http://dx.doi.org/10.12785/ugric/2026004

Parallel Pathways or Divergent Trajectories?

A Comparative Analysis of Language Acquisition in Young Children

and African Grey Parrots (Psittacus Erithacus)

Fatema Mohamed Jawad
English Lnaguage and Literature Department
University of Bahrain
Manama, Bahrain
202308334@stu.edu.uob.bh

Abstract— **This paper presents a comparative analysis of language acquisition in human children and African Grey Parrots (Psittacus Erithacus), drawing primarily on two empirical studies: Roubalová et al. (2024), who compared the productive vocabularies of 21 grey parrots and 21 Czech-acquiring children aged 8–18 months matched by vocabulary size, and Colbert-White, Beyer, and Kuczaj's study of private speech in a two-year-old child (Emily) and a home-reared parrot (Cosmo). The paper situates these findings within two major theoretical frameworks: Vygotsky's (1978) sociocultural theory and Chomsky's (1965) innateness hypothesis, to examine what cross-species similarities and differences reveal about the nature of human language. Both species demonstrated functional parallels: contextual word use, sound and word play, and repetitive practice suggesting intrinsic motivation. However, profound compositional differences emerged: children showed greater use of object labels, emotional expressions, and grammatical function words, whereas parrots produced more conversational phrases, greetings, and formulaic multi-word strings. These findings are interpreted as evidence that, while vocal learning mechanisms may be partially shared across species, the sociocognitive architecture underpinning human language, including conceptual word–meaning mapping, referential intent, and generative syntax, remains distinctively human.**

Keywords—: language acquisition, African Grey Parrot, Psittacus Erithacus, private speech, productive vocabulary, vocal learning, sociocultural theory, innateness hypothesis, comparative psychology

I. INTRODUCTION

The question of what distinguishes human language from animal communication has occupied linguists, psychologists, and biologists for decades. The African Grey Parrot (Psittacus erithacus) occupies a uniquely provocative position in this debate. Unlike most non-human animals, grey parrots can produce recognisable human words, deploy them in contextually appropriate situations, and in some documented cases, appear to attach referential meaning to them (Pepperberg, 2002, 2007). This raises a fundamental empirical question: in what ways, and to what degree, does the vocal learning of grey parrots resemble or diverge from the language acquisition process observed in human children?

This paper addresses that question through a critical comparative analysis of two peer-reviewed empirical studies. The first, by Roubalová, Jarůšková, Chládková, and Lindová (2024), published in Animal Cognition, offers the most comprehensive quantitative comparison to date of productive vocabulary composition in 21 grey parrots and 21 young Czech-acquiring children, matched by vocabulary size. The second, by Colbert-White, Beyer, and Kuczaj (published in the International Journal of Comparative Psychology), employs corpus linguistics methodology to analyse and compare the private speech of a two-year-old girl named Emily and a home-reared African Grey Parrot named Cosmo.

These studies are examined within two dominant theoretical frameworks that have shaped our understanding of language development: Vygotsky's (1978) sociocultural theory, which foregrounds social interaction and mediation, and Chomsky's (1965) innateness hypothesis, which attributes human grammatical competence to a species-specific biological endowment. Together, these theoretical lenses and empirical findings allow for a nuanced account of the

similarities and differences in how two cognitively sophisticated but phylogenetically distant species come to produce and use human-like vocalisations.

The paper proceeds as follows. Section 2 outlines the theoretical frameworks. Section 3 provides a detailed analysis of each empirical study's methodology and findings. Section 4 synthesises cross-study themes, examining key similarities. Section 5 addresses fundamental differences. Section 6 offers a critical evaluation of both studies' methodological limitations, followed by conclusions in Section 7.

II. Literature Review

A. *Vygotsky's Sociocultural Theory*

Lev Vygotsky (1978) proposed that all higher cognitive functions, including language, are fundamentally social in origin. For Vygotsky, children do not acquire language in isolation; rather, language emerges through guided participation within the Zone of Proximal Development (ZPD), the conceptual space between what a learner can achieve independently and what they can achieve with the support of a more capable partner. Caregivers scaffold early language through contingent interaction, modelling, and corrective feedback, enabling the gradual internalisation of linguistic tools.

