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The Challenge of Positioning Space and Time in Systemic Studies of Animal Utterances as Both Embodied and External Contexts

Original Study

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Abstract: Animal utterances are metastudied based on a framework describing relations between aspects of utterance, genre, and lifeworld, *form, content, act, time*, and *space*. The study concerns a set of problems: How is context perceived theoretically and empirically? Where are time and space positioned? Is time and space studied separately or as chronotope, as spacetime, as a whole? What does embodied context mean? What are systemic studies? Of the studies two focus on systemic projects, two on complexity and contextual variations, two on time and space as separate phenomena, and three on spacetime. Since aspects such as signs, utterances, and genres evolved before language, they presumably constituted animals' communicational system, working as a resource for communication even for all species, hominids and humans included. Studying such elements challenges how we conceive how they interrelate, especially in spacetime. The study revealed that spacetime was mostly positioned outside utterances and only occasionally as embodied. Integration of all key elements was not found in the excerpt.

Keywords: Context, spacetime, utterance, genre, communicational framework, communicational system, animal communication.

1. INTRODUCTION

1.1. Epistemological and methodological framing of the study

A basic example of animal communication is one animal sending one signal to one other. Historically biosemiotics has moved "from simplex to complex", realising that there is more to an utterance than just a signal: The utterer's form is part of it, a meaning might be involved, the signal might be an act, the utterance might be a certain kind of communication, and signalling always happens in dynamic contextual time and space. Not least, any utterer is simultaneously a receiver, and vice versa, a recognition that should move our attention from the simplicity of a signal to the complexity of a species in the system.

Earlier, linguistics had historically moved through similar epistemological stages towards a more *systemic* perception of verbal utterances as communication. While such *recognitions* on the one hand later have moved from the field of linguistics to biosemiotics, the development of communicational *systems* has, in an evolutionary perspective, on the other hand, moved from animals to humans. If such transfers have taken place, readiness for communication is genetically based. Hence, the faculty of *generating* utterances by means of former *received* ones is an evolutionary heritage.

For researchers, an uttering animal, its concrete signal (act), and its physical environment are more or less *directly researchable* and have historically had priority as paradigm. Confronted with complex communicational systems, which even involves all senses any species has at its disposal for communication, a challenge for biosemiotics research will be to position the more immanent and elusive aspects of meaning, time, and space. While

semantic aspects of uttering have been investigated in Ongstad (2021a, 2022b) the addressed challenge in this meta-study is a theoretical and empirical positioning of the assumed double role of time and space, both *in* and *around* utterances.

This meta-study hence works from the theoretical assumption that time and space are equal aspects to structured form, referred content, and addressed acts in animal utterances. Studying utterances empirically hence means, firstly, that these five aspects should be seen as interrelated and *systemic*, and secondly that empirical studies therefore need to consider *all* aspects when designing, analysing, and validating. Another key assumption is that some types of utterances tend to become recognisable, habitualised kinds of communication, here called genres. Genres tend to create and embody stereotyped situations, happenings, and episodes.

As the title suggests, positioning time and space *within* the utterance implies the view that all five aspects are *embodied*, as is the case with genres. Genres may function as partly *embodied contexts*. This theoretical positioning problematises a more traditional perception of context, which usually considers context as time and space or combined as spacetime. Based on *theory* there exist a double set, an embodied and external space and time as contexts. An aim of this meta-study is hence to inspect how *empirical* research, in studies and projects that regard utterances as complex and hence *systemic*, handle the simultaneity of time, space, and context as embodied and external.

To handle this challenge a theoretical framework is outlined and a set of empirical studies collected. Positioning of time, space, and context in these studies will be analysed based on the framework's key concepts. The chosen studies are grouped according to how they relate to systemness, time, space, and spacetime. Sequencing of groups is not random as it is assumed that there may exist an increased epistemological challenge moving toward positioning spacetime in communication.

The approach is hence a combination of separate, smaller 'case studies' into an overall, more coherent meta-study. Since excerpted studies are few, and not 'representative', there is no quantitative basis for generalising. Rather, this study is qualitative by giving priority just to *how* not *to which extent*. Eventually, the study poses a challenge to studies of animal communication by bringing to the surface the much under-researched problem of multiple spacetime contexts.

Having researched how utterances and genres are perceived within the fields of biosemiotics and animal communication in a number of studies (Ongstad 2019, 2021a, 2022a, 2022b) there are seemingly few studies that have an explicit systemic profile. It is rare to treat form, content, and act in utterances both as a triad and simultaneously integrate these three aspects with spacetime into an embodied systemic 'pentagon' of aspects, and discuss these in relation to spacetime as external, and hence contextual.

1.2. THE CHALLENGE OF CONTEXTS WHEN MOVING FROM LINGUISTICS TO (ANIMAL) COMMUNICATION

Historically, language theories searching linguistic essentials such as Saussure's and Chomsky's have more or less excluded context altogether. Within applied linguistics and text theories, such as Halliday's and van Dijk's a theoretical clarification of context has been essential. Also, sociological and socio-semiotic theories have conceptualised different kinds of (embodied) context, such as Halliday's register, Bakhtin's genre, Bourdieu's habitus, or Foucault's discourse. Although such theories mainly operate with interactive processes between micro and macro levels (text/context, utterance/genre, act/habitus, énoncé/discourse) the wider context of time and space 'outside' this communicational dynamics has mostly been left untheorized by these fields. Generally, sociologically anchored theories have given priority to the social, and hence pragmatic, role of language.

A growing number of studies have nevertheless moved towards multi-modality and semiotics, for instance in new media research and biosemiotic studies (Kress 2010; Sebeok 2010). Such 'extensions' of fields bring to the surface both some theoretical epistemological issues and some methodological challenges for empirical research: Firstly, that *sentence* and verbal *text* no longer is sufficiently adequate as key entities to be explored and secondly, that the contextual role of *time and space* becomes problematic, in ways that will be outlined in the following inquiry.

As long as a communication theory is not challenged empirically, problems with its relation to context may stay unproblematised. Nevertheless, when moving from theory to empirical studies it becomes clear that any project's research focus *creates* contexts (Bateson 1972). This implicitly generated scope further leaves researchers with a set of dilemmas: Where to place time and space, *within* the researched communication entity, say an utterance, or *as* external context (either/or)? Or do time and space have a role both within an utterance and as external context (both/and)? Besides, should time and space be discussed and analysed independently, or should they be treated as a whole? Or is it methodologically necessary to do both?

