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Exploring Communication Systems of Humans and Non-Human Animals: A Linguistic and Semiotic Perspective

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This study examines human and non-human animal communication from a linguistic–semiotic perspective to address the limitations of anthropocentric models that treat language and animal signaling as a strict dichotomy. Existing studies often emphasize human linguistic uniqueness without adequately accounting for semiotic continuities across species. To address this gap, the study conceptualizes communication as a semiotic continuum rather than a binary distinction. Using a qualitative comparative design, the research analyzes multimodal data from human communication and selected animal systems, including honeybee dances, dolphin echolocation, birdsong, and primate alarm calls. Data were examined through a coding framework based on Peircean semiotics and Hockett's design features to ensure analytical rigor and comparability. The findings indicate that human communication is distinguished by symbolic abstraction, open-ended productivity, recursion, and metacommunication. However, animal communication systems also demonstrate structured, intentional, and adaptive properties shaped by ecological and social demands. Continuities across species include proto-syntactic patterning in primate calls, cultural transmission in birdsong, and multimodal coordination in dolphins and bees. Despite these shared features, animal systems generally lack the generativity and metalinguistic reflexivity characteristic of human language. The study concludes that communication should be understood as a graded semiotic continuum, with human language representing the most elaborated form of meaning-making rather than an isolated system. This reconceptualization contributes to theories of language evolution and broadens semiotic inquiry by situating human communication within a wider ecology of signs.

Keywords: animal communication, human language, language evolution, semiotics, symbolic systems

ヒトと非ヒト動物におけるコミュニケーション体系の探求：言語学および記号論的な視点

本研究は、言語と動物の信号を全く異なるものとして扱う人間中心主義的なモデルの限界を克服するために，ヒトと非ヒト動物のコミュニケーションを言語・記号論的視点から検証した。既存の研究はしばしば、種間の記号論的連続性について十分な説明を行わずに、ヒトの言語の固有性を強調している。この隔たりを埋めるため，本研究ではコミュニケーションを二分法的な区別よりもむしろ記号論的な連続体として概念化する。質的比較設計を用いて、ヒトのコミュニケーションおよび，ミツバチのダンス，イルカのエコロケーション、鳥のさえずり、霊長類の警戒音（アラームコール）など選択された動物体系からのマルチモーダルなデータを分析した。分析の厳格性と比較可能性を保証するために、データはパースの記号論とホケットの設計特徴に基づくコーディング枠組みで検証された。得られた結果は，ヒトのコミュニケーションは象徴的な抽象性、非限定的な生産性、回帰、およびメタコミュニケーションによって区別された。しかし動物のコミュニケーション体系もまた、生態学的、社会的な要求によって形成された構造的、意図的かつ適応的な特性を有していることが実証された。種間の連続性には、霊長類のコールにおける原始的統辞論的（プロト・シンタクティック）なパターン、鳥のさえずりにおける文化的伝達、イルカとミツバチにおけるマルチモーダルな協調が含まれる。これらの共通した特徴を有しているものの、動物の体系は一般的にヒトの言語を特徴づける生成性とメタ言語的反照性を欠いていた。本研究は、コミュニケーションは段階的な記号論的連続体として理解されるべきであり、ヒトの言語は孤立した体系ではなく、意味生成の最も洗練された形態を具現化するものだと結論付ける。この再概念化は言語の進化の理論に寄与し、広範な記号の生態系の中にヒトのコミュニケーションの位置づけることで、記号論的探究を広げるものである。

キーワード：動物のコミュニケーション、ヒトの言語、言語の進化、記号論、象徴体系

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Una Exploración de los Sistemas de Comunicación de Animales Humanos y no Humanos: Una Perspectiva Lingüística y Semiótica.

El presente estudio examina la comunicación de animales humanos y no humanos desde una perspectiva lingüístico-semiótica para abordar las limitaciones de los modelos antropocéntricos que abordan el lenguaje y la señalización desde como una dicotomía estricta. Los estudios existentes a menudo enfatizan la singularidad lingüística humana sin considerar adecuadamente las continuidades semióticas entre especies. Para abordar esta brecha, el estudio conceptualiza la comunicación como un continuo semiótico en lugar de una distinción binaria. Mediante un diseño comparativo cualitativo, la investigación analiza datos multimodales de la comunicación humana y de sistemas animales seleccionados, incluyendo danzas de abejas, ecolocalización de delfines, canto de aves y llamadas de alarma de primates. Los datos se examinaron a través de un marco de codificación basado en la semiótica Peirceana y las características de diseño de Hockett para garantizar el rigor analítico y la comparabilidad. Los resultados indican que la comunicación humana se distingue por la abstracción simbólica, la productividad abierta, la recursión y la metacomunicación. No obstante, los sistemas de comunicación animal también demuestran propiedades estructuradas, intencionales y adaptativas moldeadas por las demandas ecológicas y sociales. Las continuidades entre especies incluyen patrones protosintácticos en las vocalizaciones de los primates, transmisión cultural en el canto de las aves y coordinación multimodal en delfines y abejas. A pesar de estas características compartidas, los sistemas animales generalmente carecen de la generatividad y la reflexividad metalingüística propias del lenguaje humano. El estudio concluye que la comunicación debe entenderse como un continuo semiótico gradual, donde el lenguaje humano representa la forma más elaborada de creación de significado, en lugar de un sistema aislado. Esta reconceptualización contribuye a las teorías de la evolución del lenguaje y amplía la investigación semiótica al situar la comunicación humana dentro de una ecología de signos más amplia.

Palabras clave: comunicación animal, lenguaje humano, evolución del lenguaje, semiótica, sistemas simbólicos

Symbolic communication is a defining feature of human interaction, enabling individuals to convey abstract meanings, cultural values, and social identities through shared systems of signs. Unlike basic signaling tied to immediate stimuli, human communication relies on arbitrary and conventional symbols whose meanings are collectively negotiated within specific cultural contexts (Arafah & Hasyim, 2023; Tchertov, 2019). This symbolic capacity allows for the transmission of complex ideas across generations and underpins cultural continuity, education, and social organization (Dúeñez-Guzmán et al., 2023). As such, language and other symbolic systems function not merely as tools of expression but as mechanisms through which societies preserve, reinterpret, and transform knowledge over time.

However, much of the existing scholarship treats symbolic communication as an exclusively human domain, reinforcing a sharp dichotomy between human language and animal signaling. Linguistic theories grounded in rule-governed systems—such as grammar, syntax, and pragmatics have been central to explaining the generative and recursive properties of human language (Chomsky, 1989). These frameworks successfully account for uniquely human features such as displacement, productivity, and metalinguistic reflexivity, but they often marginalize non-human communication by defining it in terms of what it lacks rather than what it accomplishes.

At the same time, a growing body of research demonstrates that animal communication systems are far from random or purely instinctive. Studies on birdsong, primate alarm calls, and cetacean vocalizations reveal structured, intentional, and context-sensitive signaling patterns that support survival and social coordination (Birchenall, 2016; Coye et al., 2018; Seyfarth & Cheney, 2017). These findings challenge anthropocentric assumptions and suggest the presence of rule-like regularities and semiotic complexity in non-human communication. Nevertheless, attempts to analyze animal signaling through strictly human linguistic categories—such as syntax or grammar—have proven theoretically limited and, in some cases, misleading (Fitch, 2017; Hauser, 2014).

This tension reveals a clear research gap. While linguistics has been effective in distinguishing the unique properties of human language, it lacks the conceptual flexibility to adequately capture the ecological, multimodal, and species-specific dynamics of animal communication. Conversely, many studies of animal signaling do not sufficiently integrate linguistic insights into broader theoretical frameworks. As a result, communication across species is often treated as categorically divided rather than systematically related.

To address this gap, this study adopts a semiotic perspective that conceptualizes communication as a continuum of meaning-making practices across species. Drawing on Peirce's triadic model of semiosis and Sebeok's framework of zoosemiotics, the study moves beyond binary distinctions between human language and animal signaling. Semiotics provides an inclusive lens that accommodates symbolic, indexical, and iconic signs, enabling a more balanced comparative analysis of human and non-human communication systems.

Accordingly, the objective of this study is to investigate the communication systems of humans and selected animal species through a linguistic–semiotic framework in order to identify points of convergence and divergence. By comparing human communication with systems such as honeybee dances, birdsong, dolphin vocalizations, and primate alarm calls, the study aims to demonstrate that while human language represents the most elaborated form of symbolic communication, animal communication also constitutes meaningful, adaptive, and structured semiosis. This reconceptualization contributes to discussions on language evolution and expands semiotic inquiry by situating human communication within a broader ecology of signs.

Semiotics Foundation

Semiotics, as the sciences of signs, provides a theoretical foundation for understanding communication systems across both human and non-human domains. Saussure (1998), defines semiotics—sémiologie—as the study of "the life of signs within society," highlighting the social and structural nature of meaning-making. In human contexts, this involves arbitrary signifiers and culturally shared conventions, while in animals, communication is often grounded in signals directly linked to biological imperatives. Thus, semiotics offers a comparative framework that allows both continuity and distinction to be examined without reducing one system to the other. Peirce (1991) further advances semiotics by proposing a triadic model of signs: the sign (or representamen), the object, and the interpretant. Unlike Saussure's dyadic approach, Peirce's framework accommodates dynamic processes of interpretation across species. Animal signals, such as alarm calls or mating songs, can be understood through this model as signs pointing to objects (predators, mates, food) and interpreted by conspecifics. This makes Peirce's theory especially valuable for bridging the gap between human symbolic language and animal signaling, situating both within the broader continuum of semiosis (Sebeok, 1968) extends Peirce's ideas by establishing zoosemiotics, the study of sign processes in non-human species. Sebeok emphasized that communication should not be confined to human language but instead viewed as a universal semiotic phenomenon encompassing all living organisms. This perspective allows animal communication to be analyzed on its own terms rather than judged against human linguistic benchmarks. By doing so, Sebeok dismantled anthropocentric biases and broadened semiotic theory to include biological and ecological contexts.

