The Elephant in the Room: The Impact of Domain-Expert (Dis)agreement. A Case Study on Cryptic Species.

Giorgio Maria Di Nunzio[1,*], Lucia Manni[2], Emanuela De Lisa[2] and Federica Vezzani[3]

[1]*Department of Information Engineering, University of Padova, Via Gradenigo 6/b, 35131 Padova, Italy*
[2]*Department of Biology, University of Padova, Via Bassi 58/b, 35131 Padova, Italy*
[3]*Department of Linguistic and Literary Studies, University of Padova, Via Elisabetta Vendramini, 13 35137 Padova, Italy*

Abstract

In this paper, we want to discuss an often implicit assumption in terminology: the fact that experts of a domain agree on the existence of a concept and the use of the correct term which designate that concept. This assumption that experts always provide certainty in the use of terminology can obscure the inherent subjectivity and disagreement in scientific discourse, often leaving unresolved questions overlooked or hidden in plain sight, much like an elephant in the room. By addressing these intertwined challenges, we aim to shed light on the implications of uncertainty and the need for transparency in scientific communication. This paper will focus on the challenges posed by terminology in the study of cryptic species, where disagreements among experts often obstacle clear communication and consensus. By examining how differing interpretations and uncertain nomenclature impact the recognition and classification of these species, we aim to highlight the broader implications of inconsistent terminology for scientific progress and biodiversity conservation.

Keywords

Expert disagreement, Zoology, Cryptic species, Taxonomies

1. Introduction

In terminology, one of the many roles of a terminologist involves the choice of the best methodology to ensure proper validation of the candidate terms found for a specific domain. In this validation process, experts are often consulted to provide authoritative opinions on the collected data. Whenever possible, they are not just consulted once; rather, their input is sought throughout the process either as primary sources of knowledge or as validators of terminological data. This implies that terminological validation is an ongoing, iterative process, requiring multiple rounds of consultation and feedback from experts. As [1] describes in the work dedicated to the mediation strategies between terminologies and experts:

> Experts are frequently consulted at various stages of the process in order to emit an authoritative opinion on the data submitted to them for validation. [...] In this perspective, the expert plays the role of a permanent consultant with added responsibilities related to the quality of the content available in the terminology resources.

Therefore, the role of the experts carries substantial responsibility, as they are not only validating individual terms but also ensuring the overall quality of the terminology resource and, most importantly, they contribute to the creation of a shared and standardized knowledge base. Additionally, standardized terms enhance education and public communication, ensuring that scientific concepts are accessible and comprehensible to non-experts, policymakers, and other stakeholders.

If we accept this background, we are also implicitly assuming that experts always agree, or at least most of the time, on the correct terms to use to designate a concept as this is the fundamental step to 1)

4th International Conference on "Multilingual digital terminology today. Design, representation formats and management systems" (MDTT) 2025, June 19-20, 2025, Thessaloniki, Greece.

*Corresponding author.
giorgiomaria.dinunzio@unipd.it (G. M. Di Nunzio); lucia.manni@unipd.it (L. Manni); emanuela.delisa@phd.unipd.it (E. De Lisa); federica.vezzani@unipd.it (F. Vezzani)
0000-0001-7116-9338 (G. M. Di Nunzio); 0000-0003-4257-8946 (L. Manni); 0009-0001-4496-3103 (E. De Lisa); 0000-0003-2240-6127 (F. Vezzani)

create a unified terminology to collaborate effectively, 2) minimize misunderstandings, and 3) facilitate the synthesis of findings and the advancement of science and research in general.

Our main question in this paper is to discuss why this assumption does not hold and how we have to rethink the way to deal with experts who disagree on the concepts and terms to use, especially in the design and implementation of a terminology database.

1.1. The Borneo Elephant

In order to introduce this problem, we present a notable example in the field of Systematics,[1] a branch of biology that focuses on understanding the diversity of life and the evolutionary relationships among organisms. Systematics encompasses, among other things, the identification, classification, and naming of organisms; for all these reasons, it is an interesting source of inspiration for terminology science. The example concerns the Borneo elephant,[2] also known as the Bornean pygmy elephant, which has been a point of contention among taxonomists [2, 3]. Some studies suggest that these elephants are indigenous to Borneo, having diverged from other Asian elephant populations approximately 300,000 years ago. This significant genetic divergence has led to proposals for recognizing the Borneo elephant as a distinct subspecies.