A motive for inspecting such seemingly conflicting positionings of time and space in studies of animal communication has been concerns about the role of context in such empirical research (Patricelli, Hebets 2016; Perconti 2002; Bro-Jørgensen 2010). This epistemological unease motivated an inspection of perceptions of context within communicational studies in general and within zoo-communication in particular (Ongstad 2022a). This survey concluded that context as a generalised concept mainly was considered as a direct result of a certain attention, of the very act of focusing (McLuhan 1994. A focus is made from and by a particular position taken. It generates a figure and hence a ground as a context (Bateson 1972). This basic perception, what in Ongstad (2022a, 497) was termed the *least-common-multiple*,

firstly means that when an animal utters, a context is generated (by implicit attended focusing). Attention is related to any sense or combination of applied and alerted senses (Posner, Rothbart 2018).

Secondly, the same kind of mental process will in principle even apply to research-projects studying such focused animal utterances and their relation to context(s). Besides, contexts are also generated as direct consequences of specific applied theories and by the scopes of specific research questions (Hoyningen-Huene 1987; Malinowski 1935. Thirdly, new contexts are generated by implicit or explicit choice of written genres for symbolising, verbalising, and publishing research results. The insight that contexts accordingly are *multi-layered* or *included* in each other (Hymes 1972) is generally recognised in research methodologies, also in biosemiotic studies (Weible 2011). Less common is the recognition that when context actually is a *relational* concept it will cause methodological concerns that need to be dealt with as a continuing *process*: "In conclusion, the relational status of context requires an interactive frame of reference accounting for context, contextualization, decontextualization, and recontextualization" (Fetzer 2002, 255).

The generalised vision, the least-common-principle, concerns context as a concept, and will, in empirical research on animal communication in practice embrace many different terms and notions used in different fields, such as *setting, incident, episode, situation, connection, circumstance, environment, times, time, location, spot, site, locus, place, surroundings, milieu, habitat, territory, ecosystem, biosphere, semiosphere, Umwelt, life-world* etc. Such terms range from the very concrete to rather abstract ones and may refer to external and/or internal (embodied) contexts. They are likely even to incorporate, implicitly or explicitly, a certain perception of the key aspects time and space (here even included place). Yet, time and space are not only treated as two separate phenomena. They are often perceived as a simultaneous, as an intertwined 'twin', a so-called chronotope, a term used by Mikhail Bakhtin to describe how literature represents time and space (Perrino 2020). The notation *spacetime* will be used for this particular perception (Nomura 2023).

However, a third conclusion from the context-study is more challenging. Generally, spacetime, as a dual whole, is more often seen as constituting much, if not all of what traditionally is called context. The dyad risks, from this perspective, to end as a 'leftover', a direct result of a particular chosen perception of communication, say, 'language', 'sign', 'signal', or 'utterance'. As Bakhtin (1986) notes, a code is a killed context. There are basically two principle ways to handle this challenge in research, either to rule out contextual impact, as in mathematics and within essentialism, formalism, and structuralism or to consider context as inter-related, as in most studies of communication where context(s) may be seen as potentially dynamic (Halliday 1994). In the former case time and space have no contextual role. In the latter case the conceptualisation of time and space and how it is treated empirically will be epistemologically crucial.

A key question is thus with which communicational aspects time and space actually do occur. Historically, to sort out such relationships has traditionally been a highly theoretical and often rather speculative task for philosophy and theoretical physics (Dainton 2016; Mihailović et al. 2017). In this study the interest is in temporal and locational/spatial aspects in *empirical* research on animal communication, since most zoo-communicational projects will have to deal with different kinds of context and hence different time-types, space-types, and spacetime combinations (Nomura et al. 2020). If time and space is part of what is communicationally expressed, it will in principle be mental and/or embodied in some sense or other, probably in more than one way (Low 2003; Wilson 2002).

Further, to communicate in any system will over time to a certain degree tend to be typified due to different life-functions they routinely will serve for a tribe, cohort, taxon, species, or community of joint sign users. Accordingly, a hypothesis for this study is that even *kinds* of communication, here termed genres, work as embodied and mental contexts. Besides, this epistemological position implies that such kinds work as mental preconditions and resources for any communication (van Dijk 2015).

This meta-inquiry therefore searches empirical studies that deals with contextual time and space, or spacetime, in an *explicit* communicative perspective only. Empirical projects investigating animal communication will study a focused entity, be it termed *information*, *signal*, *call*, *sign, utterance*, or the like. These are examples of dominating notions for units found in the fields of ethology and biosemiotics. The search will hence not be concerned with studies of time or space *as such*. This restricted scope, combined with prioritising newer empirical studies, has limited the excerpt. This is not to say that other types of studies would be directly irrelevant. It is a criterium though that the above focused issues are addressed. The design of my inquiry is hence fully qualitative, not quantitative. It is primarily asked *whether* time&space or spacetime can be found as integrated in studies of utterances and as external contexts, not how *frequent* such perceptions might be.

An analytical framework for studies of communication will be outlined, and an excerpt of relevant studies presented. The argumentative line throughout the text will accordingly be sequential and implicitly cumulative, by moving from clarification of one aspect to a specific next, following an epistemological line that will be outlined from section to section. The focused studies are hence chained, following specific epistemological traits, first facing the question of *systemness* (two studies), then discussing *complexity in contextual variations* related to time and space (two studies), followed by highlighting time and space as *separate phenomena* (two studies), and finally investigating studies of spacetime (chronotope), that is, as *both embodied and external*

(three studies). This present inquiry is thus mainly a conceptional, critical, and qualitative investigation and positioning of recent perceptions in the field based on the given systemic framework. It anticipates a certain wholeness for these epistemological patterns, a systemic system by hinting a systemic synthesis. Indirectly the framework could hence be said to search for confirmation of its methodological relevance.

2. A FRAMEWORK FOR POSITIONING TIME AND SPACE IN *ANIMAL* UTTERANCES

2.1. Outlining key elements

A premise for focusing *animal* utterances in this study is the assumption that animal communication through evolution developed systemic key prerequisites for hominids' and hence for human's pre-verbal communication on which verbal language developed in relation to once it occurred. Another one is that although all living creatures are believed to embody time and space in some sense, little is known about the role of timespace in animal communication.

