer more information here.

For a chronological framework based on linguistic dating to fit the proposed language stage, the inscriptions, which would date to the first half of the first millennium AD, should be later than Proto-Corachol-Nahuan and earlier than Proto-Nahuan. Available dating methods work in different ways. Glottochronology, used in Swadesh (1956; henceforth, “Swa”), assumes a constant rate of vocabulary change. Holman et al. (2011; “Hol”) also assume a constant rate of change but measure lexical-phonological change. Bayesian dating, used in Greenhill et al. (2023; “Gre”), measures lexical change. While it does not require the assumption of fixed rates, it needs internal calibration of some nodes in the tree. Greenhill et al. (2023:86) assume an AD 260 (410 BC–AD 430) calibration date for Nahuan. Finally, Rama and Wichmann (2020; “Ram”) offer a method similar to Bayesian dating, but without the requirement of internal calibration. Dates arrived at using these different methods are provided in table 5. Dates “before present” are converted assuming that “present” is 2000. Ranges for Hol dates, calculated from the latest version of the Automated Similarity Judgment Program database (Wichmann, Holman, and Brown 2022) using Holman (2011) and assuming the Glottolog classification, represent $\pm 29\%$ ranges. Dates from Swa do not include the arbitrary $\pm 25\%$ ranges added by Wright-Carr (2015). Gre do not explicitly provide dates other than for Proto-Uto-Aztecan but do offer a tree with a timeline (Greenhill et al. 2023: fig. 2). Presumably, Pharaoh Hansen and Helmke read off the dates they cite from that tree but, if so, inaccurately and with ranges of their own device. Here I cite dates and ranges from unpublished data underlying Greenhill et al. (2023) obtained from S. Greenhill (personal communication, October 10, 2025). Ranges from Ram and Gre are 95% highest posterior density intervals.

Comparing the dates in table 5, we see general agreement (overlapping ranges) on Corachol-Nahuan dating. Clearly, this subgroup split up several centuries before Teotihuacan times. For Nahuan, however, there is disagreement, with dates indi-

cating a split-off before (Ram), during (Gre), or after (Swa, Hol) Teotihuacan times. The greater difficulty in reaching agreement across methods for shallower dates is, briefly stated, rooted in the fact that there is less evidence to go by in terms of accumulated linguistic changes when less time has passed.

While I personally favor the Hol dates for Nahuan, which are also the dates that best fit the authors’ scenario, it must be recognized that a chronological framework based on linguistic dating is not likely to be free of controversy. Insights into the temporal configuration of the linguistic lineage leading to modern Nahuatl may have to come primarily from direct observations of written texts, raising the status of ancient inscriptions to firsthand evidence of linguistic change, as we have already become accustomed to in the case of lowland Mayan linguistics (Wichmann 2006).

Reply

We would like to thank the commentators for their thoughtful, insightful, and at times passionate commendations and criticisms of our proposed phonetic decipherments of Teotihuacan glyphs. We appreciate this rich interdisciplinary engagement from iconographic, epigraphic, linguistic, and archaeological perspectives—and we recognize the significant expertise that has gone into evaluating our work. Several commentators are specialists in Teotihuacan culture, while others have themselves attempted to address the challenge of Teotihuacan writing or have published extensively on graphic systems across Mesoamerica. This makes their assessments particularly pertinent, both methodologically and for contextualizing our proposal on the nature and content of writing at Teotihuacan.

At the outset, we must emphasize that our study constitutes a decipherment proposal built on testing the match between the linguistic features of a specific candidate language and the epigraphic patterns within a comparatively small and challenging textual corpus. Specifically, we have tested the match to Proto-Corachol-Nahuan (PCN), an early Southern Uto-Aztecan language that we propose was contemporaneous with the hieroglyphic texts of Teotihuacan. This method has been commended by most commentators as methodologically sound. We find the match to be highly promising, and while we do recognize other candidate languages, the onus would now be on their proponents to show that these fare better in a similar test. We therefore do not “ignore” other candidate languages, as some commenters claim, but focus on testing the language in which we have expertise, thereby setting a minimum bar of evidence for future studies seeking to test other candidate languages similarly reconstructed to an appropriate time depth.