Why the debate about the formal recognition of the Borneo elephant as a separate subspecies is interesting from a terminological perspective? First, it is a significant case where experts disagree; second, it is both a question of conceptualization (does the concept of Borneo elephant exist?) and designation (what term should be used if this concept does exist?); third, it is also a case where the recognition of the existence of a concept by the experts has serious consequences also in the real world, as classifying the elephant as a separate subspecies might complicate conservation priorities and funding allocation (consequences on policymakers and stakeholders).

The paper is organized as follows: in section 2, we present a brief review about why experts disagree; in Section 3, we focus on a specific problem in systematics related to “cryptic species”; in Section 4, we briefly describe the main issues related with the representation of disagreement and dynamic hierarchies in terminology databases. In Section 5, we give our final remarks and add some preliminary discussion about how to represent the disagreement among experts in a terminology database.

2. Why Do Experts Disagree?

In the previous section, we have provided an historical example where experts have not found an agreement on how to deal with a new concept. Technology, and the advancement of technology, plays an important part in this problem since it gives the expert new tools to “see” the world from a new perspective and split the research field into “traditionalists” and “modernists”. This issue is not new in science. One historical example was the initial reluctance of many scientists to accept the discovery of microorganisms as the cause of disease, as proposed by Louis Pasteur and supported by advances in microscopy during the 19th century [4]. Before the widespread use of microscopes, the prevailing belief was in the “miasma theory”, which held that diseases were caused by “bad air”. Despite clear experimental evidence, such as Pasteur’s germ theory experiments and Robert Koch’s work on anthrax and tuberculosis, many physicians and scientists resisted abandoning miasma theory, as it had been settled for centuries. The new technology of microscopes, which made microorganisms visible, was met with skepticism because it challenged deeply held traditional views. It took decades of evidence and practical success before germ theory gained full acceptance.

Is technology the only reason why experts disagree? In order to answer this question, we have performed a search on the recent literature by searching on Google Scholar the keywords “experts”, “disagreement”, and “terminology”. Interestingly, there is a large literature about this problem in many different research fields. For space reasons, we present only four of these works that we believe are

[1] https://www.annualreviews.org/content/journals/ecolsys
[2] https://en.wikipedia.org/wiki/Borneo_elephant

significant to start the discussion. All these works start with the premise that experts do disagree, which is the opposite to what we would usually believe or want in Terminology.

The first work by [5] (Journal of Learning and Instruction, dedicated to teaching and learning) highlights the challenges laypeople face when confronted with conflicting expert opinions, despite the accessibility of expert knowledge. The authors of the paper emphasize the need for education to help people understand the causes of expert disagreements and develop skills to evaluate and resolve such conflicts. The interpretation of expert conflicts can vary depending on the topic and individuals' epistemic perspectives, which influence how they perceive the nature and justification of knowledge in different domains.

In [6] (Journal of Critical Review, dedicated to political science), the author discusses the idea that human behavior is hard to predict because people think and act in very diverse ways; hence, it is also hard to predict and tell why two experts disagree. In particular, the paper suggests that even if we could predict behavior better, experts are likely to keep disagreeing about how to solve important societal problems. This disagreement arises from different ideas about what makes a good society, the mix of facts and values in decisions, and the unstable nature of social science facts.

The authors of [7] (Journal of Economic Theory) suggest that people's own life experiences, which are often imperfect or "noisy", play a role in shaping their beliefs. If individuals tend to over-infer expert quality, they will disagree with each other about anything because they disagree about which elements are credible. Depending on how consistent their experiences are, people might trust their own perspective more or less than outside experts. This dynamic can influence how much faith they place in external information sources.

The last paper [8] (Journal Public Understanding of Science) discuss how people increasingly encounter conflicting health information, making decisions like food choices challenging. While some attribute these conflicts to research uncertainty and complexity, many rely on credibility-based explanations. Experts' perspectives on such disagreements remain under-explored, with limited classification of their causes. To address this, a taxonomy of disagreements was developed through literature review and expert interviews, identifying ten types of disagreement.