A general framework for meta-studying life-genres and utterances in animal communication was outlined in Ongstad (2019). Ongstad (2021b) discussed text-theoretical roots for a multimodal and semiotic genre concept. Key framework concepts were later applied in two studies of semantics in animal utterances (Ongstad 2021a, 2022b). The series of planned studies further turned to the problem of context (2022a). In the following basic notions from and the visual figuration of the framework applied in these studies are outlined, discursively fairly similar to the theory-section in Ongstad (2022a) from which Figure 1 is taken.

As a whole the framework is seen as systemic due to its open-endedness – any aspect is considered as dependent on other aspects, by which they even make up a given aspect's potential context. It consists of five utterance and genre *aspects*: form, content, act, time, and space and five ditto *aspect-processes*: structuring, referring, addressing, timing, and spacing. Further, four interrelated *levels* are presumed, from the most basic to the most general: sign, utterance, life-genre, and lifeworld as well as a number of *system-processes* that may work within and/or between levels, for instance semiosis, given-new mechanisms, genrification, and overall meaning-making by a mental agent or a *mind*. Genrification (Frow 2014) means change of kinds of communication, for instance when a species changes patterns facing new environmental conditions (Ongstad 2021b). All processes involve in principle sign processes (semiosis) though. The perspective is hence a combination of general semiotics and socio-semiotics.

Figure 1 has for this purpose left out the levels of sign and lifeworld concentrating on the two levels placed in-between, the meso-levels utterance and genre, since they are expected to cause most trouble for clarifying perceptions of context and for positioning spacetime. Somewhat simplified signs can be seen as the building blocks in utterances. Lifeworld is seen as the highest level for meaning- or sensemaking, containing all communicational resources in a (species' and an individual's) communicational system. This view is close to perceptions of Umwelt and Innenwelt in biosemiotics (Sharov,Ongstad 2022a). The idea of lifeworld is mainly inspired by the German tradition after Husserl (Husserl 1970; Schütz 1970; Schütz, Luckmann 1973; Luckmann 2009; Habermas 1981). Even lifeworld and mind are considered as strongly interrelated conceptions (Deacon 2013; Dennett 2018).

Moving from a generalised description of context to more specific, empirical studies of animal communication, the assumption or hypothesis that animals communicate by genres should be explained more in detail. They are called *life-genres* due to the perception that they serve animal basic life-functions, be it alarm

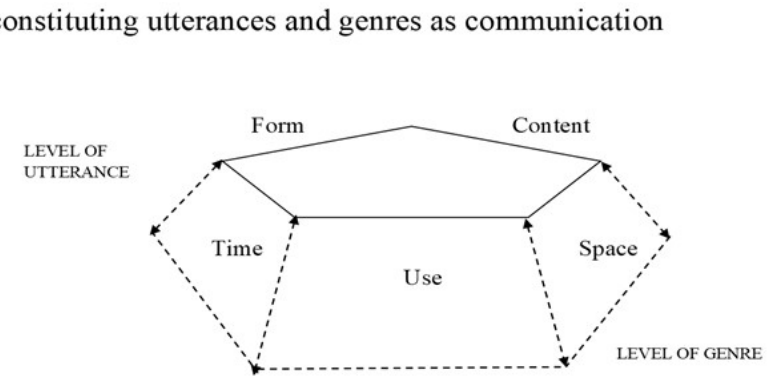

Figure 1. Five basic aspects constituting utterance as communication. Utterance and genre are modelled as a shortened or cut pentagonal pyramid with utterance as a concrete surface plane and genre as an underlying abstract part, marked by dotted lines. The pentagonal relationship between the five basic aspects applies for both levels. The double-headed arrows between the two planes symbolise the dynamic, dialogical, reciprocal relationship between of utterance and genre as well as the openness of the system. These processes work both in the moment of uttering and of interpreting (seen synchronically) and over time through communicational development of utterers/interpreters (seen diachronically). [© The Author.]

calls, birdsong, ways of territory defence, mate attraction, mate stimulation, pairbond maintenance, kinds of lek in lek-places, kinds of organised communication for hunting, kinds of bite in play ("this bite is not a bite"), etc. However, while ethological views on life-functions mostly have considered behavior related to life-functions as acts – "fixed action patterns" (Beer 2020), life-genres are defined broadly in relation to a supposed communicational system (Luckmann 2009). A key pattern is the life-genre's intimate dialogical relationship with utterances (Bakhtin 1986; Ongstad 2004).

The framework suggests that both utterances and genres, seen as a dynamic whole, and hence as communication, are joint dynamics of the five aspects. From the perspective of context each of these aspects and all their many specific sub-aspects will have different contexts, depending on each specific focusing. This insight comes as a key lesson from the search for a least-common-multiple (Ongstad 2022b, 4). Next I will, partly self-critical, point out some context-related, methodological issues for each aspect that might occur when observing, documenting, and describing (animal) communication (Ongstad 2014).

2.2. Considering challenges when applying the communicational framework

Form is the only aspect of the five that is physical for involved interlocutors and observers since it will be structured in matter, normally shaped by utterers' bodies and their bodily processes. As such, structured form is the only directly measurable, recordable aspect of what is uttered as a whole. This physicality, the structured form of the utterance may occur blurred with physicalities of the surroundings, as for instance when chimpanzees are drumming trees. Documenting will need both de- and recontextualisations during the research process since form has to be connected to, by interpretation, the four other aspects as well. Structured form might concern more than one sense. It might be multimodal (Bro-Jørgensen 2010). Besides, although uttered forms are sensed and perceived physically, neurological processes will in the animal world transform percepts to concepts. Concepts are thus *nonverbal.* In a biosemiotic perspective this happens through semiosis were concepts become immanent signs (Hoffmeyer, Stjernfelt 2016). They will further be latent, dependent of memory for later use for uttering and interpretation.

The second aspect, *content*, is immanent and can only be anticipated and hence studied as a symptom of an idea (Bühler 1934). Whether an utterance's semantic content is indexical or a 'real' reference (Manser 2013) is not an issue here. In animal semantics the more general notion *aboutness* has been suggested as an alternative to a more specific content (Yablo 2014). Content should in any case be considered as rather general when studying animals (Adams, Beighley 2013). Context for a focused content in animal communication might be just as vague as content itself. To decide how significant a certain context might be for a content observers will need to interpret a situation as a whole, that is, in a wider context of meaning or sense for involved animals.