From a linguistic standpoint, scholars like Hockett (1960) highlighted specific design features that distinguish human language from animal communication, such as displacement and productivity. However, these features also demonstrate the limits of linguistics when applied to animals. Semiotics, unlike linguistics, does not insist on syntax or recursion as prerequisites for meaning. Instead, it recognizes that meaning emerges from the interaction between signs, contexts, and interpreters, making it a more flexible tool for studying cross-species communication. Eco-semiotics further enriches this discussion by exploring how signs operate within ecological systems. Kull (1999) argues that communication in nature is not merely functional but also semiotic, involving interpretative processes that sustain ecosystems. For instance, the warning colors of a poisonous frog or the territorial songs of bird's function as signs within broader ecological networks. These examples demonstrate how semiotic foundations extend beyond linguistic categories, offering insights into the interconnectedness of life.

In humans, semiotics also explains how communication transcends immediate contexts through symbolism and abstraction. As Barthes (2021) suggested, cultural systems are constructed through layers of signification, allowing humans to generate myths, ideologies, and narratives. Animals, while often limited to indexical or iconic communication, nonetheless participate in semiosis through their ability to recognize, respond to, and interpret signs. This continuity between humans and animals underscores the importance of semiotic theory in exploring evolutionary pathways. The study of communication systems from a semiotic perspective also carries implications for language evolution. Fitch et al. (2010) noted that biolinguistics often misrepresents animal communication when it applies purely linguistic categories. By contrast, semiotics provides a framework that situates human language as a specialized form of a more general semiotic capacity. This suggests that symbolic language did not emerge in isolation but evolved gradually from earlier sign-based systems. Semiotics, therefore, offers a more comprehensive account of the evolutionary trajectory of communication.

Moreover, semiotics helps explain the multimodality of communication across species. Kress & Leeuwen (2001) emphasized that communication is inherently multimodal, involving not only speech but also gestures, images, and sounds. In animals, multimodality manifests in complex displays such as bee dances, bird songs, or primate facial expressions. Viewing these behaviors through semiotic foundations reveals them as coordinated sign systems rather than isolated signals, thereby expanding our understanding of communicative complexity. Importantly, semiotics redefines the boundaries of meaning-making by shifting the focus from linguistic absence to semiotic presence. Instead of asking why animals lack syntax or grammar, semiotic inquiry investigates how animals produce and interpret signs within their ecological niches. This aligns with Kwok (2020) who claimed that semiotics is the most inclusive sciences of communication, encompassing both human and non-human worlds. Such a reorientation not only enhances the study of animal communication but also deepens our appreciation of the semiotic richness of human language.

Therefore, semiotic foundations provide a robust theoretical lens for exploring communication systems in humans and animals. Through the contributions of Saussure, Peirce, Sebeok, Hockett, Kull, Barthes, and others, it becomes evident that communication is best understood as a continuum of semiosis rather than a dichotomy between human language and animal signals. Semiotics acknowledges both the symbolic abstraction of human language and the ecological functionality of animal communication, thereby bridging disciplinary divides. Ultimately, this perspective enriches both linguistic inquiry and semiotic theory, offering profound implications for understanding language evolution, cultural transmission, and the shared semiotic capacities that unite all living beings.

Humans Language & Communication

Humans' language represents the most advanced and complex form of communication known to date, distinguished by its symbolic, generative, and cultural dimensions. Unlike animal signaling, which is often bound to immediate biological or environmental stimuli, human language possesses the unique capacity to transcend the here and now. As Horton & Gerrig (2005) argued displacement and productivity remain defining features of human communication, enabling speakers to discuss past and future events, as well as create infinite novel utterances. This foundational distinction situates human language as more than a biological necessity—it is also a cultural and cognitive instrument. The symbolic nature of humans' language is another defining feature. De Saussure (1985) explained that linguistic signs are arbitrary and conventional, meaning there is no inherent connection between the signifier (word form) and the signified (concept). This arbitrariness allows languages to evolve independently of the physical world, granting humans the ability to construct abstract concepts such as justice, love, or democracy. Non-human animals, by contrast, rely heavily on indexical or iconic signs, which remain tied to the physical and ecological contexts in which they operate. Roberts et al. (2023) further reinforced the uniqueness of human language by introducing the concept of universal grammar, an innate mental capacity that allows humans to generate an infinite number of grammatical sentences. This theory emphasizes the recursive and hierarchical nature of human syntax, which is absent in animal communication systems. While some species display remarkable vocal abilities such as songbirds or cetaceans these lack the recursive structures that underpin human linguistic creativity.

Humans' communication is also shaped by pragmatics, the study of meaning in context. According (Pennycook, 2004; Searle, 1989), language is not merely descriptive but performative, capable of enacting actions such as promising, commanding, or declaring. This performative function of humans' language highlights its role in constructing social realities, something not observed in animal communication systems, which remain primarily functional and survival-oriented. The cultural dimension of human language cannot be overlooked. Mykhailyuk & Pohlod (2015) argued that language is both a reflection of and a shaping force for culture, influencing how speakers perceive and categorize the world. This principle, known as linguistic relativity, demonstrates how human communication extends beyond biological imperatives to encompass cultural identity, worldview, and ideology. Such a role is far removed from the limited ecological signaling seen in animals. Humans' language is also inherently multimodal, involving not just spoken words but gestures, facial expressions, writing, and digital media (Finnegan, 2023) emphasized that meaning in humans' communication is often constructed through multiple modes operating simultaneously. While animals also employ multimodal signals, such as combining sounds with visual displays, human multimodality is far more expansive, encompassing symbolic systems like writing, music, and art.

Another distinguishing feature of human communication is its reflexivity. Humans can use language to reflect upon language itself, a phenomenon known as metalinguistic awareness. Jakobson (1960) identified this as the metalingual function of language, which allows humans to discuss, analyze, and modify their communicative practices. No evidence suggests that animals possess such reflexive capacities, reinforcing the idea that human language operates at a qualitatively different level. Humans' communication also plays a central role in social organization and power structures. Foucault (1972) argued that discourse is not neutral but intertwined with power and knowledge, shaping societal norms and institutions. This perspective illustrates how human language goes beyond survival to construct ideologies, laws, and cultural narratives that govern collective life. In contrast, animal communication primarily serves immediate social functions such as mating, warning, or establishing territory. From a semiotic perspective, Palmaru (2012) highlighted how humans' communication generates secondary systems of meaning, or mythologies, through which culture is reproduced and contested. This underscores the depth of human semiotic capacity, in which communication not only conveys information but also constructs symbolic universes. Such layered signification is absent in animal communication, which lacks the symbolic abstraction necessary for myth-making or ideology.

Therefore, humans' language and communication represent a uniquely symbolic, generative, and culturally embedded system that transcends the limitations of animal signaling. Within the comparative framework of semiotics, human language emerges not as an isolated phenomenon but as the most elaborated expression of semiosis. Its uniqueness lies not only in its structural complexity but also in its ability to shape thought, culture, and society, distinguishing it profoundly from the communication systems of other species.

Animal Communication Case Clusters

The study of non-human animal communication has often been approached through detailed case clusters, each revealing distinct modalities and semiotic strategies. Unlike the universalist frameworks often applied to human language, animal communication tends to be contextual, adaptive, and species-specific. By examining these case clusters, ranging from insects to marine mammals, scholars can discern both parallels and divergences in communicative functions, highlighting the complexity of non-human semiotic systems. Casoli et al. (2022) demonstrated through his Nobel-winning research that honeybees perform a “waggle dance” to indicate the location of food sources. This system relies on encoding spatial and directional information through patterned bodily movements, a semiotic mechanism that goes beyond mere instinct and indicates symbolic capacity. Sebeok (2011) classified this as a form of zoosemiotics, showing that even insects can engage in communication systems with rule-governed structures. Birdsong represents another important case cluster. Hyland Bruno et al. (2021) argued that birdsong is not only an innate capacity but also shaped by learning and social transmission, resembling cultural processes in human language. The structured patterns of rhythm, pitch, and variation in birdsong convey territorial boundaries, mating readiness, and social hierarchy. This duality of innate and learned features challenges rigid distinctions between animal signals and human linguistic creativity.

In marine contexts, dolphins and whales illustrate highly sophisticated communication strategies. Johnson (2019) emphasized that animal use of echolocation involves not just sonar for navigation but also intentional exchanges of information, suggesting cognitive mapping of their social and ecological environment. Similarly, Garland & McGregor (2020) revealed the patterned complexity of humpback whale (*Megaptera novaeangliae*) songs, which evolve seasonally and spread socially, exhibiting cultural transmission akin to linguistic diffusion. Primates, particularly great apes, offer crucial insights into the semiotic boundary between humans and animals. Lyn (2007) showed that bonobo (*Pan paniscus*), such as Kanzi, could learn lexigrams and demonstrate intentional use of symbols to communicate with humans. While these systems lack the full grammatical productivity of human language, they demonstrate semiotic flexibility and intentionality, suggesting that language evolution may have roots in shared cognitive and communicative capacities. Another compelling case is found in elephants (*Elephantidae*) . Garstang (2004) documented their use of infrasound low-frequency vocalizations traveling several kilometers to maintain social bonds and coordinate movements across large distances. These vocalizations function not only as signals but also as affective carriers of identity, emotional states, and group belonging. From a semiotic perspective, this indicates a layered communicative structure that parallels human reliance on prosody and tone. Social insects such as ants and termites present communication systems based less on vocal or gestural modalities and more on chemical semiotics. Jackson et al. (2011) described pheromone trails as a primary mechanism of ant communication, enabling complex coordination of colony activities. These signals are efficient, durable, and contextually adaptive, illustrating that meaning can emerge from biochemical codes rather than vocal articulation, expanding the scope of semiotics beyond speech-like models.