3. The Case of Cryptic Species

In Biology, a "taxon" refers to a group of organisms classified together based on shared characteristics. "Taxa" (plural of taxon) are hierarchical categories in biological classification (taxonomy) and help organize by means of levels - such as species, genus, family, order, class - and describe the diversity of life in a systematic way. For example, the classification of the subspecies Indian elephant, "Elephas maximus indicus", tells us that it belongs to the species "Elephas maximus", where "Elephas" is the genus, and "Elephantidae" is the family.[3]

As we have discussed in Section 2, advances in technology frequently lead to new discoveries, methods, and perspectives, challenging existing terminology and requiring updates or redefinitions of concepts which, in this case, corresponds to the definition of the different levels of the taxonomy and how organisms are associated to these levels. Therefore, technology significantly influence the classification of organisms and the terms used to designate them, often reshaping the understanding and framing of scientific beliefs. This interplay is particularly evident in research fields like biology, where molecular tools, imaging technologies, and data analysis techniques have revolutionized traditional ideas.

For example, DNA barcoding is a method that uses short, standardized DNA sequences to quickly and accurately identify species and analyze biodiversity in complex ecosystems [9]. This technique is widely used in various fields where it helps assess biodiversity, detect invasive species, identify pests and disease carriers, and monitor ecosystems. Despite the ongoing discussion about the risks of misuse and overuse of DNA barcoding [10, 11], it is acclaimed that this technology has the ability to highlight the existence of differences between species that were indistinguishable by morphological traits alone.

[3] https://en.wikipedia.org/wiki/Indian_elephant

Thus, this technology not only refines the understanding of existing concepts (species) but can also create entirely new paradigms, necessitating the coinage or adaptation of terms to align with these advancements.

In this context, there is one interesting situation which brings all the problems mentioned so far into one single discussion: "cryptic species". Cryptic species are groups of two or more taxa that were once considered a single species [12]. Due to their nearly identical physical appearance, they were historically difficult to identify but with modern techniques, like DNA barcoding, these hidden species were uncovered. From a terminological point of view, we looked for the definition of the concept cryptic species given by experts. In [13], the authors collected more than 10 definitions of cryptic species or variants (like 'sibling species', 'sister species', etc.) where the two main characteristics are:

1. the two species are genetically distinguishable, and
2. they are morphologically difficult to identify.

Therefore, their identification and classification pose unique scientific challenges and the primary difficulties arise from their subtle or nonexistent morphological differences. This problem is reflected on the disagreement among experts about whether the new species should be defined so.

There are notable examples of how cryptic species complicate taxonomy, biodiversity conservation, and applied biological studies like disease management. A notable case is the "Anopheles gambiae complex", a group of morphologically indistinguishable mosquito species that vary significantly in their ability to transmit malaria [14]. The lack of clear physical distinctions initially led to all these species being grouped under a single name, which delayed targeted malaria control efforts. As molecular tools advanced, it became possible to differentiate them based on genetic markers. However, disagreements over nomenclature and the reluctance to adopt new species names hindered the uniform application of research findings.

4. Representing Disagreement and Cryptic Species in a Terminology Database

To represent cryptic species and their terminological complexities in the TBX (TermBase eXchange) ISO standard [15], one would need to structure the data to accommodate multiple perspectives, languages, term variations, and metadata indicating disagreements or levels of confidence.

If we start from the assumption that experts find a new cryptic species, the concept itself of this new cryptic species should be represented as a concept entry. For species with differing expert views, we can include multiple language section elements for terms designating that species in different languages. We tried to sketch the minimal Data Categories that should be taken into consideration for a new TBX dialect of this kind:

- Document multiple perspectives: to allow for the inclusion of multiple expert viewpoints on each concept or term, ensuring transparency about disagreements. Provide metadata on the source and level of agreement for each perspective.
- Concept differentiation: the termbase should assign unique identifiers to each potential concept and link these to their associated terms. Use qualifiers or attributes, such as "high agreement'," "disputed", or "emerging consensus", to clarify the status of each concept or term.
- Hierarchical organization: to enable the representation of both broad groupings (e.g., nominal species) and finer distinctions (e.g., cryptic species). This structure should allow for updating as new evidence emerges.
- Version control and updates: to implement a system for version control to track changes in the understanding of cryptic species and ensure the database reflects the most current scientific consensus while retaining historical perspectives.

