

# Explaining Mythical Composite Monsters in a Global Cross-Cultural Sample

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## Abstract

Composite beings (“monsters”) are those mythical creatures composed of a mix of different anatomical forms. There are several scholarly claims for why these appear in the imagery and lore of many societies, including claims that they are found near-universally as well as those arguments that they co-occur with particular socio-cultural arrangements. In order to evaluate these claims, we identify the presence of composite monsters cross-culturally in a global sample of societies, the Standard Cross-Cultural Sample. We find that composite beings are not universal, and that their presence or absence co-varies most significantly with social stratification and transportation technology. This supports hypotheses that the cultural evolution of composite monsters is driven by human concerns with social distinctions within societies as well as increased contact with distant peoples.

## Keywords

cultural evolution – monsters – composite being – mythology – folklore

### 1 Introduction

Theories of cultural transmission and evolution are most productively tested by the study of specific traits that stand at the threshold of culture and cognition, such as religion (Boyer, 2007; Pyysiäinen & Anttonen, 2002; Atran, 2004), folklore (Heath, Bell & Sternberg, 2001; Stubbersfield, Tehrani & Flynn, 2017), and stories (Bartlett, 1932; Norenzayan, Atran, Faulkner & Schaller, 2006; Terhani, 2013; Berl et al., 2021). Composite beings, those “monsters” of religion or lore that are composed of a mix of anatomical forms (e.g. centaurs, the Chimera), clearly stand at this threshold. As paradoxical violations of our expectations about living things (Sperber & Hirschfeld, 2004), composite beings continue to elicit strong emotional responses into the twenty-first century. This is attested by their enduring popularity in literature, cinema, and social media (e.g. Lee, 2018).

Composite monsters provide an excellent opportunity for testing cultural evolution theories for several reasons. First, they are very specific cultural items that can be easily identified. In one sense, they are entirely cultural fabrications, since they do not exist in the real world. But they are also clearly inspired by things in the real world and, though they may not strictly speaking “minimally counterintuitive” (Purzycki & Willard, 2016; Morin, 2016), they combine folk biological concepts to which our cognition may be well adapted (Ward, 1994; New, Cosmides, & Tooby 2007; Barrett, 2015). These concepts are clearly effective at reproducing or represent a kind of “cultural attractor” (Sperber, 1985; Boyer, 2016), since they appear across many cultures and have been culturally transmitted over thousands of years. Yet if composite beings are not universal to human cultures, this would suggest there is some additional explanation for their distribution apart from shared cognitive biases. Indeed, as we survey below, there are several functional hypotheses about their origins and transmission, ranging from purely cognitive to being affected by socio-economic circumstances.

Eliciting fear, fascination or repulsion, various scholars have identified composite beings among those “monsters” serving as potent symbols of cultural difference or social deviance (Asma, 2009; Cohen, 1996; Komatsu, 2018;

Mittman & Dendle, 2017; Strassberg, 2002; Strickland, 2003; Wittkower, 1942). Such monstrous symbols of difference or deviance have their political uses, as well (Creighton 2021; Pavel 2022). Ethnographic studies have demonstrated how monsters and their meanings emerge and adapt to particular sociocultural contexts (Musharbash & Presterudstuen 2014; 2019). Although not all monsters are composite beings, the latter are the prototypical monster for many. Monsters “from Aristotle’s time to the present, always disrupt the neat categories of taxonomy” according to philosopher Stephen Asma (2009, 125), and the Argentine author Jorge Luis Borges defines a monster as “no more than a combination of parts of real beings” (Borges, 2005 [1967], xii).

Such fantastic creatures are so familiar to many of us that scholars past and present have asserted that they are near-universal in human cultures (Wittkower, 1942; Asma, 2018). In contrast, archaeologist David Wengrow (2011, 2014) has argued that composite beings (as discernable from material culture) are neither ubiquitous nor primordial in human societies. While not objecting to the premise that counter-intuitive forms are deeply rooted in evolved human cognition, he argues from archaeological evidence that such composites are “a historical product of technological and institutional environments that came into existence at a relatively recent point in evolutionary time, with the emergence of the first cities and state-like systems of organization” (Wengrow, 2014, 110).

These hypotheses make empirically testable predictions. Although quantitative testing of theories of the spread of non-natural concepts across cultures is difficult (Lisdorf, 2004), recent advances in resources and methods now make it possible to implement some of them. Composite monsters are widely documented in ethnographies, which are now accessible and searchable digitally (e.g. eHRAF World Cultures, HRAF. n.d.). At the same time, databases like D-PLACE (Kirby et al., 2016) make obtaining and matching cross-cultural variables easier, and improvements in statistical methods allow robust controls for various confounds of history (Roberts, 2018).