It surprises us that Ortega Cabrera even questions the existence of Teotihuacan writing, despite a century of scholarship. We again must acknowledge, as we have in our paper, the seminal contributions made by such eminent scholars as Al-

Table 5. Linguistic dates from different sources

Source	Corachol-Nahuan	Nahuan
Ram	520 BC (1095–42 BC)	355 BC (832 BC–AD 82)
Gre	963 BC (1819–252 BC)	AD 375 (AD 205–460)
Swa	Not available	AD 600
Hol	1224 BC (1579–869 BC)	AD 1118 (AD 862–1374)

Note. Ram = Rama and Wichmann (2020); Gre = Greenhill et al. (2023); Swa = Swadesh (1956); Hol = Holman et al. (2011).

fonso Caso (1896–1970), Clara Millon (1912–1997), James Langley (1922–2015), Thomas Barthel (1923–1997), and, most recently, Karl Taube (1957–), who have collectively outlined the formal and functional characteristics of this writing system (Helmke and Nielsen 2021:48–52). It is on this intellectual foundation that we build our work. It is therefore ironic that Whittaker accuses us of failing to acknowledge prior work, particularly when his own forays into Teotihuacan writing appeared well after we began researching and publishing on the subject. In fact, over the past two decades, Helmke has been a leading figure in Teotihuacan epigraphy, contributing to refining our understanding of the system's internal structure, constituent signs, and paleographic variability and working in close collaboration with our colleagues Jesper Nielsen and Davide Domenici.

Most commentators emphasize that the linguistic scenario of Teotihuacan would have been a multiethnic and multilingual metropolis, and we wholeheartedly agree. Nevertheless, we do believe that the writing system would have most likely been tied to one specific language, and we propose the PCN stage of Uto-Aztecan as a strong candidate. Several commentators explicitly agree that this proposal is both plausible and productive. As noted, some form of Nahuatl has long been considered a compelling candidate for a dominant language of Teotihuacan, particularly when accounting for geographic, graphic, and historical continuities. On the basis of solid archaeological and epigraphic evidence, we can recognize the presence of ethnic and linguistic minorities such as the Zapotec and Maya and, to a lesser extent, cultures of western Mexico. We also acknowledge the distinct possibility that Otopamean and/or Totonacan populations were represented at Teotihuacan, although no specific archaeological correlates have yet been identified. We reiterate, therefore, that in proposing that the writing system of Teotihuacan records a Southern Uto-Aztecan language, we are not denying the multiethnic or multilingual character of the metropolis but identifying the language used by the social segment that wielded power in this great city. We do not, therefore, assume the presence of speakers of PCN at Teotihuacan, but rather we argue for their presence.

From an epigraphic standpoint, commentators have remarked on analyzing double spellings involving homophones, rebuses, and phonetic complements, especially when grounded in comparative Mesoamerican epigraphy and historical linguistics, as a particularly promising method for demonstrating the phonetic dimension of Teotihuacan writing. This, as Carballo writes, represents “the most promising avenue for future decipherments.” Commentators such as Domenici, Marcus, and Davletshin also find these aspects of our study especially promising, noting that they bring the Teotihuacan script into productive comparison with other phonetically deciphered Mesoamerican writing systems, such as those of the Maya and Aztec. Likewise, the connection between Teotihuacan logograms and their graphic continuity through Epiclassic and Postclassic writing systems is recognized as a major step to-

ward understanding the diachronic development of Central Mexican scripts. Although we would of course have liked to respond with counterarguments to all objections raised, we will limit our replies to the most significant points—which fall into two principal categories: (1) linguistic reservations and (2) epigraphic critiques.