This framework offers a compelling lens for understanding parrot vocalisation as well. Grey parrots kept as companion animals are immersed in human communicative environments, are exposed to adult vocal models, and, crucially, receive feedback on their vocalisations from caregivers who respond as if the parrots' words carry meaning (Pepperberg, 2007). Viewed through a Vygotskian lens, the social scaffolding provided to parrots is functionally analogous to that received by children. However, Vygotsky's theory also emphasises the importance of internalisation: the process by which external communicative tools become internal psychological instruments. In children, this results in the development of inner speech, symbolic thinking, and abstract reasoning. Whether parrots undergo a comparable process of internalisation remains empirically unresolved, making private speech, vocalisations produced in the absence of a social partner, a theoretically significant site of comparison.

B. *Chomsky's Innateness Hypothesis and Universal Grammar*

Noam Chomsky's (1965) innateness hypothesis offers a contrasting perspective, situating language acquisition within the biology of the human organism rather than in social experience. Chomsky proposed that humans are endowed with a Language Acquisition Device (LAD), a species-specific cognitive module facilitating the extraction and application of grammatical rules from impoverished linguistic input. This capacity is associated with Universal Grammar (UG): an innate set of structural principles shared across all human languages, enabling children to acquire complex syntactic structures without explicit instruction.

From a Chomskyan perspective, the central question regarding grey parrots is not whether they acquire words, clearly they do, but whether they manifest any evidence of underlying grammatical competence. If parrot vocalisations consist of memorised sequences and associative mappings without the generative, rule-governed properties of syntax, this would be consistent with the view that UG is a uniquely human biological endowment. As the empirical studies reviewed here indicate, current evidence strongly supports this interpretation, although debates remain about the degree of cognitive sophistication parrots bring to vocal communication.

III. Empirical Studies: Methodology and Findings

3.1 Study One: Comparing Productive Vocabularies (Roubalová et al., 2024)

3.1.1 Aims and Rationale

Roubalová et al. (2024) sought to conduct the first large-sample, systematic quantitative comparison of productive vocabulary composition in grey parrots and young children. Prior to this study, comparable research had been conducted only on individual parrots, most notably Alex, studied over decades by Pepperberg. The authors argued that comparing vocabulary structure, rather than raw size, across species, while controlling for vocabulary size, would illuminate the communicative functions that word-like sounds serve in each species and shed light on the sociocognitive specifics of human language.

3.1.2 Method

The study compared data from 21 grey parrots (Psittacus erithacus), ranging from 3 months to 11 years of age, kept as companion animals in Czech- or Slovak-speaking households, with 21 children between 8 and 18 months of age acquiring Czech as their first language. Crucially, participants were matched by productive vocabulary size rather than by age, as the developmental timelines of the two species differ substantially: parrots may begin producing speech-like vocalisations as early as six months of age (Wright, 2001), while children's first words typically emerge around 12 months.

Data collection differed between species due to practical constraints. Caregiver questionnaires were used for both groups: parrot owners were asked to list all human words their parrots used meaningfully, specifying the context of each use, while parents of children were asked to list words their child produced over a one-week period as part of a pre-pilot phase of the Czech Communicative Development Inventory

(Jarůšková et al., 2024). For children, reports were provided by mothers in 82% of cases.

Vocabulary items were coded into semantic categories adapted for cross-species comparability, including: person names, animal names, object labels, activity and situation labels, emotional and evaluative expressions, conversational phrases, greetings, and multi-word utterances. Statistical comparisons were conducted across these categories to identify significant differences in vocabulary composition.

3.1.3 Key Findings

The primary finding of Roubalová et al. (2024) was that, even when matched for total vocabulary size, the compositional structure of parrot and child vocabularies differed significantly. Children produced significantly more object labels, activity and situation labels, and emotional or evaluative expressions. In contrast, grey parrots produced significantly more conversational expressions, greetings, and multi-word utterances in general.

The high proportion of conversational expressions and greetings in parrot vocabularies (accounting for 30.4% and 28.4% of parrot productions respectively, compared to much smaller proportions in children) suggests that parrots preferentially acquire socially salient, frequently occurring utterances. This finding is consistent with a social–associative model of word acquisition: parrots appear to learn those utterances most frequently repeated by caregivers in emotionally salient contexts, such as greetings upon entering a room, rather than the referential object labels that dominate early child vocabularies.