Furthermore, studies of canine communication shed light on multimodal signals. Peltola & Simonen (2024) argued that dogs (*Canis lupus familiaris*), through domestication, developed an enhanced ability to interpret human gestures, gaze, and vocal intonation, effectively creating interspecies semiotic systems. This demonstrates how evolutionary pressures and social environments can reshape communicative repertoires, creating hybrid systems that blur the line between animal and human interaction. Each of these case clusters demonstrates the inadequacy of applying narrow linguistic categories to animal communication. Teravainen-Goff (2022) contended that while human language is uniquely generative, animal systems exhibit complexity, intentionality, and adaptability that resist reduction to instinct alone. By adopting a semiotic lens, scholars can recognize the richness of these communicative systems without imposing anthropocentric standards. In synthesis, animal communication case clusters from bees to whales, from ants to apes reveal a spectrum of semiotic strategies that expand our understanding of communication beyond human confines. These systems challenge the exclusivity of language as a human domain while affirming that meaning-making is a universal biological phenomenon.

Method

The present study adopts a qualitative-comparative research design grounded in linguistic and semiotic inquiry. This design is particularly suitable for examining the complexity of communication across species, as it does not limit the analysis to quantifiable units but instead emphasizes the interpretive richness of communicative acts. Qualitative approaches allow for a nuanced exploration of symbolic, indexical, and iconic dimensions of communication, while the comparative element highlights both convergences and divergences between human and non-human systems. The corpus and materials of this study consist of multimodal data representing communicative practices among humans and selected animal species. For humans, data are drawn from transcripts of spoken interactions in both natural and controlled settings, including conversational exchanges, narratives, and ritualized forms of speech. For animals, materials include published case studies and recorded data on honeybee dances, dolphin echolocation and signature whistles, bird, and primate gestural communication. This cross-species corpus ensures that the study captures a diverse spectrum of communicative modalities. The study employs a set of instruments and a coding scheme adapted from semiotic and linguistic analysis. A semiotic coding scheme, following Peirce's triadic model of signs, categorizes signals as icons, indices, or symbols. Data are coded by mapping observed communicative behaviors into these frameworks, allowing for systematic comparison between human language and animal communication systems. To enhance validity, inter-coder reliability checks are employed, with multiple researchers independently applying the coding scheme.

The procedures of this study involve several stages. First, data collection relies on integrating secondary materials such as published video recordings, spectrograms, and transcripts with primary observation of selected human communicative events. Second, coding is applied iteratively, beginning with open coding to identify emergent patterns, followed by axial coding to establish relationships between categories. Finally, selective coding synthesizes the findings into thematic clusters that reflect the semiotic and linguistic dimensions of communication across species. Ethical considerations are also addressed by ensuring transparency in data use and respecting the ecological contexts from which animal communication data were obtained.

Furthermore, the data analysis plan combines qualitative content analysis with semiotic interpretation. Linguistic features are examined through discourse analysis, identifying structural and functional patterns in human language use. For animal communication, semiotic analysis highlights how signals function as meaningful acts within their ecological and social contexts. Comparative analysis then integrates these findings, emphasizing both the continuities and discontinuities between humans and animals. The analysis moves beyond surface description toward interpretive depth, aiming to uncover the implications of semiotic processes for theories of language evolution and communication studies. Taken together, this methodology provides a systematic yet flexible framework for exploring the intersections of linguistics and semiotics in cross-species communication. By combining a comparative research design, a diverse corpus, robust coding schemes, and rigorous analytical procedures, the study ensures that its findings are both empirically grounded and theoretically significant.

Results

Descriptive Profiles

The descriptive profiles generated from this study provide a panoramic overview of how communication systems unfold across humans and animals when examined through a linguistic and semiotic lens. Rather than treating human language as a solitary phenomenon, the analysis positions it within a broader continuum of communicative practices shared with non-human species. This comparative stance illuminates both striking parallels such as the reliance on indexical and iconic signals and fundamental divergences,

particularly the uniquely expansive symbolic capacity of humans. By mapping communication onto key dimensions including medium, repertoire, function, and evolutionary adaptability, these profiles reveal how different species deploy semiotic resources to navigate their ecological and social realities. Crucially, the descriptive lens does not merely catalogue similarities and differences; it uncovers the semiotic strategies that underpin survival, identity, and meaning-making across species. This framing allows the subsequent data analysis to move beyond binary contrasts and instead highlight the layered, dynamic nature of communicative systems in both humans and animals.

Table 1

Descriptive Profiles of Human and Animal Communication Systems

Aspect	**Humans' Communication Profiles**	**Animals' Communication Profiles**	**Comparative Notes**
Medium	Multimodal: verbal, nonverbal, written, digital	Sound, gesture, dance, chemical signals	Humans are more flexible and layered
Repertoire	Open, creative, productive	Closed, limited to specific patterns	Humans are capable of creating new units
Primary Functions	Information dissemination, emotional expression, identity construction, aesthetic articulation, and ritual performance.	Navigation, signaling of danger, reproductive communication, and identity marking.	Animal communication, by contrast, tends to be predominantly survival-oriented.
Semiotic Dimensions	Symbolic, indexical, and iconic modes operating in complex combinations.	Predominantly indexical and iconic, with limited symbolic capacity.	Human symbolism is characterized by a higher degree of abstraction.
Social Contexts	Conversation, narrative, and cultural institutions.	Flocks, colonies, and small social groups.	Both forms involve interconnected social networks.
Evolutivity	Adaptive, developing across generations and technologies.	Relatively stable, determined by ecological and genetic factors.	Human beings possess a distinctly cultural evolutionary history.
Displacement	The capacity to refer to past and future events.	Minimal, typically bound to the immediate context.	Hockett identifies displacement as a uniquely human feature.
Metacommunication	The ability to reflect upon and discuss communication itself.	Not explicitly observable in non-human systems.	Self-referential communication is considered exclusive to humans.

The descriptive profile of human communication reveals a uniquely multimodal character, encompassing spoken language, writing, gesture, facial expression, and increasingly, digital forms of interaction. This multimodality enables humans to transmit messages across a wide spectrum of representational levels, from literal denotations to highly abstract symbolic constructions. By contrast, non-human animals tend to rely on a narrower range of media such as vocalizations, bodily movements, or chemical signals. Although both systems are semiotically grounded in the use of signs, the flexibility and multiplicity of human communicative media far surpass those available to other species.

From the perspective of repertoire, human communication systems are open and productive. Speakers are capable of inventing neologisms, restructuring syntactic patterns, and articulating abstract or hypothetical concepts. Animal communication, on the other hand, is typically closed. For instance, the honeybee's waggle dance consistently follows fixed patterns to indicate the direction and distance of nectar sources, with little scope for variation beyond this ecological function. This contrast illustrates the singular human capacity to generate entirely new signs and meanings that transcend immediate biological imperatives. The primary functions of communication further underscore this divergence. Human communication extends far beyond survival, encompassing emotional expression, identity construction, artistic creativity, and the organization of social and institutional life. Animal communication is largely pragmatic, serving functions such as predator warnings, mate attraction, or coordination of group movement. Thus, while human communicative practices foreground aesthetic and reflexive dimensions, animal systems remain primarily oriented toward biological necessity.

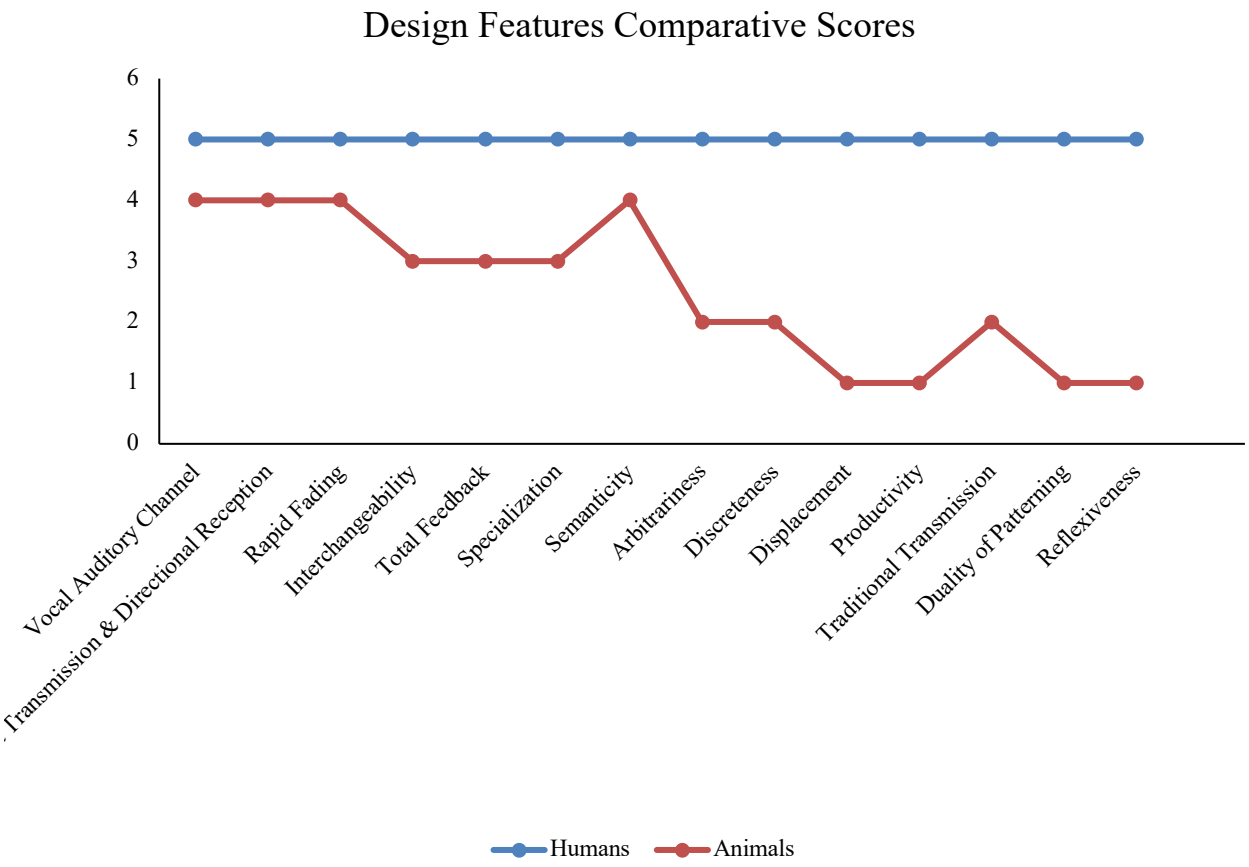
At the semiotic level, human interaction engages symbolic, indexical, and iconic dimensions in complex combinations. Even a simple conversation may integrate words (symbolic), vocal intonation (indexical), and metaphorical imagery (iconic). In contrast, animal communication is predominantly indexical and iconic. A non-human primate's alarm call is a clear index of a predator's presence, while birdsong often demonstrates iconic mimicry of environmental sounds. Symbolic capacity in animals is extremely limited, emerging only in proto-symbolic forms such as dolphins' signature whistles. Social context represents an important point of convergence. Humans engage in communication within daily conversations, cultural institutions, and collective narratives, whereas animals interact within flocks, colonies, or small social groups. However, the scale and complexity of human social networks are unparalleled, extending into formal institutions, systems of law, and globalized media. In this sense, communication functions not only as a means of coordination but also as a primary instrument for the construction of civilization.