Linguistic Considerations

The linguistic dimension of our proposal has attracted a variety of responses, ranging from strong agreement to pointed skepticism. First, an important distinction: we do not claim that Nahuatl was spoken or written at Teotihuacan but that a language ancestral to the later Nahuatl languages was. We must reiterate because it goes to the core premise of our proposal: that we must strive to match the correct stage of linguistic development for the period represented by the textual corpus. We should resist the temptation to call the language “Nahuatl” (with the final *-tl*), as that would constitute an anachronism, the Achilles’ heel of earlier proposals that have tried to employ either sixteenth-century Classical Nahuatl (Cowgill 1992; Whittaker 2021) or Proto-Nahuatl-Pochutec (King and Gómez Chávez 2004). Proposals based on Classical Nahuatl represent a temporal mismatch of roughly a millennium—which would be comparable to attempting to read *Beowulf* in modern English—a futile enterprise. Rather, we argue that the most plausible linguistic stratum for the deciphered glyphs represents the earliest stage in the process of divergence of pre-Nahuatl from PCN, centuries before its subsequent development into Proto-Nahuatl (PN).

From the perspective of historical linguistics, a critique that merits a substantial response is exactly the dating model, which is questioned by Campbell and Wichmann. As mentioned by Wichmann, any proposal based on linguistic dating will be controversial. His illustrative table of proposed splitting dates from various lexicostatistical studies clearly demonstrates why this is: they produce widely differing results, depending on the computational models applied, even when working with the same data. This is because such models are very sensitive to both linguistic interpretations of cognacy (as recognition of more cognates makes languages appear younger) and different ways of modeling the rate of linguistic change over time. Finally, representing language history with splitting dates glosses over the fact that linguistic differentiation is usually gradual, taking place as a continuous process over centuries or even millennia.

The scenario that we propose is that PCN was a dialect continuum predating the rise of Teotihuacan by several centuries and that the pre-Nahuatl dialect of PCN gradually began differentiating itself from the pre-Coracholan dialects precisely because its speakers began to interact with speakers of other Mesoamerican languages at the metropolis. Therefore, we would argue that any dating proposal that places the split-off of Nahuatl from PCN in the first millennium AD is compatible with our model.

Wichmann is absolutely correct that the best way forward is to seek to anchor the relative chronology of the development of PCN to written evidence, such as the “foreign” words written phonetically on dated Maya monuments. Pharaoh Hansen (forthcoming *d*) broaches this work, showing that “foreign” words written in the fifth century AD at Tikal would represent a much earlier stage of the language (i.e., pre-Nahuan) than that written at Seibal in the Terminal Classic (which seems to postdate the split-up of PN). We are, therefore, confident that our dating model holds and that future lexicostatistical studies with improved cognacy judgments incorporating the many new cognate sets shared by Corachol and Nahuan will support it.

An important observation made by Davletshin (2021*b*) is that the frequency of glottalized consonants in the foreign words on Stela 31 at Tikal may point to a non-Uto-Aztecan language. Given the candidate languages tested, Davletshin proposes that the frequencies form a good match with Otomí. However, we find this statistical argument to be vague and unconvincing in the absence of any actual match between glyphic readings on the stela and lexemes of an appropriately reconstructed variety of Proto-Otomí. Additionally, this argument assumes that the glyphs have precisely the same phonetic values when writing foreign words as they do when writing Maya. This is not necessarily a warranted assumption, as they could, for example, also be Maya ways of writing consonants with subtly different phonetic realizations than their Maya counterparts, if pre-Nahua stops were, for example, slightly voiced or aspirated.

With regard to the linguistic aspect of our argument, the most strongly worded objections come from Campbell, who finds several of the proposed phonological and semantic shifts unconvincing. He challenges specific readings as strained and notes the lack of direct evidence to confirm the language associated with the glyphs. We are happy that Campbell subjects our linguistic evidence to his famously critical eye, which for many decades has been a guarantor of rigor in the evaluation of Mesoamerican historical linguistics, although we are of course sorry that he is unconvinced. We are particularly disheartened by the fact that his counterarguments are themselves largely unconvincing since in his critiques he relies on claims and interpretations by the late Terrence Kaufman, who unfortunately often did not himself exemplify the rigor that he and Campbell have rightly expected from others. Kaufman’s theories of Nahua prehistory were often offered as categorical claims, sometimes without supporting evidence or sources of information, and upon scrutiny often turn out to be unfounded.