The third aspect, use, the addressed *acts* of an utterance, when studied, risks being directly associated with physical behavior (Brown, De Bivort 2018; Tomecek 2009). Further, analysts may too hastily term acts with active 'human' verbs, such as *to sing*, *to play*, *to call*, and *to warn*, metaphorising some sort of intention related to animals' basic life-functions. Such 'verb-tagging' risks being rather anthropomorphic (Wynne 2007). For the sake of validity such terms should be reinterpreted independently by (other) observers. Even the aspect act of an utterance is immanent. It needs interpretation. This is where theories of behavior and communication differ.

The fourth and fifth aspects of utterances are the assumed embodied time and space. Fusing the dyadic chronotope (Perrino 2020) with a traditional triadic version of the utterance (Bakhtin 1986) will nevertheless imply that concrete 'measurable' time and space will still work as objective, external context even for an integrated 'pentagonally' defined utterance. By sticking to the idea that utterances and life-genres both are jointly pentagonal, one will still be left with the epistemological puzzle how time and space 'entered' a living entity or a body in the first place, both in an evolutionary and in an individual perspective. Further, what embodied or mental time&space when uttering and interpreting really implies for an animal mind can only be guessed, based on symptoms, at least until neurological research has become far more sophisticated (Schumacher 2012).

Yet, animals do have brain-cells and neural networks that handle time, place, and space. During the last decade research has been able to locate neural mechanisms for handling place (Moser E., Kropff , Moser M.B. 2008), time (Tsao et al. 2018), and space (Høydal et al. 2019) in rats' brains. Also, research in ethology, zoo-communication, and biosemiotics has dealt with this challenge. Regarding time an early example of this orientation is, according to Magnus (2011), Jakob von Uexküll's explorations of the temporal constitution of living beings.

To study just the utterance and its aspects is not sufficient though. Life-genres can be seen as embodied contexts for utterances. Life-genres equip animal interlocutors, as utterers with resources to suggest and as receivers to interpret which aspects that might be dominant or foregrounded in a particular setting (Jakobson 1971[1935]). In other words: What in a particular situation or event seems most important, expressivity (aesthetics and emotionality), referentiality (what it is about), addressivity (kind of act), temporality, or locality? How to understand and to interpret the foregrounding and balancing of aspects will, for researchers, depend on their starting point, the basic theoretical position that generates a first attention, for instance prioritising form (syntax), content (semantics), act (pragmatics) or any other scientific sub-field (Morris 1938). Given this challenge of general pre-positioning, it seems sensible

for projects at least to start out with a rather broad, systemic view of communication in order to reduce context blindness later in the research-process caused by a too narrow scope and focus in the first place (Ongstad 2014).

An overall, systemic framework should, despite the above warnings, enable meta-inspections of basic epistemological positionings of time, space, and spacetime in empirical studies of animal utterances in a systemic perspective.

3. EXCERPTING ZOO-COMMUNICATIONAL STUDIES OF TIME, SPACE, AND SPACETIME

An excerpt of scientific articles on Google Scholar with the following complete set of search-terms was done at the end of 2022: "Context", "signal", "empirical", "study", "animal communication", "space", and "time". Some topics were avoided: "-language", "-plant", and "-human". This search gave approximate 220 hits. Further, these texts' abstracts were checked briefly for relevance with a set of specific criteria: 1) a specific focus on either 'time', 'space', or 'context' (or any combination), 2) whether a study was 'systemic', meaning that a set of communicational aspects characterised the study's design. Only a dozen was excepted.

Since the coarse mesh size of the general search most likely would miss relevant studies a specific search was added, this time with the terms: "animal communication", "space and time", and "context" (not including "-language", "-human", and "-plant"). This search gave around 90 hits of which just a handful was new (the ones that combined "space and time" with "context"). From these around 20 studies only nine were included in a final excerpt, based on the criterion that title-terms and abstract signalled explicit problematisation of *context*, *time*, or *space* in studies of animal communication. These nine were grouped in four themes: Two were systemic projects, two researching complexity and contextual variations, two studies time and space as separate phenomena, and three focusing time&space. It should be recognised though that this search avoided an abundance of context-terms that may work as synonyms or specifications for context, associated with culture and/or nature.

While context in earlier times has had a tendency in some disciplines to be taken for granted and left unproblematised, more advanced and complex designed studies have the last decades addressed this key issue. Such concerns can be exemplified by their titles: *Context-related call combinations in female Diana monkeys* (Candiotti, Zuberbühler, Lemasson 2012), *Contextual sensitivity and bird song: A basis for social life* (Hausberger, Henry, Testé, Barbu 2008), *Contextually Flexible Communication in Nonhuman Primates* (Snowdon 2008), *Contextual variation in chimpanzee pant hoots and its implications for referential communication* (Notman, Rendall 2005), and *Context-dependence in Human and Animal Communication* (Perconti 2002).

When also the terms *time* and *place* are included in the search many other articles are relevant, such as *The Spatiality of Being* (Ireland 2015), *The influence of spatial features and atmospheric conditions on African lion vocal behaviour* (Wijers et al. 2021), *Rethinking the Landscape: New Theoretical Perspectives for a Powerful Agency* (Farina, Napoletano 2010), *On the Diversity of Environmental Signs: a Typological Approach* (Maran 2017), *Framework of Space and Time from the Proto-Semiotic Perspective* (Matsuno 2011), *Singing in space and time: the biology of birdsong* (Naguib, Riebel 2014). *Spatio-temporal Dynamics in Animal Communication* (Hoke et al. 2021), *Theories of timing behavior* (Church 2019). *Animal behavior: timing in the wild* (Crystal 2006). *Toward a Practical Theory of Timing: Upbeat and E-Series Time for Organisms* (Nomura et al. 2020). I will focus on the most relevant of such studies – the ones that are concerned with and can add to our understanding of complexities of embodied time and space in animal utterances and their intricate relations to context as external, as positioned in title for this study.

4. PERCEPTIONS OF CONTEXT IN STUDIES OF ANIMAL COMMUNICATION

4.1. The approach

The investigation of studies does not apply formalised *analyses*. The approach is rather comparative, as differences and similarities between the framework and the grouped studies are highlighted, and hence to discuss possible compatabilities between the theoretical framework and each empirical exposed study. The overall aim is to bring to surface and to problematise, epistemologically and methodologically, the challenge of handling relationships between embodied and external spatio-temporal contexts.