In this paper, we address several questions through a systematic study of the presence of composite beings in a global ethnographic sample of societies. We ask whether composite beings are near-universal to human cultures. If not, we then ask whether features of human societies and cultures suggested by previous scholarship are associated with composite beings in our global sample. In so doing, we hope to establish whether interpretations of composite monsters derived from historical and ethnographic case studies might be generalizable to human societies more broadly.

## 2 Literature Review

In his preface to *The Book of Imaginary Beings*, Borges (2005 [1967], xv) writes:

We do not know what the dragon *means*, just as we do not know the meaning of the universe, but there is something in the image of the dragon that is congenial to man's imagination, and thus the dragon arises in many latitudes and ages.

Like Borges' dragons, some contemporary scholars see universal cognitive processes at work in the paradoxical otherness of composite beings. Composite beings of these sort are "in direct clash with naive biology, some belong to several species at the same time" and "these cultural superstimuli typically combine not just exaggerated but also *paradoxical* features with ordinary and essential ones" (Sperber & Hirschfeld, 2004, 44–45, italics in original). Chimeras are among the counter-intuitive concepts that violate expectations about living things in ways that may facilitate their recall and cultural transmission (e.g. Boyer & Ramble, 2001). For scholars like Asma (2018), this helps explain why "every culture, it seems, has monstrous mash-ups in their folklore and religion."

Given their counter-intuitive forms, however, composite monsters attract human beings' skepticism along with our attention. The first-century BCE Epicurean poet Lucretius argued against the possibility of chimeras and other composite monsters combining human, animal and plant characteristics (Lucretius 2007, 56–57). Likewise, a late nineteenth-century Christian missionary to the Paraguayan Gran Chaco found that

[The Enxet people] are keen observers of nature, and on seeing a picture of an angel, they evidently puzzled over it for a long time, and eventually remarked that they could not understand how he could use his wings, since they sprang from the backbone, instead of from the shoulder. It was a hard task to make it clear that angelic wings were only symbolic. (Grubb, 1911, 242).

Whether or not every culture does have composite monsters, they have played an important role in how many societies imagine difference. Ethnographic studies like those in the volumes by Musharbash and Presterudstuen (2014; 2019) illustrate the "close intersection between relations with a monster and questions of interethnic strangeness among different categories of humans" (Stasch, 2014, 200). Medievalist Jeffrey Cohen (1996, 7) argues "any kind of

alterity can be inscribed across (constructed through) the monstrous body, but for the most part monstrous difference tends to be cultural, political, racial, economic, sexual." Historically, composite beings are among the monsters frequenting many peoples' conceptions of the inhabitants of distant locales (Van Duzer, 2017). Roads themselves are frequent sites of peoples' encounters with monsters, from ancient Greece and Rome (Felton, 2019) to contemporary Niger (Masquelier, 2002). Distant "ethnographical monsters" were recurring elements in European ideas of India and other parts of Asia and Africa from the fourth century BCE through the sixteenth century CE. (Wittkower, 1942). For example, the *Travels of Sir John Mandeville*, popular in western Europe from the end of the fourteenth century, depicts the Andaman Islands as inhabited by various monstrous races, including animal-human composites (Strickland, 2003, 203). (Ironically, late nineteenth-century ethnographers would report for the Andamanese people themselves "of mythological animals, such as dragons and unicorns, they have no knowledge" (Man, 1932, 122)). Many such monsters served in Europe as templates for cultural difference and social deviance, as Strickland (2003, 8) argues "representations of Monstrous Races and demons were crucial to the development, both literary and artistic, of portraits of Ethiopians, Jews, Muslims, and Mongols" during the Medieval period. Especially prolific among the classical monstrous races of Europeans' imaginings of distant peoples were the man-eating cynocephali, or dog-headed people (Wittkower, 1942; Asma, 2009; Strickland, 2017), an image later applied to Carib peoples (Boucher, 1992, 15–19). Indigenous Americans, in turn, may have imagined encroaching Europeans as anthropophagous monsters as well (e.g. Ruiz de Montoya, 1993 [1639], 93).