Design Features Comparative Scores

In examining the comparative scores of design features across human and animal communication systems, this study seeks to illuminate the degree to which Hockett's classic framework remains instructive when viewed through a contemporary semiotic perspective. The analysis does not simply quantify the presence or absence of each feature; rather, it interprets how these features manifest with varying intensities and functional adaptations in different species. For humans, design features such as productivity, displacement, and reflexivity emerge with unparalleled robustness, shaping language into an open-ended, culturally embedded system. In contrast, animal communication systems exhibit selective strengths—precision in indexical signaling among bees, acoustic individuality in dolphins, or mimicry in birds—that demonstrate evolutionary optimization within specific ecological niches. By translating these qualitative distinctions into comparative scores, the descriptive profiles highlight both the convergences that suggest shared semiotic roots and the divergences that underscore the singular trajectory of human language evolution. This framework thus provides a sharper analytical lens, situating language not as an isolated phenomenon but as part of a continuum of communicative strategies that bridge humans and non-humans.

Figure 1

Design Features Comparative Scores



The comparative scoring results underscore that all of Hockett's design features manifest at full intensity in humans (score 5), whereas animals exhibit only partial and constrained variations. This aligns with Hockett's (1960) seminal theory that human language constitutes the most complex and productive communication system known. Although animals display certain features with considerable strength, none approach the integrative completeness of human systems. For foundational features such as the vocal–auditory channel and broadcast transmission, both humans and animals register high scores (5 vs. 4). Birdsongs and dolphin whistles, for instance, reveal auditory capacities that closely approximate human vocalization. Yet, humans surpass these systems by virtue of multimodal flexibility, seamlessly shifting from speech to writing, or to technologically mediated digital platforms.

The feature of rapid fading—where signals disappear once produced—appears prominently in both humans and animals. Human speech is inherently transient, just as animal calls dissipate once uttered. However, humans transcend this biological limitation through cultural and technological innovations, such as writing, sound recording, and digital storage. Animals, by contrast, remain bound to the ephemerality of their signals, with no structural means to extend their communicative temporality. Interchangeability and total feedback reveal more striking contrasts (5 vs. 3). In human communication, each participant functions simultaneously as sender and receiver, with full capacity to reflect upon and respond to their own speech. In animal systems, this reciprocity is limited; while some primates can imitate one another's vocalizations, they lack the open-ended bidirectionality and reflexive monitoring that characterize human interaction. Specialization provides an even clearer differentiation. Human utterances serve primarily symbolic and communicative purposes, whereas many animal vocalizations remain inseparable from biological or emotional states—such as cries of distress or signals of reproductive readiness. This divergence emphasizes the high degree of functional differentiation in human language, in which communication is abstracted from immediate physiological expression. Semanticity emerges as a relative point of convergence. Both humans and animals can convey specific meanings; primates, for example, employ distinct calls to differentiate between eagle and leopard threats. Yet, animal semanticity remains confined to concrete, situational references. Humans, conversely, can generate meanings that extend into the abstract, metaphorical, and symbolic, producing an inexhaustible range of interpretive possibilities. Arbitrariness and discreteness constitute critical points of divergence (humans scoring 5, animals 2). Animal communication often relies on iconic or indexical relationships—for instance, primate alarm calls are directly linked to specific predators. Human language, by contrast, rests on the principle of arbitrariness, whereby signs bear no inherent connection to their referents, enabling the construction of expansive symbolic systems. Discreteness, or the ability to combine discrete units into larger meaningful wholes, is also far more advanced in humans, underpinning the productivity of linguistic expression.

Displacement and productivity highlight perhaps the most decisive separation. Full displacement (score 5) is exclusively human, allowing references to past, future, and hypothetical scenarios. Animal communication seldom displays this capacity, with the honeybee's waggle dance standing as a rare exception, offering a highly specific but limited spatial displacement. Productivity is almost absent in animals due to their closed repertoires, while humans perpetually create new lexical items, syntactic innovations, and conceptual categories. The feature of traditional transmission (5 vs. 2) further distinguishes humans. Although some animals, such as songbirds, display rudimentary forms of social learning, human language depends fundamentally on cultural transmission across generations. This includes the inheritance of dialects, accents, stylistic registers, and innovations mediated by technological change.

Finally, duality of patterning and reflexiveness stand as uniquely human hallmarks. Animals lack systems that combine meaningless units into meaningful structures, and they show no explicit capacity for metacommunication—the ability to reflect upon and analyze communication itself. These features underscore the claim that human language represents not merely a more elaborate variation of animal communication, but rather a qualitative leap within semiotic evolution.

Multimodality Patterns

The examination of multimodality patterns offers a crucial entry point into understanding the layered complexity of communication across humans and animals. By looking beyond single-channel exchanges, this analysis reveals how meaning is constructed, reinforced, or even contested through the simultaneous use of multiple semiotic resources verbal, vocal, gestural, visual, and spatial. In human communication, multimodality emerges as a deeply integrated practice where speech, gesture, and symbolic artifacts coalesce to produce dense semiotic layering. In contrast, animals employ multimodality in more functionally constrained ways, such as bees combining movement and vibration, or dolphins pairing whistles with bodily orientation. This comparative lens not only highlights the convergences where different species strategically coordinate channels for effective signaling but also underscores the divergences in scope, creativity, and reflexivity. By tracing these multimodal patterns, the findings move beyond cataloguing modalities to expose how communicative systems are ecologically situated and evolutionarily optimized, offering insights into the semiotic continuum that binds and differentiates humans and non-humans alike.

Table 2

Multimodality Patterns in Human and Animal Communication

Species/System	Modalities Combined	Pattern Characteristics	Design Features Connection
Humans	Speech + Gesture + Facial Expression + Writing + Digital media	High integration, reflexive, abstract layering	Productivity, Reflexiveness, Displacement
Bees	Dance movements + Vibrations + Spatial orientation	Precision in indexical signaling, eco-specific	Broadcast Transmission, Semanticity
Dolphins	Whistles + Echolocation clicks + Body posture	Individual identification and spatial coordination	Interchangeability, Semanticity
Birds	Vocal imitation + Wing/feather display	Performative signaling, partly symbolic	Vocal-auditory, Rapid Fading

Patterns Identified:

- Integration Pattern – Humans uniquely integrate multiple modalities into cohesive semiotic systems.
- Eco-functional Pattern – Animals' multimodality is tightly bound to ecological survival.
- Constraint Pattern – Non-human systems show limited productivity and lack reflexiveness.
- Continuum Pattern – Shared reliance on voice + body modalities signals semiotic roots.
- Expansion Pattern – Human multimodality extends into displacement and abstract symbolism.

The multimodal patterning of human communication underscores a consistent symbolic superiority, fully aligned with the maximal scoring of design features (5) across all categories. The integration of speech, gesture, facial expression, and writing demonstrates a highly coordinated integration pattern in which each modality complements and reinforces the others. This integrative complexity enables not only limitless productivity but also reflexiveness—the capacity to discuss and analyze communication itself two features entirely absent in non-human systems. By contrast, the multimodality of honeybees illustrates an eco-functional pattern. Through precise combinations of dance movements, bodily vibrations, and spatial orientation, bees are able to indicate direction and distance to food sources with remarkable accuracy. Their scores on broadcast transmission and semanticity reach a relatively high level (4), yet remain strictly confined to ecological contexts. While undeniably efficient, this system does not support displacement or open-ended productivity in the manner of human language.

Dolphins present another form of multimodal communication, combining identity-specific signature whistles, echo locative clicks, and body postures. This configuration corresponds to relatively high scores in interchangeability and semanticity (3–4), as dolphins can recognize individuals and coordinate spatial navigation. However, their multimodal signals remain functionally tied to identification and coordination rather than advancing toward abstract symbolism. Thus, while impressive, dolphin communication illustrates a form of multimodality constrained by ecological utility. Birds display multimodality through vocalizations complemented by visual displays such as wing or feather movements. This pattern aligns with strong scores in the vocal–auditory channel and rapid fading (4). Yet, avian multimodality remains performative and contextual, lacking the duality of patterning essential to language. Even when birds mimic environmental sounds, the imitative creativity does not evolve into productive combinatorial systems. Consequently, the system remains aesthetically compelling but semiotically limited. Primates exhibit multimodal repertoires comprising vocal calls, gestures, and facial expressions. These behaviors are consistent with mid-range scores (around 3) in total feedback and specialization, as primates can coordinate signals to express emotion or to alert others to predators. Yet, their multimodality is circumscribed by immediate survival contexts, exhibiting a constraint pattern rather than the open-ended flexibility characteristic of humans.