4.2. Two *systemic* approaches

Studies applying an explicit *dynamic* context concept are still a novelty in studies of animal communication, although some advocate for more holistic (or less simplistic) views on animal communication, trying to reduce negatives of a too narrow and one-sided focus. The two following studies are not directly empirical, but they suggest analytic perspectives to be applied on empirical studies of animal communication. Hebets et al. (2016) offers "a systems approach". A set of concepts in systems biology is related to general system properties. These system concepts are further "translated" into the field of animal communication and discussed in relation to traditional aspects such as utterances' form and function. To shape this broader basis Hebets et al. offer a study of the state of the field, in other words, a meta-study.

They claim that current studies in animal communication mostly continue to focus on *signal* functions within restricted conditions, although they have come across studies with more open perceptions. They state that animal communication can rather be seen as multidimensional as it can encompass multiple strategies,

multiple functions, multiple receivers, multiple components, and multiple sensory modalities, referring among other to Bro-Jørgensen (2010). Their study is entitled *Dynamics of multiple signalling systems: animal communication in a world in flux* (Hebets et al. 2016, 2). After investigating a number of studies they find that much research focused on:

> […] relating individual signals to individual functions or individual receivers, at single time points and in single contexts, may overlook important interactions or variation among display components that are crucial to system function. As evidenced by these examples, more inclusive approaches to animal signalling are gaining momentum (Hebets et al. 2016, 3).

They suggest that such research may be significant and form possible syntheses across taxa as well as being suitable for testing of hypotheses, if integrated in their proposed framework. The theoretical outlining of their framework contains several relevant references to context throughout.

Still, there is no *principal* clarification of how extending the scope for 'communication' from specific elements to a more generalised system, may trigger a necessary reconceptualisation of *context* as a phenomenon. Also, they do not discuss the case that even a system implies context-generating. Hebets et al. do admit though that especially contextual *spatio-temporal* issues are challenging. When context is seen as less fixed and more open, research faces a validity challenge. A conclusion after my brief inspection is that their systemic, multimodal perspective indeed whirls up central context issues, some of them calling for a more principal discussion of context in relation to a systemic approach.

This challenge leads to inspection of a second example of an applied general approach for analysing animal communication. Haentjens (2018) offers *A Systemic Functional Linguistic (SFL) Approach to Animal Communication.* This approach is even sometimes termed systemic functional grammar (SFG). He has favored other researchers' case-studies, of honeybees, songbirds, and primates because they have been well researched. He concludes:

> The three case studies show that each animal has a unique and species-specific communication system. Consequently, it is indeed possible to apply SFG concepts, such as 'stratification', 'metafunctions', and the importance of 'context', to different types of animal communication. The analysis shows that the degree to which these concepts can be applied to each type of communication, *i.e.* communicative dancing, vocalizing, and gesturing, is related to the cognitive abilities, the complexity of the communicative system, and the *context* (e.g. wild or captivity, human observers, stressful situations, and other circumstantial factors) *in which the communicative act is performed* (Haentjens 2018, 66/SO's italics).

Two recognitions can be made from Haentjens' exposure of SFL (SFG) applied on animal communication, the need both to theorise context explicitly (van Dijk 2015) and to study how a performative communicative act is related to so-called communicative metafunctions (Martin 2011). According to SFL there are three metafunctions: ideational, interpersonal, and textual which all work as contexts for a concrete text's field, tenor, and mode, respectively. The somewhat corresponding aspects in utterance theory (the framework) are hence content, act, and form, respectively. Moreover, the two levels, text and metafunction, correspond roughly to the framework's concepts and levels utterance and genre, respectively. This means that meaning will depend on more than one level. Concrete communication hence has to be perceived, not just as 'multi-aspected' and multi-modal, but even as *multi-stratified*. Stratifying or levelling implies a partly systemising of context. This position represents a crucial difference between structural theories on the one hand and socio-semiotic text-theories on the other. The latter is seen as both functional and contextual (Martin 2011). Both the framework and SFG are systemic, which implies that if this principle is applied on studies of zoo-communicational utterances, a given animal has to consider which *kind* a given utterance is, which life-genre it might be, while interpreting its 'meaning', its sense, its implication (in its own lifeworld/mind).

Haentjens (2018) thus offers a framework partly similar to mine. It should be underlined that in the framework notions that involve language and text are discarded. In his somewhat shortened version of SFL there are three strata or levels, in SFL visually often symbolised by three circles enclosed in each other (Martin 2011). The widest represents *context*. It includes a medium sized one, representing *semantics* or *meaning*, which again includes the smallest circle representing the semiotic equivalent of 'text', or means of expression, for instance in the analysis of songbirds, researching their concrete vocalisations. When these elements are interrelated, in SFL's scope, they form a *stratification,* at least visually exemplifying songbirds *communicative system* (Haentjens 2018, 43).

This solution leads to the following: Firstly, context, meaning, and vocalisation in his study of songbirds are termed *levels*. They are not seen as *simultaneously working aspects* (Haentjens 2018, 46). This conceptualisation or choice of focus partly side-lines SFL's core idea of interplay and cooperation between textual functions and *meta-functions*.

Secondly, as a result, there is no focused dynamics between SFL's double set of triads in the analyses. The role of life-genre is seemingly not yet considered. Nevertheless, under 'vocalisation' one can find *begging calls*, *distress calls*, and *alarm calls* and under 'meaning' also their *functions* (or use situations). As a result, what is put into 'context' is non-specific or *general*. Such contexts are thus probably seen as left-overs, as rests, or concrete environments and physical conditions, and comes as a direct result of the choice of theory in the

first place.

Thirdly, the found contexts are hence seen as indirect results of the prioritised, focused dyad of semiotic syntax-semantics or formed structure and referred content in my words. However, these three arguments should not create the impression that Haentjens' applied version of SFL is not functionable. On the contrary his analyses of three taxa's communicational systems make likely that SFL indeed can increase our awareness of the importance of context even for a complex systemic theory. However, it needs to be stripped off its dependence on text and language and consider the importance of the *level* of genre.

Combined with Hebet et al.'s claim that more inclusive approaches to animal signalling are gaining momentum in the fields, Haentjens' SFL-approach give convincing arguments for further inspection of studies that take increased complexity of zoo-communication into account. Spacetime/chronotope is not mentioned though. Haentjens and SFL stratify three levels where the most general is seen as an external context. As a contrast a key idea behind the pentagonic framework's is to integrate form-content-act with spacetime (time&space) on *two* levels, both for utterance *and* life-genre. Hence, a main motivation for this article is to clarify how systemic research in the field handles a possible *constraint* within the dyad spacetime when assumed both to be present in utterances and serve as external contexts.