Europeans were not alone in imagining socioculturally different and geographically remote peoples as composite beings. The Chinese *Guideways through Mountains and Seas* (*Shanhaijing*) compiled during the fourth through first centuries BCE contains descriptions of multitudes of such composite beings. The Han dynasty court biographer Liu Xin (46 BCE–23 CE) reported that court officials at the time considered the work "a means of investigating auspicious and strange phenomenon as well as observing the customs of foreign peoples in distant lands" (Strassberg, 2002, 13). The fantastic creatures described in this Chinese work disseminated widely, perhaps even inspiring local peoples' folklore in Madagascar through designs imported on Chinese porcelain polychromes (Molet, 1974). Likewise in Japan, the horned humanoid ogres called *oni* have long-served as a label for social deviance as well as cultural and linguistic otherness (Komatsu, 2018, 102). The counter-intuitive otherness of composite beings does not always suggest moral deviance, however. Benevolent composite beings include the animal-human avatars of Vishnu



FIGURE 1 Babylonian cylinder seal of winged divinity between winged lions with human heads. Neo-Babylonian period (ca. 800–600 BCE). Michael C. Carlos Museum, Emory University.

PHOTOGRAPH BY TIMOTHY W. KNOWLTON

in the classical Indian tradition (Rāy, 1891, 775), the human-headed celestial steed al-Burāq in Islamic traditions (Gruber, 2012, 2021), and certain *yōkai* of Japanese folklore (Merli, 2020).

The origin and transmission of composite monsters as appearing on material culture is the subject of works by archaeologist David Wengrow. Rather than being ubiquitous and primordial to human societies, Wengrow (2011, 2014) argues that images of composite beings only became stable and widely transmitted with developments in the Bronze Age societies of the Near East and Mediterranean during the fourth millennium BCE (Figure 1). Wengrow interprets the archaeological distribution of images of composite beings as being “clearly associated with the expansion of political and commercial networks and, on a local scale, with the growth of urban settlements and the emergence of social elites” (2014, 2). In these Bronze Age societies, crafting technologies like modular assembly and cylinder seals, as well as the bureaucratic modes of thought accompanying writing and record-keeping, provided a sociocultural setting conducive to “the cultivation of an otherwise latent mode that confronts the world ... as a realm of divisible subjects, each comprising a multitude of fissionable and recombinable parts” (Wengrow, 2014, 110). According to him, this “underlying logic of figuration – based on the extraction of subunits from their given frames and their recombination into composite wholes – expresses modes of practical and abstract reasoning that underpinned the growth of large-scale social formations” (*ibid*). Wengrow (2014, 59–60) incorporates many features of these early civilizations in the course of his argument: urbanization, political and ritual centralization, the expansion of long-distance trade preceded by new transport technologies, forms of craft specialization, and bureaucratic technologies of writing and record-keeping.



FIGURE 2 Mississippian ceramic engraved with winged horned rattlesnake. Hemphill Engraved Style, ca. 1150–1450 CE. Moundville Archaeological Park, University of Alabama

PHOTOGRAPH BY TIMOTHY W. KNOWLTON

Of course, images of composite beings are found in the archaeological record elsewhere, such as throughout the pre-Columbian Americas (e.g. Reilly 2011; Figure 2). However, Wengrow argues images of composite beings from the ancient Americas to be fundamentally different in verisimilitude and function from those of ancient Greece and Mesopotamia (Graeber and Wengrow, 2021, 388–389). This raises important problems of interpretation when dealing exclusively with ancient material culture. In his review of Wengrow's monograph, Maurice Bloch (2016, 210) notes that there “is also the question about whether exclusively concentrating on material culture (as the archaeologist must while ignoring, for example, mythology) is theoretically legitimate.” Therefore, for our purposes we focus not on material culture, but on composite

beings in the mythology and folklore of ethnographically-documented societies. We are, however, interested in those features of the sociocultural setting which Wengrow argues facilitated the origin and transmission of Bronze Age monsters, insofar as they might help us account for these composite beings' distributions globally.

To summarize, we derived several questions from the previous scholarship on composite beings to examine in light of our global ethnographic sample. First, is there evidence that composite beings are near-universal features of human cultures? If evidence is lacking that composite beings are near-universal, then are there sociocultural correlates for their presence? Given the historical case studies arguing that such monsters are symbols of social difference or deviance, is the presence of composite beings associated with stratified societies? Furthermore, the frequent depiction of composite beings among the "ethnographic monsters" inhabiting distant lands raises the question of whether their presence is associated with increased long-distance travel, perhaps reflecting an increased concern with difference between societies.

Wengrow (2011, 2014) invokes increased urbanization, political centralization, long-distance trade, as well as particular craft and information technologies when accounting for the distribution of composite monsters in the ancient Near East and Mediterranean. Although we are examining ethnographically-documented mythology and folklore, we ask whether these various measures of cultural complexity are significantly associated with the presence of composite beings worldwide. Furthermore, since different measures of sociocultural complexity tend to co-occur (Peregrine, Ember and Ember, 2004), we ask which of those variables statistically associated with composite monsters have greater explanatory power? Given Wengrow's (2014, 110) arguments about the underlying logic of Bronze Age monsters, we give particular attention to assessing whether composite beings in the ethnographic record are associated with increased technological specialization, increased political integration, or the presence of bureaucratic technologies of record-keeping and writing.