Children's greater use of object labels is theoretically significant. Research in language development has established that early object labelling is underpinned by children's capacity for joint attention, intentional understanding, and the formation of word–meaning mappings tied to conceptual categories (Tomasello, 2003). The authors note that parrots may lack the spontaneous interest in referential labelling that characterises human children, consistent with prior observations that parrots in untrained settings show little motivation to acquire labels when labelling is not linked to direct reward (Bradbury & Balsby, 2016).

Interestingly, the study also found suggestive evidence that some parrots produced intentional word combinations, raising the possibility of limited productive multi-word capacity. However, the authors caution that many observed multi-word strings appeared to be holistically learned phrases rather than genuinely compositional utterances. One parrot, for instance, reproduced long phrase strings containing words not individually present in its vocabulary, a pattern consistent with chunk learning rather than word-level combination.

3.2 Study Two: Private Speech in a Child and a Home-Reared Parrot (Colbert-White, Beyer, & Kuczaj)

3.2.1 Aims and Rationale

The second study, by Colbert-White, Beyer, and Kuczaj, investigated private speech, vocalisations produced in the absence of a social partner, in a two-year-old child (Emily) and a home-reared African Grey Parrot named Cosmo. Private speech is theoretically significant from a Vygotskian perspective as a transitional form between social speech and internalised inner speech, serving functions including vocal practice, self-regulation, and narrative thinking (Vygotsky, 1978). Earlier research on Alex by Pepperberg and colleagues (1990) had documented monologue behaviour during novel vocalisation acquisition, finding parallels with children's presleep monologues. Colbert-White et al. extended this line of enquiry using corpus linguistics methodology on a naturally socialised, untrained parrot.

3.2.2 Method

The study employed corpus linguistics techniques to quantitatively and qualitatively analyse private speech corpora derived from both speakers. For Cosmo the parrot, transcriptions were drawn from recordings of spontaneous vocalisations produced when alone, compiled into a large corpus that could be categorised by social context. Emily's private speech was recorded during periods of solitary play and bedtime monologues. Utterances were coded for functional categories including: sound and word play, repetition and practice of new words, running narrative commentary, self-soothing, and formulaic social phrases. Compositional features including vocabulary size, type-token ratio, use of function words, and multi-word combinations were also analysed.

3.2.3 Key Findings

The study's principal finding was captured in its title: compositional differences and functional similarities. Both Emily and Cosmo demonstrated previously documented functions of private speech. Both engaged in sound and word play, repeating and varying vocalisations in ways not directed at social partners. Both showed repetitive practice of new or recently acquired sounds, suggesting intrinsic motivation for vocal exploration. These functional parallels are consistent with what Colbert-White et al. describe as a shared role for private speech in vocal repertoire development across vocal-learning species.

However, the compositional structure of the two speakers' private speech differed substantially. Emily's speech contained a larger and more varied vocabulary, more frequent use of grammatical function words (prepositions, articles, pronouns, and conjunctions) to link propositions, and deployment of multiple verb tenses indicating temporal reference. Emily's speech also showed evidence of generativity: the ability to

produce novel combinations that extended beyond fixed phrases, consistent with emerging productive grammar.

Cosmo's private speech, by contrast, relied heavily on formulaic utterances and showed patterns consistent with a substitution strategy, fixed phrase frames with variable elements inserted (for example, 'that's ___' followed by a range of substitutions). This pattern, noted in the child language literature as an early transitional form (Kuczaj, 1983), appeared to characterise much of Cosmo's combinatorial speech. Critically, whereas Emily appeared to have progressed beyond substitution into genuine generativity, Cosmo's corpus showed limited evidence of fully compositional, novel sentence formation.

The cross-species finding that private speech serves similar functions in both species was interpreted by the authors as offering insights into the evolution of human language: it suggests that intrinsically motivated vocal practice may be an ancient feature of vocal-learning lineages, predating the emergence of fully compositional language in the human lineage.