Implementing hierarchical organization and version control in a TBX structure for handling cryptic species presents significant challenges, primarily due to the dynamic nature of scientific knowledge and the complexity of taxonomic relationships. In particular, representing dynamic hierarchical relationships, such as grouping cryptic species under a single nominal species or linking related concepts, is inherently difficult in TBX. Also the implementation of version control in TBX would be challenging because it lacks native features for tracking the evolution of terms or concepts over time.

5. Final Remarks and Future Perspectives

In this paper, we have highlighted the challenges and assumptions in terminology, particularly the often implicit belief that experts universally agree on the existence of concepts and the terms that define them. By focusing on the study of cryptic species, we have shown that such assumptions can obscure the inherent subjectivity and disagreements in scientific studies, leaving critical issues unresolved. The ambiguity and inconsistent use of terms in this context can interfere with effective communication and slow scientific progress, particularly in fields like biodiversity conservation where clarity and precision are crucial.

Addressing these challenges requires a commitment to transparency and the acknowledgment of uncertainty in scientific communication. When applied to terminology databases, these issues become even more pronounced. The dynamic nature of cryptic species classification demands mechanisms to represent hierarchical organization of concepts and version control to track changes and disagreements over time. However, implementing these requirements poses significant technical and organizational challenges, especially when they have to be implemented in TBX. These difficulties may suggest the need for hybrid approaches that integrate terminological standards like TBX with complementary tools better suited for dynamic, taxonomic data management.

Our future directions in this field will analyze the ecology of the Lagoon of Venice and focus on addressing the taxonomic and ecological challenges posed by the presence of cryptic species among ascidians [16]. Given the Lagoon's complex ecosystem and its historical role as a hotspot for the introduction of non-indigenous species, we need targeted efforts to refine species identification and track changes in biodiversity. Comprehensive studies using modern technologies, such as genetic analysis, can help clarify taxonomic ambiguities, such as distinguishing different subspecies, and deepen our ecological and taxonomic understanding of this unique environment. In particular, we will discuss the recent debate that started by [17] where the authors presented their findings which clearly differentiate the species previously identified "Ciona intestinalis'[4]' types A and B as distinct species: "Ciona robusta" and "Ciona intestinalis", respectively. The last paragraph of that paper, quoted here, is an exemplification of how important the agreement among experts is for the clarity of scientific results:

> [...] we invite, encourage and advocate the use of the specific names C[iona] robusta and C[iona] intestinalis for types A and B, to clearly distinguish the individuals in future research and publications. Considering the relevance of C[iona] intestinalis in the study of chordate evolution and developmental biology, and the number of researchers working with this species all over the world, we expect that the impact on the scientific community of the easy morphological discrimination of type A and type B and finally the assigning of correct species names to both will be welcome.

Finally, we will also discuss the strong connection between the taxonomic clarification and the broader significance of precise conceptualization in scientific discourse. From a terminological perspective, semic analysis may offer a valuable framework for identifying and distinguishing concepts [18, 19]. In fact, just as morphological traits enable differentiation between species, a rigorous semic analysis can facilitate the disambiguation of terms and concepts, promoting clarity and coherence in both taxonomy and broader research contexts. To further strengthen this process, we advocate for an interdisciplinary approach that integrates insights from, for example, digital philology [20] and conceptual analysis [21]. Formal models developed in fields such as computational linguistics and software engineering have demonstrated

[4] https://en.wikipedia.org/wiki/Ciona_intestinalis

their capacity to capture complex textual evolutions, particularly in the analysis of historical and literary documents. Similarly, corpus-based methods for conceptual analysis are increasingly capable of supporting the cognitive operations involved in delineating semantic structures, addressing challenges such as synonymy, polysemy, and contextual modulation.