### 3 Sample

This study is based on the most widely used global ethnographic sample, the Standard Cross-Cultural Sample or *SCCS* (Murdock & White, 1969). The *SCCS* comprises 186 societies designed to represent the known and well-described societies in the ethnographic record and at the same time minimize historical relatedness by choosing one case per cultural cluster. Each society is given a

time and a place focus (see Gray, 1996 for an evaluation of possible biases in the selection of the SCCS societies). Those previously published datasets for the SCCS utilized in this study were downloaded from D-PLACE (Kirby et al., 2021). These include the ten scales of cultural complexity for the SCCS societies published by Murdock and Provost (1973) which serve as variables in our analysis.

Each society of the SCCS was coded for the presence or absence of composite beings, defined as those beings with a mix of different anatomical forms (e.g. centaurs, chimeras, winged deer-horned rattlesnakes) in the religion or lore of a society. Shapeshifters, beings that can change shape from one distinct life form to another, but who do not maintain permanently or temporarily a mix of two or more forms, are not considered composite beings for the purposes of this study. Neither are those mythological beings characterized by an original state of nondifferentiation between humans and animals (perspectival multinaturalism) (Viveiros de Castro, 2004) considered composite beings for our purposes, as composites by definition require recognition of differentiation. Furthermore, the kinds of hybrid beings recognized within totemism (Descola, 2013) are only judged composite beings for the purposes of this study when they are characterized by mixed anatomical forms. Mixed anatomical forms documented among the SCCS societies typically involve a mixture of body parts between humanoid and/or different animal species, although rare examples of mixed humanoid with plant or animal with tool ("cyborgs") do occur.

The procedure for coding involved first searching the documents on each SCCS society in the EHRAF World Cultures database (EHRAF, n.d.). An aim was to match the SCCS time and place focus, so when the matching ethnographies were not available through EHRAF World Cultures, these sources were located and consulted separately. Furthermore, since we are concerned with evaluating the universality of composite beings, additional literature on each society was consulted if no composite being was identified initially. At that point, another search for potentially relevant ethnographic sources was conducted with the EBSCO Anthropology Plus database. If a composite being still was not found, a Google search was then conducted with the hopes of identifying the names of potential composites or relevant authors and sources missed which might be entered back into the previously consulted databases or into WorldCat. This iterative process continued until either a composite being was identified for the SCCS society or accessible sources were exhausted and no new leads could be generated, at which point composite beings were coded as "Absent" for that society.

Composite beings were coded as "Present" for a society if a composite being fitting the operational definition was a documented part of local religion or

lore of the community during the relevant time period. Where the description of a likely composite being was presented too vaguely in the sources to confirm a mixed anatomical form, attempts were made to identify a second possible composite being. Composite beings evidently peculiar to a given society were preferred, but in their absence, composite beings accompanying major world religions were counted if it was clear from the context that the composite being was integrated into local thought and practice and did not simply reflect familiarity with other societies.

Because we are interested in universality, and because observers documenting the specific community and time period originally pinpointed for each sccs society may differ in their interest or access to knowledgeable consultants in the topics of religion and folklore, we judged composite beings to be “Present” in some limited other cases as well. For example, the sccs focal time and location for the Natchez people of the Lower Mississippi Valley is 1718 CE at the “Grand Village” or Fatherland site in the present-day U.S. state of Mississippi. Composite beings are not unambiguously described in the eighteenth-century French accounts. However, given that composite beings were explicitly documented in Natchez material culture and lore in the centuries immediately before (Steponaitis, Knight, & Lankford, 2019, 2) and after (Swanton, 1995 [1929], 239), we judged them to be “Present” in Natchez society for our purposes.

In making such judgements, earlier sources were preferred to later sources relative to the sccs time period for the society. Where a later source was used, the composite being should not be one that may have been introduced by missionaries or colonizing powers subsequent to the sccs time period. Occasionally, sufficiently robust collections of mythology or folklore for the society were only documented many years or even decades after the pinpointed sccs time period. For a somewhat extreme example of this, the sccs time period for the Tehuelche people is 1870, but substantial folklore for the group was only collected in 1969 (Wilbert & Simoneau, 1984). However, because the composite being in the Tehuelche narratives was so unlike those introduced by settler colonists, and it was described in traditional narratives by two consultants (who were eighty and ninety years old, respectively), it was judged reasonable to code composite beings as “Present” based on this salvage ethnography. Coding notes and bibliographic sources for those composite beings identified are provided for each sccs society in the supplementary materials.