IV. Cross-Species Similarities: What the Two Studies Reveal

A. *Dependence on Social Input and Vocal Modelling*

Both studies confirm that grey parrots, like human children, are profoundly dependent on social input for vocal learning. Roubalová et al. (2024) found that parrots' vocabularies reflected the most salient and frequently repeated elements of their caregivers' speech, particularly socially loaded utterances such as greetings and conversational phrases. Colbert-White et al.'s corpus analysis of Cosmo similarly demonstrated that Cosmo's vocalisations varied systematically with social context, and that her private speech reproduced patterns drawn from her domestic communicative environment. This dependence on social input is consistent with Vygotsky's (1978) emphasis on the role of social mediation in cognitive and communicative development.

B. *Functional Word Use and Contextual Appropriateness*

Both species demonstrated functional, contextually appropriate word use. Roubalová et al. (2024) report that parrot owners identified productions where the parrot 'knew what it said', using words in situations where their deployment was contextually fitting, such as vocalising food-related words during mealtimes or greeting phrases when caregivers arrived home. In the Colbert-White et al. study, Cosmo's spontaneous speech was shown to vary systematically across social contexts, indicating a level of social-contextual sensitivity consistent with communicative intent. These observations challenge a purely mimicry-based account of parrot vocal behaviour.

C. *Sound and Word Play and Intrinsic Vocal Practice*

A particularly theoretically significant shared feature is the presence of private speech characterised by play and intrinsic practice. Both Emily and Cosmo engaged in spontaneous sound and word play and repeated novel or recently acquired vocalisations when alone. This finding parallels the classic observations by Pepperberg (1990) of Alex's presleep monologues during novel word acquisition. From a Vygotskian perspective, such practice may reflect a process analogous to the rehearsal and consolidation of linguistic forms. Colbert-White et al. interpret this cross-species finding as evidence that vocal-learning species share a motivational architecture that supports autonomous vocal development, independently of human uniqueness in language.

D. *Neural Plasticity and Vocal Learning Circuits*

At a neurobiological level, both species share the capacity for vocal learning, the ability to acquire and reproduce vocalisations through auditory experience and practice, a capacity absent in many mammals including non-human primates. Research has identified specialised neural circuits for vocal learning in parrots, involving pallial regions with functional analogues to cortical and subcortical structures implicated in human speech production (Jarvis, 2004). This convergent evolution of vocal learning circuits across the human and parrot lineages provides a neurobiological basis for the behavioural parallels documented in both studies, without implying that the underlying cognitive computations are identical.

V. Fundamental Differences: The Limits of the Parallel

A. *Vocabulary Composition and Referential Semantics*

Despite the functional parallels described above, the compositional differences identified by Roubalová et al. (2024) are theoretically decisive. Children's vocabularies were dominated by object labels, activity words, and emotional expressions, categories that reflect the human child's drive to map words onto concepts and to use language for referential communication about the world. Parrots' vocabularies were dominated by conversational phrases and greetings, categories that can be acquired and deployed through associative learning without necessitating a conceptual word–meaning mapping.

This difference aligns with Tomasello's (2003) account of word learning in children as grounded in joint attention and intentional understanding: children learn words because they understand that other agents have intentions about objects and events, and that words can be used to share those intentions. The evidence from Roubalová et al. suggests that grey parrots, even when living in rich human domestic environments, do not spontaneously acquire the

referential vocabulary that reflects this capacity, consistent with the view that joint attentional word learning is a species-specific human adaptation.

B. Grammatical Competence and Generative Syntax

The most decisive difference between child and parrot language relates to grammatical competence. Both studies converge on the finding that, while children show rapidly developing grammatical organisation, parrots' multi-word productions remain largely formulaic or substitutional. In Roubalová et al. (2024), the multi-word utterances parrots produced with greatest frequency appeared to be holistically acquired chunks rather than composites built from productive syntactic rules. In Colbert-White et al., Emily's private speech showed emerging generativity, the production of novel, non-formulaic combinations, while Cosmo's was characterised by the substitution strategy, a more primitive combinatorial form.

From a Chomskyan perspective, this is consistent with the absence of Universal Grammar in the parrot lineage. Children acquire hierarchical, recursive syntax without explicit instruction because they are biologically primed to do so. Parrots acquire impressive vocal repertoires through powerful associative and imitative capacities, but the resulting output lacks the structural properties, morphosyntactic productivity, embedded clausal structure, systematic argument relations, that characterise human grammatical competence.