When analyzed across the continuum, both humans and animals rely fundamentally on voice and body as the basis of multimodality. The divergence lies in the semiotic quality of these signals: human vocalizations are articulated as arbitrary symbols, while animal sounds are predominantly iconic or indexical. This distinction corresponds to the scoring differences in arbitrariness and discreteness, with humans attaining the highest possible values (5) and animals ranking considerably lower (2). Human multimodal expansion transcends face-to-face communication, extending into symbolic media such as writing, art, and digital platforms. This expansion pattern is directly linked to the features of traditional transmission (5) and displacement (5), allowing humans not only to transmit multimodal signs across generations but also to engage in discourse about non-immediate, temporal, and historical phenomena. No other species demonstrates multimodal expansion with equivalent temporal and cultural depth.

In comparative perspective, the relatively high semanticity scores of animals (3–4) confirm that their multimodality produces context-specific meanings. Yet these meanings remain bound to immediate ecological situations. Human multimodality, by contrast, extends semanticity into abstraction, metaphor, and collective symbolic systems. This shift demonstrates that language functions not merely as a biological tool but as a cultural instrument of knowledge, identity, and social organization. The interconnection between multimodal patterns and reflexiveness is especially telling. Only humans employ multimodality to discuss multimodality itself. For example, a lecturer may simultaneously use speech, gestures, and visual diagrams to explain the nature of human communication. Such meta-communicative capacity highlights that multimodal patterns are not simply technical mechanisms but constitute a uniquely human arena of reflective practice.

Finally, animal multimodal patterns demonstrate ecological sophistication yet remain limited by the absence of productivity, displacement, and reflexiveness. Human multimodal patterns, by contrast, reflect the full scoring of design features, integrating complementary modalities, expanding into cultural and technological domains, and enabling reflexive analysis. This multimodal analysis therefore reinforces the claim that human communication stands on a semiotic continuum with animal systems, yet surpasses biological constraints to enter the realm of culture, abstraction, and symbolic creativity.

Intentionality and Combinatoriality

The exploration of intentionality and combinatoriality within communication systems serves as a critical window into the cognitive and semiotic sophistication that distinguishes human language while also illuminating continuities with animal signaling. Intentionality highlights the degree to which communicators design their messages with an audience in mind, adjusting signals in ways that anticipate interpretation and response. Combinatoriality, in turn, underscores the capacity to merge discrete units sounds, gestures, or symbols into patterned sequences that yield layered meanings. When examined comparatively, these features reveal distinct trajectories: humans display advanced audience design, repair strategies, and sequential meaning-making that allow for negotiation, creativity, and reflexivity; animals, though more constrained, exhibit selective instances of audience-sensitive signaling, corrective adjustments, and ordered combinations, such as primate gestural sequences or dolphins' patterned whistles. By framing the findings around audience design, repair strategies, and sequentiality, the analysis uncovers not only structural divergences but also shared semiotic logics that challenge rigid human–animal divides. This perspective situates communication as an evolving continuum of intentional and combinatorial practices, where complexity emerges in diverse yet interconnected forms.

Table 3

Intentionality and Combinatoriality

Dimension	Humans	Animals
Audience Design	Messages tailored to interlocutors; sensitivity to status, familiarity, and context.	Selective audience sensitivity (e.g., primates altering calls based on group composition).
Repair Strategies	Explicit repair through clarification requests, rephrasing, or gestures.	Limited repair observed; primates sometimes repeat or exaggerate signals when misunderstood.

The analysis of audience design underscores the profound intentionality that humans exhibit when constructing messages tailored to specific interlocutors. Human communication is not merely a matter of signal transmission but is embedded within layers of social cognition and cultural awareness. Individuals consciously account for variables such as social hierarchy, relational proximity, and prevailing cultural norms when encoding their messages, ensuring that communication aligns with contextual expectations. By contrast, non-human species display a more restricted yet functionally significant form of audience sensitivity. Primates, for instance, alter their vocalization patterns in the presence of particular group members, signaling an awareness of their audience, albeit within a narrower cognitive and semiotic scope.

These findings demonstrate that intentionality in human communication cannot be reduced to biological mechanisms alone, but is also inherently cultural. Message design in human interaction integrates symbolic systems, prosodic modulation, and multimodal gestures, all orchestrated to resonate with the expectations of the audience. In animal communication, similar though less elaborate strategies are observable. Honeybees, for example, calibrate the intensity of the waggle dance to optimize its comprehensibility within the colony, yet this adaptation lacks the reflexive awareness characteristic of human communication.

Within the domain of repair strategies, humans exhibit a highly explicit and reflexive system for managing communicative breakdowns. Such mechanisms manifest through clarification requests ("What do you mean?"), self-repair formulations ("I mean to say…"), and supplementary gestural cues that reinforce or amend verbal output. Animals, by contrast, rarely demonstrate deliberate repair strategies. Nevertheless, research on primates reveals that they occasionally repeat or amplify signals when the initial attempt fails, suggesting the presence of rudimentary, proto-repair mechanisms that sustain social coordination.

The critical distinction between humans and animals lies in the degree of metalinguistic awareness. Humans possess a reflexive capacity to recognize communicative failure and to engage in strategies aimed at rectification, reflecting advanced levels of symbolic and pragmatic consciousness. Animal repairs, in contrast, tend to be mechanical and context-driven, operating without evidence of reflective monitoring. Even so, the repetition and intensification of signals among primates can be interpreted as evolutionary precursors to the sophisticated repair strategies that characterize human dialogue. The dimension of sequential meaning reveals a sharp divergence between human and non-human systems. Human communication relies on combinatorial rules and syntactic organization, enabling the construction of narratives, arguments, and complex explanations that unfold in logical sequence. Animals, while lacking full-fledged syntax, nevertheless exhibit meaningful sequential structuring. Chimpanzees, for instance, combine gestures in patterned ways, and birds produce alarm calls in ordered variations, each conveying distinct situational information. Dolphins provide an especially compelling example, generating structured whistle chains that serve to reinforce group identity and social cohesion. Although these sequences do not achieve the recursive complexity of human syntax, they nevertheless indicate a semiotic capacity for layered meaning construction. Such evidence supports the view that sequentiality is not the sole prerogative of humans but rather exists along a continuum of communicative capacities across species. These observations affirm that combinatoriality in human communication is generative and open-ended, permitting the creation of an infinite array of novel meanings. In contrast, animal combinatorial systems are generally closed, oriented toward specific adaptive functions such as danger signaling, emotional expression, or group coordination. Yet even within these constraints, animal communication exhibits semiotic tendencies toward increasing complexity, pointing to deep evolutionary continuities.

From a semiotic perspective, the intentionality, audience-sensitivity, repair mechanisms, and sequential structures observed in animals can be regarded as proto-linguistic strategies that prefigure the emergence of human language. While lacking the symbolic flexibility of human systems, these features demonstrate that the foundations of complex communication are already embedded within non-human species. The theoretical implication of this analysis is that communication must be conceptualized not as a rigid dichotomy between humans and animals but as an evolutionary spectrum. Intentionality, repair, and sequentiality constitute a developmental continuum in which humans occupy the generative-symbolic pole, while animals exhibit early yet meaningful instantiations of these principles. Such a perspective illuminates the transitional processes by which indexical and iconic signals evolved into the abstract symbolic systems of human language.

Consequently, this inquiry strengthens the argument that cross-species communication should be interpreted not only as an adaptive response to ecological pressures but also as an arena in which semiotic capacities progressively unfold. Intentionality, repair, and sequential meaning thus provide critical insights into the evolutionary roots of language, rendering this line of research significant both empirically and theoretically for the study of linguistic evolution and semiotic theory.

Discussion

The findings presented in this study invite a deeper reflection on the dynamic interplay between human and non-human communicative systems, highlighting both convergent strategies and divergent pathways shaped by evolution, ecology, and cognition. Moving into the discussion, it becomes essential to shift from descriptive comparison toward a more critical engagement with what these similarities and differences imply for our broader understanding of language and semiotics. The question is no longer whether animals "have language" in the human sense, but how their communicative repertoires embody semiotic principles that overlap with, and diverge from, human symbolic capacities. By interrogating issues such as intentionality, multimodality, repair mechanisms, and sequential meaning, the discussion aims to situate language not as an isolated human privilege but as a continuum of semiotic practices distributed across species. This perspective challenges anthropocentric hierarchies and opens new possibilities for theorizing language evolution, communication ethics, and cross-species semiotics.

The comparative profile of human and animal communication underscores a fundamental semiotic and functional divergence that scholars have long emphasized. Hockett (1960), through his design features of language, already distinguished human systems by their openness, displacement, and reflexivity, traits absent in animal signaling. This aligns with Vigliocco et al. (2014) view that language constitutes not merely a biological adaptation but a cultural and symbolic system that perpetually reinvents itself through multimodality. By contrast, animal repertoires remain primarily closed and ecologically determined, a point corroborated by Sebeok(1995), who argued that animal semiosis, while sophisticated, is largely constrained by survival imperatives rather than creative or aesthetic pursuits. The multimodal nature of human communication encompassing speech, writing, gesture, and digital interaction further attests to its symbolic depth. Vigliocco et al. (2014) stress that multimodality expands the representational resources available for meaning-making, allowing humans to shift seamlessly between literal, metaphorical, and abstract dimensions. Animal systems, although capable of integrating vocalizations, bodily signals, and chemical cues, operate within narrower semiotic channels. The honeybee's waggle dance, often celebrated for its ecological precision, exemplifies a system of remarkable informational value but lacks the productivity that enables humans to generate neologisms, metaphors, and hypothetical constructs. At the functional level, Jakobson (1960) model of communication illustrates that human language exceeds transactional purposes, serving emotive, poetic, and metalinguistic functions. This explains why communication is central not only to coordination and survival but also to identity construction, artistic expression, and the institutionalization of knowledge. By contrast, animal communication is typically indexical and iconic, oriented toward immediate environmental contingencies such as predator alerts or reproductive signaling (Seyfarth & Cheney, 2003). Symbolic communication in animals, as seen in dolphins' whistles or primate alarm calls, remains proto-symbolic and rarely extends into reflexive commentary.