Of the 186 societies of the sccs, two societies were found to have insufficient information on religion and folklore to make a judgement of “Absent”. In nine cases, possible composite beings were identified, but either the available descriptions were too vague or else the sources were judged to be an

insufficient match to the SCCS time period or community in line with the considerations discussed above. For these cases, composite beings were assumed to be absent, but the datapoints were additionally marked as “Unclear”, and further analyses were done to test the robustness of the findings (see below).

While the procedure for determining the presence of a composite monster is extensive, it is possible that mention of a composite monster may be more likely in societies which are the subject of more extensive ethnographic documentation. Therefore, we use the number of pages of documentation for each society included in HRAF (HRAF, 2021) as a proxy for ethnographic coverage in general (e.g. Garfield, Syme, & Hagen, 2020). We use the log number of pages of coverage in evaluating and controlling for this possible bias in our analysis below.

For our independent variables, we utilized the ten ordinal scales of cultural complexity published for the SCCS by Murdock and Provost (1973). Their scales are:

1. Writing and Records, a scale devised to account for the use of mnemonic devices, non-written record-keeping practices and language-based writing.
2. Fixity of Residence, the scale proceeding from fully nomadic to relatively permanent sedentary settlements.
3. Agriculture, for the degree of dependence on agriculture for subsistence and the intensity of methods used.
4. Urbanization, for the average population of local communities.
5. Technological Specialization, to measure the degree of complexity and specialization in crafts such as pottery, weaving and metalworking.
6. Land Transport, “is designed to measure the degree of complexity in the means of land transportation and thus presumably indirectly the extent of inter-group trade” (Murdock & Provost 1973, 381).
7. Money, “is designed to measure the degree of complexity with respect to media of exchange and thus indirectly the level of economic organization” (Murdock & Provost, 1973, 381).
8. Density of Population, measured in terms of persons per square mile.
9. Level of Political Integration, “indicates the complexity of political organization in terms of the number of distinct jurisdictional levels recognizable in the society” (Murdock & Provost, 1973, 382).
10. Social Stratification, “designed to indicate the relative complexity of graded status distinctions within the society” (Murdock & Provost, 1973, 382).

Originally Murdock and Provost (1973, 379) ordered each of these along a five-point scale of relative complexity. We modified their scales in three

instances to better address our specific hypotheses about composite monsters. For Writing and Records, we collapsed their levels 3 and 4 into a single category “true writing”. For Technological Specialization, we collapsed their levels of “pottery only” and “loom weaving only” into a single category. And for the variable Land Transport, we collapsed their levels of animal-drawn wheeled vehicles and automotive vehicles into a single “wheeled vehicles” category. In other words, we maintained Murdock and Provost’s five-point ordinal scales for seven of the variables, and reduced three variables to four-point scales.

#### 4 Analysis

All analyses were conducted in R (R Core Team, 2021). The full analysis script and results are shown in the supplementary materials, and all data are available in an online repository (<https://github.com/seannyD/CompositeMonsters>). Composite beings were identified as present in 115 societies (62.5%) and absent in 69 societies (37.5%) in the sample. Composite monsters are found around the world (Figure 3) and are present in societies that speak languages from sixty-two different language families, including five isolates, and across a range of ecologies. We found no evidence of a strong phylogenetic signal nor geospatial clustering in the data (see supplementary materials).

From these data we conclude that, although relatively common, composite beings are evidently not “in the thought and imagery of all peoples at all times” (Wittkower, 1942, 197). For example, they are less prevalent than belief in ghosts (present in 98% of sccs societies; Rosenblatt, Walsh, & Jackson, 2011) or trance states (present in 88% of sccs societies; Bourguignon, 1973). Composite monsters are roughly as prevalent as belief in high gods (60% of sccs societies, Gray, 1999), which have been hypothesized to co-evolve with specific cultural contexts (e.g. Botero, Gardner, Kirby, Bulbulia, Gavin, Gray 2014; Norenzayan, Shariff, Gervais, Willard, McNamara, Slingerland, et al., 2016; Jackson, Caluori, Abrams, Beckman, Gelfand, & Gray, 2021). Similarly, although evolved mental tendencies may help account for composite monsters being widespread in cultures around the globe, this does not by itself account for the global distribution of these paradoxical beings. Therefore, we then turn to the question of what are the sociocultural correlates of composite beings. The variables for the sccs in Murdock and Provost (1973) described previously provided the measures for these further analyses.