For example, Kaufman’s claim that Nahuan borrowed heavily, which is central to Campbell’s critique, was never substantiated with data. If his proposed loans into PN from Huastecan, Mixe-Zoquean, and Totonacan are scrutinized, for most of them equally plausible or in many cases better etymologies can be posited within Uto-Aztecan—only Kaufman apparently never looked for family-internal etymologies, con-

fident in his own ability to recognize loans on sight. This ability, however, was hampered by his belief that certain sound sequences, such as initial *p*- or palatal sibilants before nonfront vowels, are enough to demonstrate a loan—but this is not the case (see Pharaoh Hansen 2024). Pharaoh Hansen (forthcoming *a*) provides stronger internal Uto-Aztecan etymologies for more than half of Kaufman’s proposed loans and shows that for others, the direction of borrowing is indeterminable and in yet others the proposed loans exist only in a specific geographical region and cannot be reconstructed for PN at all. Of the 10 lexemes specifically mentioned as loans by Campbell, six have better Uto-Aztecan etymologies: PN **pah* (“medicine,” “cure”) from Proto-Uto-Aztecan (PUA) **puha* (“medicine”), PN **pocho*- (“ceiba”) from pre-Proto-Nahuatl (PPN) **potsi*- (“fluffy”), PN **yewaka* (“avocado species”) from PPN **piwaka* (“avocado”), PN **topoh* (“fish species”) from Proto-Southern-Uto-Aztecan (PSUA) **tepo* (“fish”), PN **fikal* (“gourd bowl”) from PPN **si-kari* (“shell container”), and PN **pi/ka* (“harvest”) from PCN **pira(-ka)* (“gather, tie”). The root “dish/plate” and the diminutive (reverential) suffix may well be Totonac loans into PN, but the words for “cork tree” and “chicle” cannot be reconstructed to PN, as they are shared only by Eastern varieties and so must be late loans specific to the region where those plants are found. Pharaoh Hansen (forthcoming *a*) also demonstrates loanwords from PCN or early pre-Nahua into Oto-Pamean languages—demonstrating that this language was indeed also a donor.

Regarding Kaufman’s unsubstantiated (and frankly very strange) claim that Huasteca Nahuatl has only 400 inherited roots out of 3,000, a systematic study of the etymology of pre-Nahua and PN vocabulary shows that of around 500 currently reconstructed items of the lexicon, fewer than 5% of the roots do not have Uto-Aztecan etymologies. Contrary to Kaufman’s data, this set of etymologies is being prepared for publication in the near future.

Campbell finally states that there is copious counterevidence suggesting that PN was not a fully Mesoamericanized language. This is an odd assertion since of course he knows that all of the features with which he himself defined the Mesoamerican language area (relational nouns, no switch reference, no V-final syntax, vigesimal numeral system, semantic calques) can be reconstructed for PN—but are not shared with most of the Southern Uto-Aztecan languages. This complete transformation of Nahuan morphosyntax in the development from pre-Nahua to PN surely testifies to prolonged and intense contact between speakers of Nahuan and other Mesoamerican languages in the centuries before the split-up of PN (which Kaufman places in the early ninth century AD). Despite the few lexical loans in pre-Nahuatl and PN, there is no doubt that, as Kaufman argued, PN developed as the result of close contact with other Mesoamerican languages and that this completely transformed the morphosyntax in the development from pre-Nahua to PN. There is all the more reason to believe that PN developed, not at the fringe of Mesoamerica, as claimed by Kaufman and others, but within Mesoamerica itself, in a

multilingual environment, such as Teotihuacan in the Classic period (see also Pharao Hansen forthcoming *a*, forthcoming *c*). For these reasons, we are not overly concerned that our arguments do not fit with Kaufman's conclusions since this is simply because we build on more extensive data and a more rigorous analytical framework.

Finally, we must address several comments (Campbell, Davletshin, Whittaker) that mention the relation of PCN *naka* ("nopal"), PCN **naka-sa* ("ear"), and PN *naka* ("meat"). Here we apparently need to be clearer about what it is that we propose.