The evolutionary trajectory reinforces this divide. Acerbi (2016) proposes that human communication evolved through stages mimetic, mythic, and theoretic culminating in literate and digital cultures that transcend biological limitations. Animal communication, while adaptive, remains relatively fixed, guided by ecological pressures rather than cumulative cultural elaboration. O'Madagain & Tomasello (2022) emphasize culture as a selective force in human evolution, enabling language to function not merely as a biological signal but as a tool of collective intentionality and shared understanding. Two features crystallize the uniqueness of human communication: displacement and metacommunication. Displacement allows reference beyond the here and now, enabling historical narration and future projection, while metacommunication permits reflexive discussion about communicative practices themselves. Both are absent in animal systems, which remain tethered to immediate contexts. These distinctions, however, do not render animal systems inferior but reveal divergent evolutionary adaptations. As Sebeok (1968) reminds that each species develops communicative strategies attuned to its ecological niche, with the honeybee dance demonstrating a level of spatial abstraction unparalleled in other non-human species.

Furthermore, the comparative scoring outcomes strongly reinforce Hockett (1960) proposition that human language uniquely embodies the full spectrum of design features, whereas animal communication manifests only fragmentary and constrained forms. This comprehensive realization of features positions human communication as the most productive and flexible system known, consistent with Christiansen et al.'s (2011) view that language represents a cultural and symbolic resource rather than a mere biological adaptation. While animals achieve partial strengths such as auditory capacities demonstrated in birdsong and dolphin whistles these systems lack the integrative multimodality that allows humans to transition seamlessly from oral speech to writing and digital media (Kress & Leeuwen, 2001). Thus, the comparative scoring not only validates Hockett's theoretical model but also situates human communication within a broader cultural and technological continuum that animals cannot replicate. The feature of rapid fading provides an instructive example of how humans transcend biological limitations. Like animal calls, human speech is inherently transient; however, through literacy, recording technologies, and digital storage, humans have structurally extended the temporality of communication. Donoghue (1996) highlights this as the critical shift from orality to literacy, enabling discourse to outlast the speaker's presence. Animals, by contrast, remain bound to the ephemeral nature of their signals, with no structural capacity for permanent preservation or deferred interpretation. This contrast underscores the role of culture as an evolutionary force in human communication (Tamariz et al., 2014).

Interchangeability and total feedback further sharpen this divide. Humans exhibit reflexive reciprocity, functioning simultaneously as senders and receivers, capable of monitoring, critiquing, and adjusting their utterances. Tamariz et al. (2014) capture this capacity for reflexive commentary, absent in most animal systems. While some primates imitate conspecific vocalizations (Hauser, 1996), they lack the open-ended bidirectionality and metacommunicative sophistication of human dialogue. Similarly, specialization highlights how human utterances are abstracted from immediate biological states, serving symbolic and communicative functions. Fernald (2023) emphasizes that while many animal signals are tied directly to physiological conditions such as distress cries or reproductive calls human speech achieves a high degree of detachment, allowing meaning to be constructed independent of bodily states. Semanticity offers partial convergence yet reveals human distinctiveness in scope. Both humans and animals can assign specific meanings to signals, as in vervet monkey alarm calls that differentiate predators (Seyfarth et al., 1980b). However, human semanticity extends beyond concrete referents to encompass metaphorical, symbolic, and abstract domains. Lakoff & Johnson (2020) argue that human thought itself is structured metaphorically, demonstrating how language allows conceptualization far removed from immediate context. Animals, by contrast, remain bound to situational specificity. The principle of arbitrariness, paired with discreteness, constitutes perhaps the most radical point of departure. Animal communication often relies on iconic and indexical signs directly tied to referents whereas human language thrives on arbitrary conventions, generating expansive symbolic systems. As Peters & Ritchie (1973) posits, it is precisely this arbitrariness that grants language its combinatorial and generative power. Discreteness further amplifies this by enabling the recombination of minimal units (phonemes, morphemes) into infinite expressions, a property absent in animal repertoires.

Displacement and productivity crystallize the decisive uniqueness of human communication. Displacement permits humans to refer to past, future, or hypothetical events, a feature absent in animal systems except for narrow ecological cases such as the honeybee waggle dance (Root-Bernstein, 2010). Productivity follows from displacement and discreteness, enabling the endless creation of new words, syntactic constructions, and conceptual innovations. Human linguistic competence is fundamentally open-ended (Tchertov, 2019).

Moreover, the multimodal patterning of human communication exemplifies what Veronesi (2014) describes as the "semiotic ensemble," wherein different modes—speech, writing, gesture, and visual expression—interact cohesively to amplify meaning. The maximal scoring of design features (5 across categories) is not accidental, but rather a structural outcome of this integrative semiotic capacity. Unlike animal systems that remain bound to ecological functionality, human multimodality demonstrates symbolic superiority by embedding reflexivity, or what Jakobson (1960) termed the metalingual function: the ability to use language to discuss language itself. This reflexive potential is absent in animal communication, even in the most sophisticated cases such as dolphins or primates, marking a decisive boundary between symbolic flexibility and ecological constraint. Honeybee communication

provides a striking counterpoint, aligning with what Dixon (2023) characterized as a system of "precision ecology." The waggle dance is multimodal—combining body movement, vibration, and spatial orientation—yet its functionality is tightly bounded to food localization. The relatively high scores in semanticity and broadcast transmission (4) illustrate efficiency without symbolic abstraction. (Mukute, 2015) argues that such eco-functional systems should not be dismissed as primitive, but understood as finely tuned semiotic adaptations to survival. Nonetheless, their closed nature reinforces Jerome's (1932) claims that productivity and displacement remain uniquely human features. Bruck & Pack (2022) reveal a more complex multimodality through signature whistles, echolocation, and body postures. This repertoire supports identification, coordination, and social bonding, corresponding to mid-to-high scores in interchangeability and semanticity (3–4).

Birds, too, demonstrate multimodal integration, combining song with wing or feather movements. Price (2013) emphasizes that while birdsong displays extraordinary acoustic variation and even mimicry, it does not evolve into combinatorial productivity. Their strong scores in the vocal–auditory channel and rapid fading (4) align with a performative repertoire that is aesthetically compelling but semiotically limited. The absence of duality of patterning—what Hockett identified as the ability to recombine minimal units—prevents avian multimodality from achieving the generativity found in human language. Primates occupy an intermediate position, employing calls, gestures, and facial expressions in coordinated repertoires. Seyfarth et al. (1980a) show that primate alarm calls exhibit semantic specificity, distinguishing predators like leopards or eagles. However, the system remains contextually bound, yielding scores around 3 for feedback and specialization.

When the continuum is assessed holistically, the divergence becomes semiotic rather than merely quantitative. Humans and animals alike depend on voice and body as basic channels, yet the symbolic quality of human signs arbitrary, discrete, and combinatorial elevates their semiotic scope. Human communication thus represents a qualitative leap, where modalities do not merely coordinate signals but instantiate symbolic systems with infinite productivity. Unlike animals, whose communicative repertoires remain bounded by immediacy, humans extend multimodal patterns temporally and culturally across generations. This expansion pattern corresponds directly to traditional transmission (5) and displacement (5), embedding communication into the structures of culture, law, sciences, and memory. This cultural transmission is the true evolutionary driver of linguistic complexity (Smith & Kirby, 2008).

Interestingly, the relatively high semanticity scores in animals (3–4) indicate that multimodality is not meaningless but rather ecologically situated. Vervet monkeys' predator-specific calls or dolphins' identity whistles demonstrate that animal multimodality produces concrete meanings. Yet, as Barsalou (2003) observes only humans extend meaning into metaphor, abstraction, and symbolic systems. This gap reveals the transformation of communication from a survival tool into a cultural instrument of knowledge and identity. The most decisive difference lies in reflexivity. Humans uniquely employ multimodality to explain and critique multimodality itself. A teacher using speech, gestures, and diagrams to explain communication exemplifies this meta-communicative capacity. Lucy (2010) stresses that reflexivity is not simply an advanced feature but a categorical shift, situating human language as both object and medium of analysis. Animal systems, however complex, lack this recursive dimension.

Furthermore, the analysis of audience design vividly demonstrates the profound intentionality embedded in human communication. Pérez-Sabater (2021) highlights that speakers do not simply deliver messages but strategically orient them toward an "imagined audience," adjusting tone, style, and modality according to relational dynamics and social expectations. Keysar & Henly (2002) argue that speakers continuously recalibrate their language in response to addressees, overhearers, and even imagined listeners. Such reflexive design underscores that human communication is simultaneously symbolic and cultural, going beyond signal transmission toward a socially embedded semiotic practice.