One common claim in the scholarship discussed previously is that monsters, including composite beings, serve as symbols of social difference or deviance.

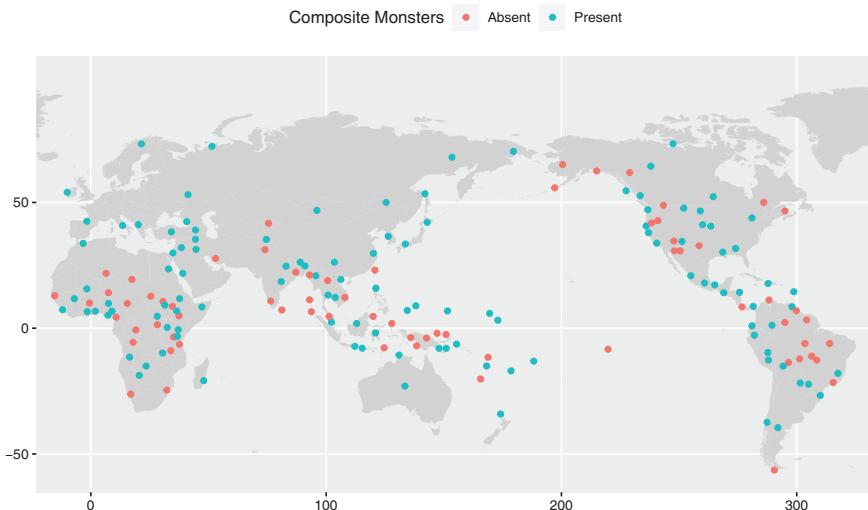


FIGURE 3 Map of SCCS societies by whether composite beings are present or absent

We might say that the category violations embodied by composite beings have greater interpretative potential in a context of greater internal distinctions between groups of people like those found in socially stratified societies. So is the presence of composites associated with increased social stratification in our global sample? Composite beings were more likely to be present in more hierarchically stratified societies (present in 43% of egalitarian societies, 63% of societies with wealth differences or hereditary slavery, 63% of societies with 2 social classes and no castes/slavery, 78% of societies with 2 social classes and castes/slavery, and 93% of societies with more than 3 social classes or castes, Kendall's rank correlation = 0.32, Fisher's exact test  $p = 0.00002$ ).

Also, historically composite beings are counted among the “ethnographical monsters” thought to inhabit distant lands, in sources as geographically and chronologically diverse as the Chinese *Guideways through Mountains and Seas* and early modern European travel literature. Does this reflect increased long-distance travel, perhaps resulting in increased concern with intersociety cultural differences? Murdock and Provost’s (1973) scale of Land Transport serves as our proxy measure for increased long-distance travel in SCCS societies. The presence of composite monsters varied significantly by scale of land transport, with the likelihood increasing with each level of complexity (present for human only: 51%, pack animals: 65%, draft animals: 85%, wheeled vehicles: 100%, rank correlation = 0.31, Fisher's exact test  $p < 0.0001$ ). In addition, the presence of composite monsters varied significantly by the fixity of the population (present for 52% of nomadic societies, 38% for seminomadic, 68% for

semisedentary, 40% for impermanent sedentary, and 73% of sedentary societies, Kendall's rank correlation = 0.20, Fisher's exact  $p = 0.0056$ ).

In the case of the Bronze Age Near East and Mediterranean, Wengrow (2013, 74) has argued that "urban and state-like societies" provided a setting conducive for composites. If this is generalizable to a global ethnographic sample, we ought to find composite beings associated with increased Urbanization and/or an increased Level of Political Integration (Murdock & Provost, 1973). Indeed, the presence of composite beings varied significantly by urbanization (societies of less than 100 people: 55%, 100–199: 53%, 200–399: 50%, 400–999: 75%, 1000+: 95%, rank correlation = 0.21, Fisher's exact test  $p = 0.0003$ ), and level of political organization (no political organization: 64%, autonomous local communities: 50%, 1 level above community: 63%, 2 levels: 64%, 3 levels: 90%, Kendall's rank correlation = 0.21, Fisher's exact test  $p = 0.004$ ).

Furthermore, Wengrow (2014) sees Bronze Age composite figures as operating according to the same underlying logic as particular crafting technologies and bureaucratic technologies of writing and record-keeping. In line with this, we found evidence that composite beings are globally associated with greater specialization in crafting technologies (none: 41%, pottery or loom: 59%, metallurgy: 66%, multiple specialists: 87%, Kendall's rank correlation = 0.27,  $p = 0.0004$ ) and recording-keeping technologies (none: 52%, mnemonic devices, 51%, non-written records: 76%, true writing: 86%, rank correlation = 0.25,  $p = 0.0003$ ). Similarly, the presence of composite beings varied significantly by complexity of monetary systems (rank correlation = 0.21,  $p = 0.007$ ), agriculture (rank correlation = 0.21,  $p = 0.02$ ), and population density (rank correlation = 0.20,  $p = 0.01$ ).