(1) For PSUA, we can reconstruct a minimal pair of words distinguished only by accent: **náka* ("ear") and **naká* ("opuntia"). (2) In PCN these roots are reflected as **naka-sa* and **naka*, respectively. (3) In PN we have **nakas* ("ear") and **naka* ("meat"), but the word for nopal is **nohpal*, from PSUA **nawo-pari* (*nawo* being specifically the cactus fig, also giving PN **no:ch-* from **nawo-tsi* ["nopal point"]). That is, regardless of whether PN derives the word for "meat" from the word for "nopal" or not, we know that in PN the root **naká* ("opuntia") was lost or changed its meaning. The Nahuatl word for "meat" could be from another source, but is that really more likely? In Nahuatl itself the root **naka* is found in two common words for nonmeat foodstuffs, *na-naka* ("mushroom") and *xo-naka* ("onion"; from PSUA **siwi* ["onion"] + *naka*), which strongly suggests that in pre-Nahuatl the root **naka* did not mean "meat." The semantic change from "nopal" to "meat" is not as unlikely as Campbell would have it, as the world's languages do see semantic changes between food categories that may seem counterintuitive at first sight. The obvious example is English "meat" from the Germanic term for "food." Other examples are Proto-Semitic **lahm* ("food"), which became both Hebrew *לֶחֶם* (*léhem*, "bread") and Arabic *لَحْم* ("red meat"), and even "fish" in some varieties or "condiment" in others. If we assume that early Nahuatl speakers consumed more nopal than they did meat (which is not an unjustified assumption), then the change could have occurred naturally. Additionally, none of the words used for "meat" in other SUA languages are found in Nahuatl—also strongly suggesting Nahuatl innovation and subsequent loss of the original word for "meat."

Epigraphic Considerations

Criticisms of an epigraphic substance mostly pertain to details of sign identification, pairing, and function. Before addressing these specifics, we need to outline some general considerations that have a bearing on our response.

Whereas Teotihuacan writing has the distinction of favoring full-figure or emblematic signs, this does not deter the graphic identification of signs, especially when grounded in a coherent understanding of the visual repertoire and graphic conventions of the great city—particularly as this writing system recurrently shares more features in common with other Central Mexican writing systems than with other Mesoamerican scripts (e.g., emphasis on logography, double spelling, rebus use, un-

derspelled suffixes, and a focus on short captions and calendrical statements). Cumulative evidence across media confirms the existence of a coherent writing system at Teotihuacan (Helmke and Nielsen 2021; Taube 2000). It is not simply decorative or emblematic and open to broad interpretations disassociated from language, as favored by semasiographers. While some commentators question its continuity or direct descent from Teotihuacan to Aztec writing, such critiques overlook the inherited logographic elements at the core of the system. We argue that Aztec logograms descend from earlier Central Mexican scripts, whereas phonograms appear as later innovations, specifically developed within a Nahuatl linguistic matrix (Velásquez García 2019). The evolution of signs such as the "shallow basin" and quincross into later forms in Aztec writing (Helmke and Nielsen 2023:65) further supports this trajectory, as does the evolution of calendrical and numerical notations from the Classic to the Postclassic (Helmke and Nielsen 2023:60–61).

The Epiclassic here provides a crucial link or bridge in the script tradition, where, rather than a clear break, we repeatedly witness adaptations of earlier Classic traits that foreshadow later Postclassic features (Helmke and Nielsen 2023; Helmke, Nielsen, and Rivera Guzmán 2023). Rather than distinct systems, Teotihuacan, Epiclassic, Toltec, and Aztec scripts thereby represent successive phases of a continuous Central Mexican writing tradition (Helmke and Nielsen, forthcoming). This continuity also challenges claims that Teotihuacan writing is somehow a later development within a broader Mesoamerican vantage. Evidence from sites such as Tlatilco and Tlapacoya indicates that Central Mexican writing emerged as early as the Late Formative (Helmke and Nielsen 2021:58), contemporaneous with and perhaps even earlier than the earliest Zapotec inscriptions (dated to 500 BC), thus undermining any assumed precedence of Oaxacan writing.