By contrast, animal communication, while less expansive, still reveals traces of audience sensitivity. Struhsaker (1968) shows that call types vary depending on the group composition and the presence of dominant individuals. This selective signaling suggests that animals possess an elementary form of audience awareness, albeit limited to immediate ecological and hierarchical contexts. However, as Heyes & Dickinson (1990) note while animals exhibit intentionality in directing signals, they lack the cultural scaffolding that allows humans to integrate symbolic codes, prosody, and multimodal gestures into fully audience-tailored interactions. Repair strategies further sharpen the divide between human and animal systems. Dingemanse & Enfield (2024) demonstrate that humans employ elaborate repair mechanisms clarification requests, self-repair, repetition, or multimodal supplementation revealing a metalinguistic capacity to monitor and amend interaction in real time. This reflexivity enables communication to be sustained even under conditions of misunderstanding. Animals, however, rarely demonstrate explicit repair strategies. The presence of proto-repair in primates suggests important evolutionary continuities. As Buckley (2017) argues even minimal repair behaviors indicate that communicative systems are adaptive and flexible, preserving coordination in socially complex environments. These rudimentary strategies may represent evolutionary precursors of the highly reflexive mechanisms that dominate human conversation. From a semiotic standpoint, such proto-repairs can be viewed as early markers of metacommunicative potential—a necessary step toward the development of language as a self-referential system. Sequential meaning marks another critical point of divergence. Human communication relies on what Chomsky (1957) termed "generative grammar," where discrete elements are combined recursively to create infinite variations of meaning. This combinatoriality allows humans to construct narratives, arguments, and discourses with complex logical and temporal sequencing. By contrast, animal communication exhibits sequentiality in more bounded forms.

The comparative perspective here is not one of deficiency but of continuum. Engesser & Townsend (2019) emphasizes that combinatorial communication exists in graded forms across species, with humans extending these systems into the open-ended symbolic domain. Bird alarm calls, primate gestural chains, and dolphin whistle sequences each demonstrate semiotic layering, but they lack recursion the hallmark of human syntax. Nevertheless, the very presence of ordered sequencing in non-human systems points toward deep evolutionary roots in the capacity for structured meaning-making. While animal systems embody intentionality in directing signals for survival purposes, human intentionality is enriched by symbolic abstraction and cultural mediation. McConachy (2013) reminds that language is not only an instrument of communication but a meta-pragmatic system that reflexively comments on itself. This reflexive awareness explains why humans can design messages for imagined audiences, repair breakdowns with deliberate strategies, and construct sequential meanings that extend into myth, law, and sciences.

Taken together, these findings affirm that intentionality, repair, and sequentially are not discrete human inventions but evolutionary continuities shaped along a developmental spectrum. Humans occupy the generative-symbolic pole, marked by arbitrariness, recursion, and metalinguistic reflexivity. Animals, meanwhile, embody proto-forms of these features indexical audience design, rudimentary repair, and patterned sequentially that sustain ecological adaptation. Farina et al. (2021) argue that these semiotic strategies must be understood as species-specific solutions, each finely tuned to survival and social organization. The theoretical implication of this analysis is that communication should be reconceptualized not as a dichotomy but as a continuum of semiotic complexity. From honeybees' calibrated waggle dances to human rhetorical debates, all systems reveal intentional design, yet at varying levels of abstraction and cultural embedding. Heesen et al. (2017) capture this trajectory as the evolution of "shared intentionality," where animal coordination evolves into human symbolic cooperation. This spectrum highlights that the emergence of language was not a sudden leap but the gradual amplification of features already presents in ancestral systems.

Theoretical Integration

The analysis of audience design underscores the profound intentionality that humans exhibit when constructing messages tailored to specific interlocutors. Human communication is not merely a matter of signal transmission but is embedded within layers of social cognition and cultural awareness. Individuals consciously account for variables such as social hierarchy, relational proximity, and prevailing cultural norms when encoding their messages, ensuring that communication aligns with contextual expectations. By contrast, non-human species display a more restricted yet functionally significant form of audience sensitivity. Primates, for instance, alter their vocalization patterns in the presence of particular group members, signaling an awareness of their audience, albeit within a narrower cognitive and semiotic scope. These findings demonstrate that intentionality in human communication cannot be reduced to biological mechanisms alone, but is also inherently cultural. Message design in human interaction integrates symbolic systems, prosodic modulation, and multimodal gestures, all orchestrated to resonate with the expectations of the audience. In animal communication, similar though less elaborate strategies are observable. Honeybees, for example, calibrate the intensity of the waggle dance to optimize its comprehensibility within the colony, yet this adaptation lacks the reflexive awareness characteristic of human communication.

Within the domain of repair strategies, humans exhibit a highly explicit and reflexive system for managing communicative breakdowns. Such mechanisms manifest through clarification requests ("What do you mean?"), self-repair formulations ("I mean to say…"), and supplementary gestural cues that reinforce or amend verbal output. Animals, by contrast, rarely demonstrate deliberate repair strategies. Nevertheless, research on primates reveals that they occasionally repeat or amplify signals when the initial attempt fails, suggesting the presence of rudimentary, proto-repair mechanisms that sustain social coordination. The critical distinction between humans and animals lies in the degree of metalinguistic awareness. Humans possess a reflexive capacity to recognize communicative failure and to engage in strategies aimed at rectification, reflecting advanced levels of symbolic and pragmatic consciousness. Animal repairs, in contrast, tend to be mechanical and context-driven, operating without evidence of reflective monitoring. Even so, the repetition and intensification of signals among primates can be interpreted as evolutionary precursors to the sophisticated repair strategies that characterize human dialogue. The dimension of sequential meaning reveals a sharp divergence between human and non-human systems. Human communication relies on combinatorial rules and syntactic organization, enabling the construction of narratives, arguments, and complex explanations that unfold in logical sequence. Animals, while lacking full-fledged syntax, nevertheless exhibit meaningful sequential structuring. Chimpanzees, for instance, combine gestures in patterned ways, and birds produce alarm calls in ordered variations, each conveying distinct situational information.

Dolphins provide an especially compelling example, generating structured whistle chains that serve to reinforce group identity and social cohesion. Although these sequences do not achieve the recursive complexity of human syntax, they nevertheless indicate a semiotic capacity for layered meaning construction. Such evidence supports the view that sequentially is not the sole prerogative of humans but rather exists along a continuum of communicative capacities across species. These observations affirm that combinatoriality in human communication is generative and open-ended, permitting the creation of an infinite array of novel meanings. In contrast, animal combinatorial systems are generally closed, oriented toward specific adaptive functions such as danger signaling, emotional expression, or group coordination. Yet even within these constraints, animal communication exhibits semiotic tendencies toward increasing complexity, pointing to deep evolutionary continuities.

From a semiotic perspective, the intentionality, audience-sensitivity, repair mechanisms, and sequential structures observed in animals can be regarded as proto-linguistic strategies that prefigure the emergence of human language. While lacking the symbolic flexibility of human systems, these features demonstrate that the foundations of complex communication are already embedded within non-human species. The theoretical implication of this analysis is that communication must be conceptualized not as a rigid dichotomy between humans and animals but as an evolutionary spectrum. Intentionality, repair, and sequentially constitute a developmental continuum in which humans occupy the generative-symbolic pole, while animals exhibit early yet meaningful instantiations of these principles. Such a perspective illuminates the transitional processes by which indexical and iconic signals evolved into the abstract symbolic systems of human language. Consequently, this inquiry strengthens the argument that cross-species communication should be interpreted not only as an adaptive response to ecological pressures but also as an arena in which semiotic capacities progressively unfold. Intentionality, repair, and sequential meaning thus provide critical insights into the evolutionary roots of language, rendering this line of research significant both empirically and theoretically for the study of linguistic evolution and semiotic theory.

Implication and Contribution

Comparative findings redirect the study of language evolution away from the rigid dichotomy of "language versus non-language" toward a model of evolutionary continuum. Features such as audience design, sequentially, and proto-repair in primates, dolphins, and bees illustrate that the cognitive and behavioral substrates of complex communication were already present in non-human ancestors. The theoretical implication is that the evolution of language was most likely mosaic in nature an accumulation and reinforcement of multiple capacities (combinatoriality, social learning, multimodal coordination)—rather than the product of a single leap. This supports approaches emphasizing the interplay between biological capacities and cultural scaffolding (e.g., Tomasello, Deacon) in accounting for the emergence of human symbolism.

At the mechanistic level, comparative results imply that combinatoriality and recursion are not "ex nihilo" human inventions but rather evolved from prior capacities to order and combine units for adaptive functions. Quantitative differences (larger repertoires, unlimited productivity) and qualitative innovations (metacommunication, displacement) appear only when social learning and cultural transmission enable the accumulation of communicative innovations. Hence, models of language evolution must integrate intergenerational dynamics—tracing how multimodal innovations become disseminated, standardized, and reinforced by social institutions. For semiotics, the implication is an expansion of analytical frameworks. The Peircean triad (icon–index–symbol) remains highly valuable, yet cross-species evidence demands a more integrated semiotics: multimodal analysis, biosemiotics, and cultural contextualization. Semiotic inquiry must integrate sensitivity to the iconicity and indexicality dominant in animal communication with Saussurean principles of arbitrariness and structure in human language, thereby producing a typology of signs capable of spanning the spectrum from bee dances to human metaphors. In this way, semiotics can effectively bridge ethological studies with formal linguistics.

From pedagogical perspective, however, these "failures" can serve as learning triggers. (Agustin & Siswana, 2022) observed that Indonesian students who identified and corrected Mt's idiomatic mistakes actually improved their awareness of contextual meaning. Such post- editing tasks align with Schmidt's Noticing Hypothesis, whereby students internalize language patterns through error connection. Seen this way, idiomatic mistranslations are not merely obstacles but opportunities for language awareness pedagogy.

A sociocultural lens also provides insight that idioms embody cultural worldviews. When NMT mishandles them, it reveals the cultural distance between L1 and L2 and invites learners to engage with those gaps. This study's focus on South Sulawesi is especially relevant, since local idioms and cultural markers are unlikely to appear in global training datasets. Thus, the mismatch is sharper, offering a unique testing ground for how students adapt. By foregrounding these localized experiences, the study exposes the unevenness of NMT's "universal" promise and underscores the role of culture in shaping usability.