Acknowledgments

This work is partially supported by the HEREDITARY Project, as part of the European Union's Horizon Europe research and innovation programme under grant agreement No GA 101137074, and it is part of the initiatives of the Center for Studies in Computational Terminology (CENTRICO) of the University of Padua and in the research directions of the Italian Common Language Resources and Technology Infrastructure CLARIN-IT. This work is also partially supported by the "National Biodiversity Future Center - NBFC" project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.4 - Call for tender No. 3138 of 16 December 2021, rectified by Decree n. 3175 of 18 December 2021 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU. Project code CN_00000033, Concession Decree No. 1034 of 17 June 2022 adopted by the Italian Ministry of University and Research, CUP F87G22000290001.

Declaration on Generative AI

During the preparation of this work, the authors used ChatGPT-4 for grammar and spelling checks. The authors have subsequently reviewed and edited the content and take full responsibility for the publication's final version.

References

[1] R. Costa, R. A. Silva, S. A. F. Barros, Mediation strategies between terminologists and experts, in: Proceedings of GLAT 2012 - Terminologie: Textes, Discours et Accès aux Savoirs Spécialisés, GLAT Genova 2012, Genova, 2012, pp. 297–308.

[2] A. L. Roca, Y. Ishida, A. L. Brandt, N. R. Benjamin, K. Zhao, N. J. Georgiadis, Elephant Natural History: A Genomic Perspective, Annual Review of Animal Biosciences 3 (2015) 139–167. URL: https://www.annualreviews.org/content/journals/10.1146/annurev-animal-022114-110838. doi:10.1146/annurev-animal-022114-110838, publisher: Annual Reviews.

[3] R. Sharma, B. Goossens, R. Heller, R. Rasteiro, N. Othman, M. W. Bruford, L. Chikhi, Genetic analyses favour an ancient and natural origin of elephants on Borneo, Scientific Reports 8 (2018) 880. URL: https://www.nature.com/articles/s41598-017-17042-5. doi:10.1038/s41598-017-17042-5, publisher: Nature Publishing Group.

[4] J. A. Shaw, Historical Theories of Disease Causation, Prevention, and Cure, in: J. A. Shaw (Ed.), Historical Diseases from a Modern Perspective: The American Experience, Springer Nature Switzerland, Cham, 2024, pp. 1–13. URL: https://doi.org/10.1007/978-3-031-52346-5_1. doi:10.1007/978-3-031-52346-5_1.

[5] Thomm, Eva, Barzilai, Sarit, Bromme, Rainer, Why do experts disagree? The role of conflict topics and epistemic perspectives in conflict explanations, Learning and Instruction 52 (2017) 15–26. URL: https://www.sciencedirect.com/science/article/pii/S0959475217301901. doi:10.1016/j.learninstruc.2017.03.008, publisher: Pergamon.

[6] J. Reiss, Why Do Experts Disagree?, Critical Review 32 (2020) 218–241. URL: https://doi.org/10.1080/08913811.2020.1872948. doi:10.1080/08913811.2020.1872948, publisher: Routledge _eprint: https://doi.org/10.1080/08913811.2020.1872948.

[7] Cheng, Ing-Haw, Hsiaw, Alice, Distrust in experts and the origins of disagreement, Journal of Economic Theory 200 (2022) 105401. URL: https://www.sciencedirect.com/science/article/pii/S0022053121002180. doi:10.1016/j.jet.2021.105401, publisher: Academic Press.

[8] K. Deroover, S. Knight, P. F. Burke, T. Bucher, Why do experts disagree? The development of a taxonomy, Public Understanding of Science 32 (2023) 224–246. URL: https://doi.org/10.1177/09636625221110029. doi:10.1177/09636625221110029, publisher: SAGE Publications Ltd.

[9] G. Abdi, S. Singh, S. Selvakumar, S. K. Dhar, G. Mudgal, P. Swaminathan, M. Jain, M. A. Tarighat, DNA Barcoding and its Applications, in: V. Singh (Ed.), Advances in Genomics: Methods and Applications, Springer Nature, Singapore, 2024, pp. 91–117. URL: https://doi.org/10.1007/978-981-97-3169-5_5. doi:10.1007/978-981-97-3169-5_5.