Thus far, we have found the presence of composite beings associated with each of Murdock and Provost's (1973) measures of cultural complexity. However, since different measures of sociocultural complexity tend to co-occur (Peregrine, Ember & Ember, 2004), how might we determine which of these variables are most important when accounting for the presence of composite beings in our global sample?

A machine learning method (decision trees and random forests) was used to identify the most efficient combination of variables to predict the presence of composite monsters. We then entered these variables into a predictive regression model to test significance. Decision trees are a computational method of making predictions by dividing the data into sub-sets (see Strobl, Malley & Tutz, 2009). The algorithm works out the most efficient series of binary questions to ask about a set of independent variables in order to make a guess about the dependent value of a data point. The method is robust to

correlations between independent variables and to small sub-sample sizes, and it can detect interactions and non-linearities in the data.

A single decision tree is the most efficient set of questions for the given dataset. However, small differences in the sample can lead to very different tree structures. One way of evaluating the relative importance of variables is to calculate a large number of decision trees (a “random forest”) using random sub-samples of data and independent variables. Each variable receives an “importance” score based on how many trees it is selected for and how high in the tree the variable is placed. (For the use of decision trees in social science, see Roberts (2018)).

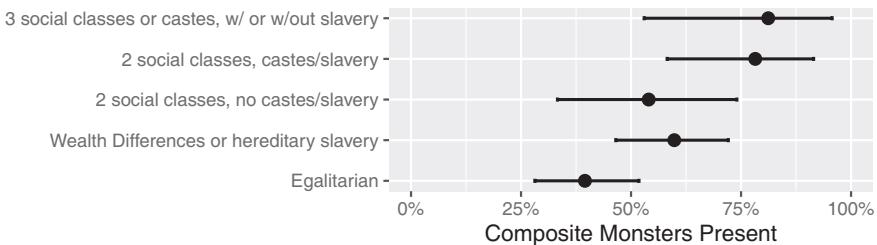
The process was run using the package *party* (Hothorn, Hornik, & Zeileis, 2006; Hothorn, Bühlmann, Dudoit, Molinaro, & Van Der Laan, 2006; Strobl, Boulesteix, Zeileis, & Hothorn, 2007; Strobl, Boulesteix, Kneib, Augustin, & Zeileis, 2008) on the ten independent variables above. Three most important variables were identified: social stratification, land transport, and fixity of the population (see supplementary materials for details).

A binomial regression model was fit to the data, predicting whether a composite being is present or absent. To control for the amount of documentation, the log number of pages of documentation in HRAF for each culture was entered as an independent variable in the baseline model. This predictor was significant, with the presence of composite monsters associated with more extensive documentation (mean pages of documentation for societies with composite monsters = 2535, without = 1139,  $\beta = 1.05$ ,  $z = 4.6$ ,  $p < 0.001$ ). Then, the sociocultural independent variables identified above were added to the model one by one in order of the random forests importance measure. In order to obtain a relatively simple model that is not over-fitted, this process was stopped when adding a variable did not significantly increase the fit of the model to the data, as evaluated using a likelihood ratio test.

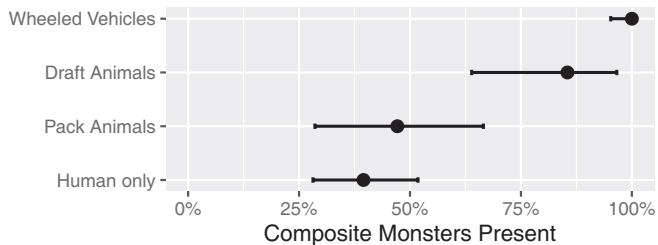
The final combined model included two variables: the degree of social stratification ( $\text{LR } \chi^2 = 18.5$ ,  $df = 4$ ,  $p = 0.001$ ) and the complexity of land vehicles ( $\text{LR } \chi^2 = 14.2$ ,  $df = 3$ ,  $p = 0.003$ ) (Figure 4). There was no significant interaction between these variables. This model accounted for 38% of the variance in the presence of composite beings (adjusted pseudo r-squared based on likelihood ratio tests), or 30% including only the cultural variables without the control for amount of documentation.