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Methodologically, these findings encourage interdisciplinary, multi-level approaches. Human multimodal corpora, animal ethological recordings, social learning experiments, neuroimaging, and computational modeling must be synthesized to rigorously test evolutionary hypotheses. For example, cultural transmission models can examine when and how simple signal sequences evolve into more complex discursive systems, while neurocognitive studies may identify memory and attentional mechanisms that underlie combinatoriality. The emerging integrative framework coherently aligns three levels of analysis: (a) formal structures (combinatorial mechanics, duality of patterning), (b) multimodal semiotics (icon/index/symbol in action), and (c) socio-pragmatic dynamics (shared intentionality, audience design). Practically, this yields more parsimonious, empirically grounded theories that honor the insights of formal linguistics while recognizing semiotic homologues in other species.

Within conservation, the recognition that many animals possess complex communicative systems—cultural dialects in whales, song traditions in birds, or informational structure in bee dances—reshapes ethical and policy frameworks. Communication is no longer to be seen merely as individual behavior but as part of a species' culture that warrants protection. Policy implications are profound: conservation must extend to the safeguarding of soundscapes, migratory communication routes (e.g., whale pathways), and social structures that enable cultural transmission, not solely to the preservation of physical habitats. Operational recommendations include long-term passive acoustic monitoring, mitigation of marine and terrestrial noise pollution, protection of critical social groups (e.g., marine mammal families), and legal recognition of "non-human cultures" in policy documents. Collaboration among ethologists, linguists, policymakers, and local communities would enhance effectiveness: communication data can serve both as indicators of population well-being and as early-warning systems for ecological disruption. Conservation ethics also undergo transformation: acknowledging communicative and cultural capacities in animals necessitates sharper normative debates regarding animal rights, human intervention, and conservation priorities. While anthropomorphism unsupported by evidence must be avoided, moral weight must nonetheless be accorded to the destruction of non-human communication systems and cultures—for instance, the loss of whale dialects caused by population fragmentation.

For future research and policy, the implications call for an integrated agenda: (a) open-access cross-species multimodal databases, (b) longitudinal studies capturing cultural transmission, (c) adaptive models linking ecological disruption to communicative degradation, and (d) translation of scientific findings into evidence-based conservation policies. Investment in acoustic technologies, social tracking, and public education will facilitate these goals. Finally, the philosophical and sociocultural implications cannot be overlooked: the recognition of communicative continua challenges traditional boundaries between humanity and nature, reshaping how sciences, law, and the public conceptualize "culture" and "language." It promotes an ethics of interconnection—affirming that safeguarding communicative diversity is integral to preserving both biological diversity and human cultural heritage.

Limitations and Future Work

First, the most evident limitation lies in the taxonomic scope and modalities analyzed. Existing literature and field corpora are disproportionately concentrated on a handful of "model" species (primates, birds, whales, bees, dolphins), while numerous other phyla—non-apid insects, cephalopods, and microorganisms—likely harbor distinct semiotic strategies that remain underrepresented. Consequently, generalizations about the "spectrum" of cross-species communication risk biasing toward the most observable or historically salient cases. For evolutionary validity, broader taxonomic sampling and balanced coverage of modalities (acoustic, visual, gestural, chemical, mechanosensory) are imperative. Second, many studies rely on asynchronous or fragmented data (short recordings, controlled experiments versus naturalistic observations), which often results in the loss of pragmatic context. Communication is inherently contextual; short recordings lacking metadata—environmental conditions, social structure, life-cycle stage—severely constrain functional interpretation. The absence of standardized metadata further complicates cross-study comparison and increases the risk of misattributing communicative function to specific signals. Third, annotation bias and coding schemes represent systemic challenges. Human annotators carry theoretical assumptions (e.g., labeling "call X = alarm"), and research cultures influence granularity. Inter-coder variation, low reliability, and heterogeneous coding protocols across laboratories hinder replication and meta-analysis. Automation alleviates some issues but inherits biases if training data are unrepresentative. Fourth, technological constraints and sensor sensitivity hinder the capture of certain modalities, particularly chemical communication and signals at frequency extremes. Microphones, hydrophones, and high-speed cameras remain limited in range and resolution; chemical detectors (GC-MS, SPME) are rarely employed in tandem with behavioral recordings at scale. Insufficient methods risk under-sampling subtle signals—such as quantitative pheromones or ultrasonic pulses—skewing multimodal representations. Fifth, conceptual bias shapes interpretation: dominant evaluative frameworks (e.g., Hockett's design features) facilitate comparison but narrow focus toward specific aspects (vocality, productivity) and implicitly privilege human symbolism as the benchmark. Such approaches risk marginalizing semiotic modalities (chemical, electromagnetic) that do not conform neatly to classical categories. A pluralist theoretical stance is needed to avoid overlooking non-linguistic communicative innovations. Sixth, functional assumptions are often difficult to substantiate: correlations between signals and behavioral responses do not necessarily reveal underlying cognitive mechanisms or internal representations. Misattributing referentiality or intentionality remains a methodological risk—especially when analyses rely solely on associative frequency without causal testing (e.g., playback, chemical manipulation). Seventh, ethical and conservation constraints pose further barriers. Threatened populations and habitat disturbance restrict longitudinal sampling and invasive experimentation. Fragmented datasets from small populations may introduce cultural artifacts (loss of dialects, fragmentation of vocal traditions) that obscure natural patterns. Thus, field limitations are not merely technical but fundamentally ethical.

Future research directions must strategically prioritize chemical communication. Many taxa—insects, small mammals, fish—deploy complex semiochemical repertoires (pheromones, aggregation/repellent semiochemicals) that remain poorly integrated into cross-species multimodal corpora. Recommended methodologies include chemical sampling (SPME), GC-MS molecular profiling, behavioral bioassays for functional validation, and electroantennography (EAG) or patch-clamp to assess sensory receptivity. Integrating chemical data with high-resolution video, environmental metrics, and behavioral catalogs will allow for stronger functional inference. Equally critical is the longitudinal study of ontogenetic trajectories of communication. Central questions concern how multimodal signals accumulate across development and the relative contributions of social learning versus genetic predispositions. Experimental designs such as cross-fostering, tutorship manipulation, and juvenile cohort tracking can disentangle learning processes. Integration of genetic/transcriptomic tools (e.g., RNAseq) to examine expression of genes linked to vocal or pheromonal behaviors will further connect communicative phenotypes to biological mechanisms.

From an analytical standpoint, urgent advances are needed: (a) development of standardized multimodal annotation ontologies with training protocols and reliability metrics; (b) unsupervised machine learning for pattern discovery (clustering, motif detection) beyond human labeling biases; (c) agent-based and cultural evolutionary modeling to test hypotheses on how simple signal sequences accumulate into productive systems; and (d) quantitative phylogenetic comparative methods to examine correlations between communicative features and ecological niches. The future research agenda must be interdisciplinary and ethically grounded: teams should integrate ethologists, organic chemists, linguists, cognitive scientists, computational modelers, and conservation policymakers. Required infrastructure includes open multimodal repositories (audio, video, chemical), standardized ethical protocols, and capacity-building programs in biodiversity-rich regions. Long-term funding and investment in innovative sensor technologies are essential; without them, gaps in taxonomic coverage and annotation biases will continue to constrain our understanding of communicative spectra.

Finally, current limitations taxonomic scope, annotation bias, technological constraints, and ethical boundaries restrict the inferences possible in cross-species communication studies. Yet, a roadmap for integrated research prioritizing chemical communication, longitudinal ontogeny, standardized annotation, and evolutionary modeling offer concrete strategies to close knowledge gaps. Such approaches will not only enrich linguistic and semiotic theory but also provide a stronger scientific foundation for conservation policies that recognize and protect the communicative heritage of non-human species.

Conclusion

This study demonstrates that human and animal communication should not be understood through a rigid dichotomy but as a semiotic continuum shaped by evolutionary, ecological, and cultural forces. The comparative analysis shows that while human communication uniquely exhibits symbolic abstraction, open-ended productivity, recursion, and metalinguistic reflexivity, these advanced features are grounded in proto-communicative capacities observable across non-human species. Audience sensitivity, sequential patterning, and rudimentary repair mechanisms found in primates, birds, dolphins, and bees indicate that the foundations of complex communication predate the emergence of fully symbolic language.

Theoretically, the findings support a shift away from strictly linguistic frameworks toward an integrated semiotic perspective. Hockett's design features remain valuable for identifying qualitative distinctions, but when combined with Peircean semiotics and zoosemiotics, they allow communication to be conceptualized as graded rather than categorical. Human language emerges as the most elaborated form of semiosis—distinguished by arbitrariness, discreteness, and reflexivity—yet it remains evolutionarily continuous with indexical and iconic systems in animals. This integration refines theories of language evolution by framing linguistic uniqueness as an amplification of pre-existing semiotic strategies rather than a sudden rupture.

The study contributes to semiotic theory by demonstrating that meaning-making is multimodal, species-specific, and ecologically embedded. It also has broader implications for biolinguistics and biosemiotics, emphasizing the role of social learning, cultural transmission, and multimodal coordination in the emergence of symbolic systems. Beyond theory, the findings carry ethical and practical implications: recognizing communicative complexity in non-human species challenges anthropocentric assumptions and supports conservation approaches that protect not only habitats but also animal communicative cultures, such as birdsong traditions or cetacean acoustic systems.

Despite these contributions, the study has limitations. The analysis relies on secondary data and focuses on a limited set of well-studied species, leaving other taxa and modalities—particularly chemical communication—underexplored. In addition, comparative scoring frameworks such as Hockett's features, while analytically useful, may inadvertently privilege human symbolism and underrepresent alternative semiotic logics. Future research should therefore adopt broader taxonomic sampling, integrate chemical and sensory modalities, and employ longitudinal and interdisciplinary methods to capture communicative development and cultural transmission across species.

In sum, this research affirms that communication—human and non-human alike—is intentional, adaptive, and meaning-bearing. By situating language within a continuum of semiosis, the study advances linguistic and semiotic scholarship while reinforcing the view that humanity's communicative capacities are deeply interconnected with those of the wider living world.

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