The notion that Teotihuacan writing was used in "limited contexts" such as walls and floors misrepresents the archaeological reality. In fact, the majority of Teotihuacan texts appear on ceramics (Helmke and Nielsen 2021:35, forthcoming), and the apparent restriction of writing to specific media is more likely a function of preservation bias than cultural preference. Like all Mesoamerican societies, Teotihuacan was almost certainly a culture of books, and much of its writing would have been rendered on perishable media now lost to us. The depiction of codices in the iconography of mural scenes—wherein priestly figures bear screenfold books (Helmke 2023:35–36, fig. 12d; Helmke and Nielsen 2021:34)—and the almanac-like formatting and thematic content of the glyphic texts at La Ventilla (Nielsen and Helmke 2011:360–363; Valdez Bubnova 2022) provide compelling visual and formal parallels with later Central Mexican manuscript traditions.

Our proposed readings have drawn criticism both for identifying phonetic complements (Davletshin and Domenici) and, paradoxically, for placing too strong of an emphasis on logograms in Teotihuacan writing (Davletshin and Whittaker). The logographic nature of Teotihuacan writing is easily

demonstrated by the fact that most glyphic compounds involve just one to three signs, with a mean of 1.95 and a standard deviation of ± 0.75 (contrast this with Epiclassic writing, where glyph compounds range from two to seven signs, with an average of 3.5 signs; see Helmke and Nielsen, forthcoming). The Teotihuacan script is, therefore, primarily logographic, with the occasional use of phonetic complements—especially in the form of double spellings. It is precisely in such double spellings that the phonetic dimension of Teotihuacan writing becomes apparent while maintaining its emphatic use of logographic signs. This is in keeping with the convention of double spelling that was inherited by Aztec writing, which yet again attests to the continuity of this script tradition. Signs used primarily as phonograms remain within the purview of future research, but at present the logographic emphasis of Teotihuacan writing is apparent. This compares intimately to the scribal practices of Tenochtitlan, where logograms predominated on both public monuments and codices, which contrasts with other scribal schools in the Valley of Mexico and Tlaxcala, where phonograms were favored in writing (see Lacadena 2008).

One of the readings that has attracted several comments pertains to what we have called the “stone series,” especially the “mountain” sign and the infixed triangular serrations. By calling into question the identification and function of the internal sign as a semantic qualifier or determinative, the readers suggest that this sign does not necessarily carry a phonetic value (an observation already made some years ago by Helmke and Nielsen [2014b:81]). However, what the commentators fail to recognize in this case is that the reconstructed lexemes for “mountain” (*tepe), “cave” (*teso), “knife” (*tékā-pari), and “stone” (*te) are all *te*-initial. This remarkable linguistic congruence matches what we see in the graphic properties of the signs since these each typically contain the triangular serrations, which do serve as qualifiers for “stone.” Although Domenici remarks that he is unaware of “mountain” signs without such serrations, we must point out clear examples in the murals of Tetitla and La Ventilla (Helmke and Nielsen 2014b: figs. 6h–6i, 7c, 9a, 9c; also illustrated in Domenici 2023: fig. 1.4b, 1.4g–1.4i). These examples of “mountain” signs without the “stone” markings make it clear that these are two separate signs that conform to the behavior of optional phonetic complements, as these serve to reinforce the reading. Their presence in some contexts and absence in others is precisely the sign behavior we expect from phonetic complements. Accepting the value of “stone” as *te, we must necessarily conclude that mountain signs record [TE]TEPE, cave signs [TE]TESO, and curved obsidian knives [TE]TEKA when these are infixed by the triangular serrations, with the “stone” sign serving in a phonetic capacity.