Comparison of the estimates for each level of each variable suggested that the critical threshold for social stratification is between the first level (egalitarian societies, composite beings present in 43%) and other levels (composite beings present in 73%). For land transport, the critical threshold is between

## Social Strata



## Land Vehicles



**FIGURE 4** Estimates and 95% confidence intervals from the combined model for the probability of the presence of composite beings according to different levels of social stratification and land transport

Note: These are derived using MCMC estimation using a binomial model in *brms* (Bürkner, 2021) with uninformative priors. The results are nearly identical to the standard regression reported in the main paper (coefficients are correlated at  $r = 0.998$ , all significance tests are qualitatively identical). The difference is that, in the standard regression, the confidence interval for societies with wheeled vehicles spans the whole probability range. This is misleading, and likely due to a convergence issue, since all societies with wheeled vehicles in our sample have composite monsters. The MCMC estimation leads to more reasonable confidence intervals. See the Supporting Information for more details of both models.

societies with only human or pack animal transport (composite beings present in 55%), and societies with more complex transport (composite beings present in 94%).

As mentioned previously, in nine cases possible composite beings were identified, but either the available descriptions were too vague or else the sources were judged an insufficient match to the SCCS time period or community. The results of the analysis above are robust to the uncertainty about the presence of composite beings for these societies. For example, all main tests are still significant when excluding the nine unclear cases. In addition, since the number of unclear cases is small, we ran the main tests above with all possible combinations of presence and absence (there are 512 possible combinations for nine societies). For all Fisher exact tests, there is no combination of the nine unclear

cases that increases the p-value above 0.05. Both variables in the final combined model remained significant for all combinations of settings, except for the 5 out of 512 cases where the pattern went exactly against the predictions. In this case, land transport was still significant, but social stratification became marginally non-significant.

## 5 Discussion and Conclusion

As we have discussed, a number of contemporary scholars (e.g. Boyer & Ramble, 2001; Sperber & Hirschfeld, 2004) argue that mythological beings like chimeras which violate the expectations of evolved universal cognition and folk biology are more easily recalled and culturally transmitted. While agreeing that such innate mental tendencies exist, Wengrow (2014, 110) argues that the distribution of representations of composite beings should be understood as “a historical product of technological and institutional environments” of early civilizations that cultivated this “otherwise latent mode of perception”. Upon investigating a global sample of societies we found that composite beings are a common, but not a near-universal, element of human culture. The presence of composite beings globally is positively associated with numerous measures of greater sociocultural complexity, including those invoked by Wengrow in his study of Bronze Age composites in western Eurasia. However, our analyses found that of these measures, those which best account for the global cross-cultural patterns are the presence of social stratification and the increased inter-group contact facilitated by land vehicles. These findings are consistent with previous scholarship that interprets such monsters as expressions of heightened concern with sociocultural difference, whether that is difference found within a given society or between societies across geographic distance (i.e. “ethnographical monsters”).

While the explanatory model explains a reasonable proportion of variance, composite monsters are still present in 32% of societies with neither formal social stratification nor complex land vehicles. This suggests three possibilities. The first is that the variables used here are not direct measures of the most relevant kinds of sociocultural difference. More data is needed to fully test some measures such as market integration, and a more direct measure of interest in foreign cultures may be possible to obtain.

The second possibility is that there may be additional explanations which are not captured in the current model. We recognize that some important claims of previous scholarship concerning composite beings were not examined here. We did not, for example, distinguish in our sample between those

composite beings which are understood as benevolent and others as malevolent. Furthermore, the possibility that composite beings are associated cross-culturally with other kinds of intrasociety differentiation besides social stratification was not evaluated. It seems likely that anxieties concerning sexuality and gender stratification inform the female composite monsters of Western traditions (Hopman, 2012; Miller, 2017). Future cross-cultural studies may determine whether these and other characteristics of composite beings are associated with particular features of society and culture globally as well.

The final possibility relates to the role of cultural transmission, which has not been addressed here directly. While we found no phylogenetic signal (indeed there was some evidence of overdispersion that might suggest resistance to borrowing), fully disentangling the historical evolution of composite monsters will require different kinds of data and analyses. These include continued historical, archaeological and ethnographic work on specific cases (e.g. Musharbash & Presterudstuen, 2014; 2020), and phylogenetic analyses of more closely related societies. Indeed, we suggest that composite monsters make an ideal testing ground for models of cultural evolution: they are constructs that are highly salient and functional within societies, but exist in the realm of human imaginations.

### Supplementary Information

All data and analysis scripts are available at: <https://github.com/seannyD/CompositeMonsters>

A searchable resource for the data sample is available at: <https://correlation-machine.com/CompositeMonsters>

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