C. Developmental Trajectories

A further dimension of difference concerns developmental trajectory. Children's language develops along a predictable path: from early holistic forms through the one-word and then multi-word stages, with grammatical morphemes gradually emerging and syntactic complexity increasing over the preschool years (Brown, 1973). This trajectory is consistent across languages and cultural contexts, suggesting an underlying maturational schedule tied to human biological development. Grey parrots, by contrast, may begin producing multi-word strings at an early stage but do not show a corresponding progressive development of grammatical complexity. The compositional ceiling appears to be reached relatively early and does not increase over time in the way that child language does.

D. The Role of Conceptual Understanding

Roubalová et al. (2024) propose that the most important difference between parrot and child vocabulary acquisition may lie in the relationship between word learning and conceptual understanding. For children, acquiring a word typically involves forming a conceptual representation of its referent, an understanding that generalises across contexts and supports flexible, novel use. The high proportion of object labels in children's early vocabularies reflects this: children are mapping words onto structured conceptual categories of objects, people, and events in the world. For parrots, word acquisition appears more strongly tied to contextual association: a word is learned in a specific context and reused in similar contexts, without the same capacity for conceptual generalisation. This difference may ultimately reflect a deeper distinction in the cognitive architecture of the two species, one that transcends mere differences in input or motivation.

VI. Critical Evaluation of the Studies

A. Methodological Strengths

Both studies represent genuine methodological advances over prior single-subject research. Roubalová et al. (2024) is the first study to conduct a large-sample, controlled comparison of vocabulary composition across species, using a matched-pair design that controls for vocabulary size and a validated coding scheme adapted for cross-species use. Colbert-White et al.'s use of corpus linguistics methodology provides a systematic, replicable framework for analysing private speech that goes beyond impressionistic description. Both studies engage rigorously with the theoretical literature and situate their findings within broader debates about language evolution and animal cognition.

B. Limitations and Critical Concerns

However, both studies are subject to significant methodological limitations that warrant careful consideration. Roubalová et al. (2024) have been criticised by Pepperberg (2024) in a published commentary in the same journal for their assumption that the input received by parrots and children was comparable. Pepperberg argues, with considerable force, that children are exposed to rich, redundant, and intentionally communicative language throughout their waking hours, whereas parrots, even as companion animals, receive substantially less directed communicative input and are rarely the recipients of intentionally pedagogical speech. If the quality and quantity of input differ substantially, attributing observed differences in output to species-level differences in cognitive architecture is methodologically problematic.

A related limitation concerns the measurement of parrot vocabulary through caregiver questionnaires without standardised verification. Parrot owners' reports of 'meaningful' word use may reflect anthropomorphic interpretation rather than objective behavioural criteria. The absence of direct observational or acoustic data means the coding of parrot productions relies entirely on owner judgements

that may be systematically biased. Colbert-White et al.'s corpus approach partially addresses this concern by working from transcribed recordings, though the single-subject design of that study limits its generalisability substantially.

The case study design of the Colbert-White et al. study presents additional constraints: Emily and Cosmo are individuals, and both represent their respective species at particular developmental stages. Emily was a typically developing two-year-old at what is generally a particularly productive and verbally advanced period of early language development. Cosmo was described as an unusually linguistically capable parrot. Whether the findings generalise to other children, other parrots, or other developmental stages cannot be assumed without further research.

Finally, both studies face the inherent challenge of cross-species comparison: the categories developed for human communicative analysis may not translate straightforwardly to parrot vocalisations. Categorising a parrot's vocalisation as a 'greeting' or a 'conversational expression' imports assumptions about communicative intent that may not be justified. Future research would benefit from the development of behavioural criteria for cross-species coding that are theoretically motivated without presupposing the communicative structures of either species.

VII. Conclusion

The studies reviewed in this paper paint a nuanced picture of the relationship between language acquisition in human children and vocal learning in African Grey Parrots. The picture is not one of simple similarity or simple difference, but of convergence at the level of functional process and divergence at the level of cognitive architecture.

Both species rely on social input and immersion in a communicative environment to develop their respective vocal repertoires. Both show contextually appropriate word use, intrinsic motivation for vocal practice, and a propensity to engage in sound and word play when alone. These functional parallels suggest that some of the building blocks of language, social attunement, vocal learning, and autonomous vocal rehearsal, may be more widely distributed in the animal kingdom than previously thought, and may have deep evolutionary roots.