4.3. Relations between utterance complexities and aspects of physical context

The second 'group' consists of studies focusing utterance complexity and of contextual variation, which I present under 4.3. and 4.4. respectively.

A rough distinction so far has been made between possible subjective/internal and concrete objective/external contexts. The following study concerns the latter. Candiotti et al. (2012) investigated call complexity in relation to a well differentiated set of contextual factors in female Diana monkeys in the wild, hypothesising that social calls would contain high acoustic diversity in relation to certain contextual variables. They found, as hypothesised, significant connections between call types (in my term life-genres) and environment and other, social, contexts: "In Diana monkeys, the concatenation of one of several possible introductory calls to the arched call unit seems to function as a contextual refiner of this contextually neutral call" (Candiotti et al. 2012, 337).

From the perspective of utterance theory this find may indicate that simple or 'basic' utterances (called *'A'calls*) when combined with new or other elements seem close to what is termed *genrification* (Frow 2014), in other words a further developed, new kind of communication based on a former one. Such a mental change both in emitters/utterers and listeners/interpreters is seen as a symptom of a genre (van Dijk 2015). Candiotti et al. (2012, 337) just hint in that direction, but add carefully that the degree to which these subtleties are intentionally produced or rather are mere reflections of a caller's motivational state, is not addressed.

Several studies touched upon have argued that future studies should be more *system oriented* in order to trace undiscovered, more subtle and complex communicational structures, contents, and acts. Such ambitions may challenge the design of projects, requiring more extensive studies, long-lasting projects, and larger research teams. In Ongstad (2022a), studying perceptions of context concepts in the field more generally, this argument was supported. A strength of Candiotti et al.'s study in this respect is their relatively high number of registered mixed types of utterances. They operate with four basic types, or 11 if further sub-differentiated. They are correlated with well differentiated sets of (possibly relevant) context elements (variables). The latter concerns among other territory (*place/space*), group activity (*life-functions*), and immediate non-vocal state (the receiving of a group's basic *emotionality*), in all almost 30 context factors. Regarding validity challenges Candiotti et al. admit that in several cases the number of registrations is too low for firm conclusions and further generalisations.

Symptoms of life-genres may be found in Candiotti et al.'s study, in Table 5, p. 336. Both basic social interaction types (*friendly*, *agonistic*, and *neutral*) and main life-functions (*foraging*, *travelling*, *resting* etc.) seemingly affect female Diana monkeys' call patterns (the degree of structural complexity of their utterances). They underline though that syntax complexity does not mean that a parallel semantic sophistication (content-wise) is found or proven (Candiotti et al. 2012, 337). Advanced animal aesthetics may not necessarily indicate complex references.

What their study makes clear is firstly that their many noted sub-categories (variables) can work as empirically documented examples of life-genres applied in contexts. For receivers they function as a communicative repertoire making sense of what simple utterances can mean in a particular concrete, contextual setting, a communicational situation. Secondly, their research supports the idea that more variated, fine-tuned, and specified utterance structures may increase the likelihood that receivers can make more out of advanced structured form semantically than earlier believed. It also supports the hypothesis that animal communication seems based on more sophisticated, complex, interrelated system of basic aspects. Finally, it increases the likelihood of the existence of both a shared, inner, variated mental context and a connected external one. However, Candiotti et al. do not address the question of embodied spacetime. Although their context factors could have made that possible.

4.4. Contextual variation and acoustic structures of the ape life-genre *pant hoot*

Notman and Rendall (2005) studied *Contextual variation in chimpanzee pant hoots*. The project's overarching epistemological goals were to search traces of animal semantics and hence to find connections between great

apes' and humans' communicational sound repertoire. While their main conclusions concerned so-called *functional reference*, my own interest in this particular study concerns (positive) correlations between significant utterance structures and specific context components ('variables') in the light of utterance theory, as their research can even shed light on *contextual spacetime*.

Notman and Rendall focused pant hoots produced by wild chimpanzees, *Pan troglodytes schwienfurthii*, living in the Budongo Forest, Uganda. They analysed the acoustics of 201 pant hoot series produced by seven adult males. Uttering is by them termed *call production* and the three major context types studied are *behavioural activities*, *social circumstances*, and *ecological circumstances*. Key dimensions of the registered structural (acoustic) variations were correlated with a large set of variables (components) from the three context types (Table 9, p. 187). While there was "little evidence" of positive correlation between pant hoots and social and ecological circumstances, they rather found that: "[…] they were produced with higher probability at abundant food sources" (Notman, Rendall 2005, 177).

They suggest three explanations for why several studies in the field fail to nail certain sub-call types to specific (production) contexts (Notman, Rendall 2005, 185). First, that insufficient number of data/calls missing (out) of important structural acoustic patterns. Second, that contexts might be mischaracterised (other aspects of context are of relevance for the chimpanzees). Third, that the very function of pant hoots is misunderstood. I dwell on these points because they resonate with the view that part of the field's problem with grasping such challenges may relate to too narrow communicational theories when designing studies (Ongstad 2021a).

Based on a broad definition of utterance (call) and life-genre (types of call) for instance emotionality and expressivity can be related to the structuring of form. Arousal and loud pant hoots are thus interpretable for receivers as symptoms of an inner state of the utterer and as an indication of, in this case "abundance of food", and thus content-wise as a semiotic index sign as a broad semantic category (Ongstad 2021a). Such loudness might, within the lifeworld of apes semantically be interpreted as *about* abundance of food. This general semanticity has been termed aboutness (Adams, Beighley 2013; Yablo 2014).

From the perspective of utterance theory and the framework, a form, and hence, its expressivity, in physical contexts carries *meaning* in this taxon's life-world (Umwelt). The possible subtype of the life-genre pant hoot Notman and Rendall most likely have documented here, makes sense within the ape community. If an observed activity, which here is the life-function foraging, correlates positively and consistently over time with concrete, distinctive acoustic patterns, we can speak, in terms of utterance theory, of a 'chimpanzeian' life-genre that has a general social function (Notman, Rendall 2005, 187). They admit though that to *prove* this requires more than 201 series from seven chimps, since other explanations are possible: "We hope that future research can be designed to explore this possibility more systematically using generally accepted indexes of internal state (e.g. piloerection and respiration rate)" (Notman, Rendall 2005, 187).