[10] M. E. Cristescu, P. D. N. Hebert, Uses and Misuses of Environmental DNA in Biodiversity Science and Conservation, Annual Review of Ecology, Evolution, and Systematics 49 (2018) 209–230. URL: https://www.annualreviews.org/content/journals/10.1146/annurev-ecolsys-110617-062306. doi:10.1146/annurev-ecolsys-110617-062306, publisher: Annual Reviews.

[11] K. W. Will, B. D. Mishler, Q. D. Wheeler, The Perils of DNA Barcoding and the Need for Integrative Taxonomy, Systematic Biology 54 (2005) 844–851. URL: https://doi.org/10.1080/10635150500354878. doi:10.1080/10635150500354878.

[12] D. Hending, Cryptic species conservation: a review, Biological Reviews 100 (2025) 258–274. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/brv.13139. doi:10.1111/brv.13139.

[13] C. P. Shin, W. D. Allmon, How we study cryptic species and their biological implications: A case study from marine shelled gastropods, Ecology and Evolution 13 (2023) e10360. URL: https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.10360. doi:10.1002/ece3.10360, publisher: John Wiley & Sons, Ltd.

[14] B. Caputo, C. M. De Marco, V. Pichler, G. Bottà, K. L. Bennett, A. Amambua-Ngwa, S. B. Assogba, K. O. Opondo, C. S. Clarkson, J. A. Tennessen, D. Weetman, A. Miles, A. della Torre, Population genomic evidence of a putative 'far-west' African cryptic taxon in the Anopheles gambiae complex, Communications Biology 7 (2024) 1–12. URL: https://www.nature.com/articles/s42003-024-06809-y. doi:10.1038/s42003-024-06809-y, publisher: Nature Publishing Group.

[15] ISO, ISO 30042: 2019. Management of Terminology Resources - Term-Base eXchange (TBX)., Geneva: International Organization for Standardization., 2019.

[16] L. Manni, The colonial tunicate Botryllus schlosseri: A key species for evolutionary developmental studies, genesis 61 (2023) e23544. URL: https://onlinelibrary.wiley.com/doi/abs/10.1002/dvg.23544. doi:10.1002/dvg.23544, _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/dvg.23544.

[17] R. Brunetti, C. Gissi, R. Pennati, F. Caicci, F. Gasparini, L. Manni, Morphological evidence that the molecularly determined Ciona intestinalis type A and type B are different species: Ciona robusta and Ciona intestinalis, Journal of Zoological Systematics and Evolutionary Research 53 (2015) 186–193. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/jzs.12101. doi:10.1111/jzs.12101, _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/jzs.12101.

[18] V. Bonato, G. M. Di Nunzio, F. Vezzani, A Novel Approach to Semic Analysis: Extraction of Atoms of Meaning to Study Polysemy and Polyreferentiality, Languages 9 (2024) 121. URL: https://www.mdpi.com/2226-471X/9/4/121. doi:10.3390/languages9040121, number: 4 Publisher: Multidisciplinary Digital Publishing Institute.

[19] V. Bonato, G. M. D. Nunzio, F. Vezzani, Preliminary Considerations on a Systematic Approach to Semic Analysis: The Case Study of Medical Terminology, Umanistica Digitale (2021) 211–234. URL: https://umanisticadigitale.unibo.it/article/view/12621. doi:10.6092/issn.2532-8816/12621, number: 10.

[20] R. D. Gratta, F. Boschetti, A. M. D. Grosso, L. Bambaci, S. Zenzaro, La Filologia come sistema dinamico, Umanistica Digitale (2022) 1–20. URL: https://umanisticadigitale.unibo.it/article/view/13684. doi:10.6092/issn.2532-8816/13684, number: 13.

[21] D. Pulizzotto, J.-F. Chartier, F. Lareau, J.-G. Meunier, L. Chartrand, Conceptual Analysis in a computer-assisted framework: mind in Peirce, Umanistica Digitale (2018). URL: https://umanisticadigitale.unibo.it/article/view/7305. doi:10.6092/issn.2532-8816/7305, number: 2.