However, the compositional differences documented by Roubalová et al. (2024) and the structural divergence identified by Colbert-White et al. confirm that these shared functional building blocks do not add up to human language in the parrot. Children acquire a vocabulary dominated by referential object labels and emotional expressions, reflecting their capacity for joint attention and conceptual word–meaning mapping. Their private speech rapidly develops generative properties. Parrots, by contrast, acquire the most socially salient and frequently repeated elements of their human environment's speech, primarily conversational phrases and greetings, and their multi-word productions remain largely formulaic.

Interpreted through Vygotsky's sociocultural framework, both species benefit from social scaffolding, but only human children internalise language into an abstract cognitive system that extends and transforms beyond the social contexts in which it was learned. Interpreted through Chomsky's innateness framework, only human children bring to the task of language acquisition a biologically grounded syntactic endowment that enables them to construct a generative grammar from impoverished input.

Together, these perspectives and findings suggest that grey parrots are remarkable vocal learners and communicators whose abilities merit serious scientific attention. But they also confirm that the capacity for human language, referential, generative, recursive, and grounded in shared intentionality, remains a distinctively human achievement, one whose origins and mechanisms continue to reward comparative investigation precisely because the comparison ultimately reveals not just what we share with other species, but what makes human language uniquely our own.

References

[1] Bradbury, J. W., & Balsby, T. J. (2016). The functions of vocal learning in parakeets. Behavioural Ecology and Sociobiology, 70(3), 293–304. https://doi.org/10.1007/s00265-016-2068-4

[2] Brown, R. (1973). A first language: The early stages. Harvard University Press.

[3] Chomsky, N. (1965). Aspects of the theory of syntax. MIT Press.

[4] Colbert-White, E. N., Beyer, T., & Kuczaj, S. (n.d.). Compositional differences, functional similarities: A linguistic analysis of private speech from a young child and a home-reared African Grey Parrot (Psittacus erithacus erithacus). International Journal of Comparative Psychology. https://escholarship.org/uc/item/9mf27427

[5] Colbert-White, E. N., Covington, M. A., & Fragaszy, D. M. (2011). Social context influences the vocalizations of a home-raised African Grey Parrot (Psittacus erithacus erithacus). Journal of Comparative Psychology, 125(2), 175–184. https://doi.org/10.1037/a0022097

[6] Jarvis, E. D. (2004). Learned birdsong and the neurobiology of human language. Annals of the New York Academy of Sciences, 1016(1), 749–777. https://doi.org/10.1196/annals.1298.038

[7] Jarůšková, L., Paillereau, N., & Chládková, K. (2024). Czech Communicative Development Inventory: Pre-pilot validation. Charles University. [Unpublished manuscript].

[8] Kuczaj, S. A. (1983). Crib speech and language play. Springer.

[9] Pepperberg, I. M. (1990). Referential mapping: Attaching functional significance to the innovative utterances of an African Grey parrot (Psittacus

erithacus). Applied Psycholinguistics, 11(1), 23–44. https://doi.org/10.1017/S0142716400008687

[10] Pepperberg, I. M. (2002). The Alex studies: Cognitive and communicative abilities of Grey parrots. Harvard University Press.

[11] Pepperberg, I. M. (2007). Grey parrots do not always 'parrot': The roles of imitation and phonological awareness in the creation of new labels from existing vocalizations. Language Sciences, 29(1), 1–13. https://doi.org/10.1016/j.langsci.2005.12.002

[12] Pepperberg, I. M. (2024). Comments on 'Comparing the productive vocabularies of Grey parrots (Psittacus erithacus) and young children'. Animal Cognition, 27, 79. https://doi.org/10.1007/s10071-024-01917-y

[13] Roubalová, T., Jarůšková, L., Chládková, K., & Lindová, J. (2024). Comparing the productive vocabularies of grey parrots (Psittacus erithacus) and young children. Animal Cognition, 27, 45. https://doi.org/10.1007/s10071-024-01883-5

[14] Tomasello, M. (2003). Constructing a language: A usage-based theory of language acquisition. Harvard University Press.

[15] Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

[16] Wright, T. (2001). Nest-box use by African Grey Parrots: Implications for conservation. Psittacine Research Group Reports. [Cited in Roubalová et al., 2024].