Regarding the life-function foraging *space* plays a key role. Therefore, as soon as it is clear that the apes' increased excitement may imply abundance of food and not just food, direction and distance and hence place from which the pant-hoot is uttered become relevant for receivers. However, for an observing researcher it may be hard to know for certain why some receivers do not react. Is the food too far away? Is the ape not hungry enough, or is the utterer not considered to be trustworthy? Etc. Moreover, in their lives great apes are probably progressively socialised to functional communication, as variations within a life-genre have to be learned throughout life. In a group of receivers there may be a great variety of experiences and communicative competences. Younger and unexperienced individuals may not (yet) associate the sounds of a call with something *meaning*-full.

In this section I have tried to clarify and exemplify how complexities in animal utterances may relate to complexities of contexts, both in theoretical considerations and empirical studies. The inspection of some few studies points to or indicate that time and place are likely to take part both in utterances and in external context. This is a general statement though. What is needed is more subtle and differentiated descriptions of subtypes of times and spaces both within utterances and as 'physical' contexts – the *how*, not just *whether*.

5. PERCEPTIONS OF TIME AND SPACE IN STUDIES OF ANIMAL COMMUNICATION

5.1. On the concept *time* in time-studies

Phenomenologically time and space are often thought of and appear as inseparable twins. Yet, the two studies in this third of four groups are presented in 5.2.-5.4. They are investigated *separately*. In 5.5. (the fourth group) three studies investigate time&space as an interrelated whole. In the last section, 6., time and space are discussed in relation to context in the light of the framework.

In 5.2, where I inspect studies of perceptions of time, I will not deal with aspects related to scientific theories in physics (Dowden 2009; Buccheri et al. 2012). Nevertheless, long-time physical results of a Big Bang, such as cycles of time in our solar system, such as year and season, night and day, are of significant importance, because life, and hence organisms' senses, have adapted bodily and organic to these inevitable physicalities (biological clocks). Further, I will not deal with theories of time in philosophy although 'time-philosophers', such as Husserl and Heidegger, are referred to in some of the studies. Neither will I dwell with grammatical time although grammar has equipped us with valuable terms, notions, and concepts for time (Innis 2004). My narrowed focus is on concepts found in empirical research on animal communication, especially concepts that can illuminate

how spacetime as a chronotope is related to utterances and life-genres. The focus also included a possible systemic communicational system for a taxon, as argued by Fuller (2013) with support in Gros-Louis et al. (2008). The notion *systemic system* is "not butter on pork" but means a partly open-ended system. Openness equips communicational systems with flexibility to varying external contexts.

5.2. Perceptions of time according to the idea of E-series

Jaszczolt (2016) points to the difference between McTaggart's classical A- and B-theories of time (McTaggart 1908). For some people reality itself appears tensed – future changes into present and ends eventually as past (A-theory). For others reality is static. Reality is *the* moment (B-theory) and thus non-temporal. However, physicists can argue that moments do not exist, given that in nature everything changes in principle continuously. On the other hand it can be argued that 'reality', the 'true' nature of things, can not be understood without a mental and/or a symbolic fixating of those dynamic processes by trying to catch an essence of the phenomenon in a 'killed' or frozen moment. "The physical movement does not presume time; the interpreter does", declare Nomura et al. (2018, 67). In studies of nature and animals this position was also taken by Uexküll and Kriszat already in the 1950ies, when they stated: "Instead of saying, as heretofore, that without time, there can be no living subject, we shall now have to say that without a living subject, there can be no time" (Uexküll, Kriszat 1957, 13). In practise though sciences and disciplines have accepted the necessity of thinking about time both as diachronic process in materiality and as a synchronic mental and cultural product. For zoology and ethology, a vital question is whether the fact that animals have memory (Clayton et al. 2001) also means that they have a sense of past (A-theory) and further, whether mammals' ability to plan implies that they have a sense of future (A-theory), a view held by Cowley and Steffensen (2015). In other words, that organisms learn to create their own temporal domain (Nomura et al. 2018).

Besides, Nomura et al. (2018, 66) argue that time should be considered as a semiotic meaning-making system, with a grammar and taxa-specific methods for timekeeping, and that living organisms adopt multiple time codes. One such is what they call *E-series* where time emerges through local synchronisation between organisms or between parts of organisms. Their semiotic position implies that different time aspects are regarded as signs or part of signs. A bird's call contains sounds stretched in time as intervals, and with *pauses* that may carry sign meaning. Nomura et al. (2018, 67) first imagine two distinct time types:

> (1) the subjective time of living organisms with a sense of duration and tense, and (2) externally measured objective time indicating the sequence of an unbroken series of events as epitomized in the succession of a linear sequence of now-points. The latter is tense-less. While subjective time exists in the construction of experience by integrating the past, present, and future at the moment of now, objective time is a construct already completely counted by an external observer (i.e., the third-person observer).

Nomura et al. (2018, 70) can therefore add two series to McTaggart's' A and B, called C and E. E-series time refers to inter-agential or interactive time. These four are schematically compared, offering a set of aspects or perceptions of time, in their terms – time as a meaning making *system*. They further hold that living organisms use all time codes except the B-series, mostly E-series time though and to a lesser degree A-series and C-series time codes (Nomura et al. 2018, 73). E-type have their main focus. B-series time is reserved for outside observers in the laboratory and in field research.

In Nomura et al. (2020) they dwell with E-series in particular. E-series is *inter-subjective* time and explicitly related to communicative interaction, in which local synchronisation is crucial (Nomura et al. 2020, 2). Synchronicity in relation to time is seen as semiotic in nature. Time in the E-series flows through interactions. Since time in the E-series is interactive, this co-adjusting of individual times may end in shared rhythms (cf. de Reus et al. 2021) and coordinated movements:

> When you conjointly determine the timing of punctuation with other people through interaction and if the effects were reciprocal, the process would represent time in the E-series. The E-series is neither objective nor subjective but *inter-subjective* (Nomura et al. 2020, 5/SO's italics).

Time in the E-series is thus a *shared* endeavour of the participants of a society of sign-users to combine a shared *now* from one moment to the next through a process of transactions and adjustments. Timing as verb, belongs to E-series, because ongoing timing adjustments of "tempo and duration" are in constant negotiation with one's communicative partners or with the environment (Nomura et al. 2020, 6). As an example the timing for hatching seems to be environmentally determined or interactively negotiated within each environment.

They make clear that time runs differently for observers of a system analysing from the outside than for organisms within a system trying to tune in. Participants mutually determine the timing of punctuation for the event in which they participate. Therefore these functions have been considered to be tense-markers in the E-series: "Such sequences virtually punctuate temporal spans and incite the partner to anticipate the next action in the near future; therefore, they are organizational, which corresponds to a player-dependent act of meaning" (Nomura et al. 2020, 17). Nomura et al. (2020, 19) thus underline that biological time is *communicative* and should be placed in the E-series.