Critiques that the “shallow basin” and “twisted root” signs are ambiguous in their linguistic function (as prefix or suffix) ignore both their visual placement and the conventions of Central Mexican glyphic syntax, wherein suffixes are preferentially written below larger sign compounds. The optionality of both of these signs speaks of patterns of abbreviation or

“underspelling” that directly support the interpretation of these signs as suffixes. The practice remained prevalent in later Aztec writing, especially the scribal practices of Tenochtitlan, where weight is placed on logograms and suffixes are frequently omitted, leaving the reader to provide these linguistic details (see Berdan and Anawalt [1992: vol. 3, fol. 2r–55r] for repeated codical examples and Umberger [1981] for monuments). Also, as we have suggested, the pairing of the “twisted root” and the “shallow basin” signs in the same glyphic compound does yield, via rebus, a grammatically viable locative suffix, *-nawa-ko, anticipating the Nahuatl suffix -nāwak (“near,” “proximate”). The phonetic and syntactic coherence of this sign combination surely cannot be ignored.

Finally, Whittaker offers a diatribe on what he perceives to be a lack of acknowledgment for his contributions to Teotihuacan writing. This is not the place to engage in detail with the readings proposed by Whittaker (2012, 2021:174–193), but suffice it to say that we have not considered them in our study because they rely, almost without exception, on sixteenth-century Nahuatl anachronistically projected onto Classic period texts. We should also specify that we have not proposed that the circular element infixed into the full-figure coyotes of Atetelco should be read *koyo*; we were commenting on sign behavior. In this connection, it is also noteworthy that several of the identifications Whittaker claims as his own (e.g., the classic example of the [KOYO]KOYO double spelling in Aztec writing) should be credited to earlier scholars such as Peñafiel (1895: vol. 1, 69, vol. 2, 23; who first identified the circular element in the toponym <Coyohuacan>), Thouvenot (1987: 685–686; who first identified the logographic value of *koyok*-[“agujero”]), and Berdan and Anawalt (1992: vol. 1, 181; where they propose an etymology and correctly identify the glyphic components)—none of whom are either acknowledged or cited by Whittaker (2009:61–62). Likewise, he uncritically repeats some of the readings proposed by King and Gómez Chávez without crediting them (cf. King and Gómez Chávez 2004:218–219 and Whittaker 2021:185–188). Other proposals—such as misreadings of the “star” sign as a “shell” (Whittaker 2021:193)—rest on misidentifications. For these reasons, his interpretations did not factor into our analyses, and they have not influenced our thinking.

Concluding Remarks

This response has sought to clarify our methods, correct mischaracterizations, and engage directly with the most substantive critiques of our proposal and to take this opportunity to refine and, where necessary, strengthen our arguments. At its core, our study presents a testable decipherment model rooted in comparative epigraphy and historical linguistics to explore the glottographic potential of Teotihuacan writing. The match to PCN has proved both methodologically productive and linguistically coherent, yielding plausible readings. Our findings suggest real potential for phonetic decipherment

grounded in a plausible linguistic context and anchored in patterns of usage across a defined corpus. While some commentators remain skeptical, others have acknowledged the strength of our approach and the promise it holds for further decipherment.

Among the key contributions of our work is the demonstration that Teotihuacan writing functions as a structured, logophonetic system—one that privileges logograms while also employing phonetic complements in syntactically meaningful ways. The continuity of certain signs, compounds, and scribal conventions into later Central Mexican scripts, especially of the Epiclassic and Postclassic, supports that these traditions form part of a unified script tradition.

Our proposals are not intended as final answers but serve as an applied test of a promising candidate language, open to refinement and further testing. The phonetic values and linguistic identifications we have put forward are supported by sign patterning and linguistic correspondences, but these remain hypotheses open to refinement as the corpus expands and as others apply comparable methods to further candidate languages. We invite our colleagues to continue testing our proposals.

Much remains to be done. Future progress will collectively depend on continued documentation and analyses of Teotihuacan glyphs; integration of new archaeological discoveries and other lines of evidence; dissemination of further motivated readings, subjected to peer review; continued reconstructions of early linguistic strata of SUA (including PCN); and the comparative testing of additional candidate languages reconstructed at appropriate time depths (including Proto-Otomian and Proto-Totonacan).

As we note in the appendix, only those readings with strong internal support have been included in the present proposal. Several additional readings remain under preparation and will be disseminated in due course. We thank the reviewers for their engagement, and we hope that this response and the original article will help to advance the study of one of Mesoamerica's most important and increasingly better understood writing systems.

—Magnus Pharao Hansen and Christophe Helmke

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