5.3. Making sense of E-series time in light of the framework

To utter is to communicate, but to focus on utterances may restrict the scope to the utterer and reduce the possibility of discovering a possible *shared* system (Hebets et al. 2016). E-series seems to support a systemic view. Nomura et al. (2020) illustrate their theory by examples. To illustrate epistemological familiarities between E-series and the systemic view life-genres represent I pick one that concerns communication in particular, their example 4, *Courtship Sequence of the Stickleback*. Tinbergen's well-known report on the three-spined sticklebacks' courtship (Tinbergen 1953) serves as an example illustrating *sequences* in animal interaction where timing is involved (Nomura et al. 2020, 9–11).

It is argued that interactional characteristics are clearly seen in the stickleback's courtship, with mutual engagements of a male and female fish. Steps of their courtship sequence from the male-female encounter to the final stages of spawning and fertilizing are described. When a female appears a zigzag dance is the male's first step. It may appeal or not. If attracted (instead of leaving) she turns toward the male. He swims to the nest, followed by her. The nest is shown and she slips in. He then prods her tail with his snout and eventually she spawns. He enters the nest and fertilises the eggs. He "chases" her away (Tinbergen 1953, 8–14).

To explain the exchange of moves Nomura et al. (2020, 357) distinguish between upbeat and downbeat as part of a general time-rhythm pattern. In principle each single move functions as an invitation to a next step:

> Such interactive sequences have some basic principles in common. The animal's actions toward the other – whether they are sending acoustic cues or displaying nonverbal behaviors – always exhibit communicative functions at two different levels simultaneously. One level reports the content of the message, and the other level commands some action of the partner (Ruesch, Bateson 1951, 179–181).

Nomura et al. make clear that *report* and *command* are somewhat anthropocentric if associated too strongly with verb-terms from human language. They rather see these terms as indices, as indexical signs. From the framework's perspective it seems unproblematic to equalise both their use of *content* to the framework's and to conceive their *command* as addressivity, as a particular pragmatic *act*. The framework considers them as aspects, not levels, though, since it perceives utterance aspects as occurring *simultaneously* (Habermas 1981) and considers (life-)genre as a separate *level*.

An utterance, for instance a bird's call, has hence four other aspects between which time should find its place. Firstly, the physical sounds and moves are the aspect structured forms in which stretches of time have to be included. Secondly, this form is content-wise about something (possible mating). Thirdly, form and content simultaneously do something, for instance encouraging *dance* as a prelude for mating. Fourthly, the whole sequence happens at a place, in a particular space (the nest). However, within a life-genre the utterance elements in courtship dance and nest-building should in the final interpretation be considered as a meaningful or sensitive whole, where even space/place is fully integrated. In short, Nomura et al. have explained theoretically and exemplified from earlier empirical studies how time as part of utterance and life-genre may work, in which time is given a key *integrative* position. This holds both regarding single utterances (moves as downbeats and upbeats) and regarding a particular life-genre – in their example as a part of the stickleback's communicational culture, in the species' internal lifeworld and in their external context.

Sharing has to happen not only in time, but in space. Hence, are there approaches studying space that can match both the framework's systemic perspective and the idea of *integrative* time?

5.4. Perceptions of space and studies of types of space

While defining and typifying time is slippery and risky, space, as a contrast, is often for practicalities reduced to physical *place*. In this context I will not open a discussion of place versus space, but just state that when space is used, it includes place, although I am aware of relevant discussions about differences (Nomura 2023). Places are generally more directly 'researchable' than spaces. Nevertheless, the surplus of terms associated with place/space indicates that confining concepts is still a challenge: "It is difficult to discuss space without falling into the trap of terminology or rebounding between those prevalent treatises on space which have become so ingrained" (Ireland 2015, 398). Further Ingold (2011), according to Ireland, has argued that space is a frustrating idiom because, for instance organisms inhabit an environment, not space and artists paint landscapes, not space.

What can be registered is a move in the field toward redefining terms. Maran (2017) focuses on *environment*. He typifies environmental signs in a biosemiotic perspective, but his interest is in relationships between semiotics and environment, by which how animals relate to space is more out of focus. Others discuss *landscape*. Farina and Napoletano (2010, 183) in their article *Rethinking the Landscape: Theoretical Perspectives for a Powerful Agency* give a new definition of *habitat*:

> The conceptualization of the landscape as the sum of all the spatial configurations that carry meaning (i.e. eco-fields) recognized by a species bases on resource requirements effectively dissolves the traditional separation between landscape and habitat. Because the landscape becomes the space in which a species locates necessary resources, the concept of landscape and habitat become functionally synonymous.

Space as such does not have their main focus though. Further, Wijers et al. (2021) do investigate how spatial

features, such as long distances or distances from home-base affect lions' vocal behavior, in other words, a study of communication *in space*, that is, space as external only. However, due to their interest in shifts in roaring-patterns, they deliberately pay less attention to space as such. Hence, their perception of spatial context is of a more traditional type. In short, it is hard to find updated sources about internal and external space that match the specific scope of my study.

Ireland (2015) seems partly relevant though. Although Ireland studies space, his interest in architectural issues points in a different direction. He argues that various organisms have developed the capacity to modify their contextual environments. Like architects they can construct artefacts: "The web defines that of the spider, the dam that of the beaver and a building that of humans" (Ireland 2015, 382). On the other hand, he connects space with sign, which is in tune with how the framework bridges contextual space with uttering as communication:

> Space is a property of life, as are signs. Both have materiality and form, but neither can be rationalised in the same way as an object because, while they have physicality, they are not physical. Just as perception and action are interdependent (von Uexküll 1926), so are signs and space. Claiming space is a sign transcends categorising the matter, and thereby having to reconcile *how signs and space interrelate*. (Ireland 2015, 399/SO's italics).

Ireland combines Peircean semiotics with Lefebvre's ideas about space. Relating to space semiotically develops three aspects of space, *physical-space* in which there is a spatial practice. This space-type "determines" *lived-space*, which is the social/representative space, which in turn is mediated through *mental-space* or representations of space. All three are produced and productive in interrelated processes (Ireland 2015, 386/interpreted from his Figure 1.): "As productive (a representation) mental-space and lived space articulate physical-space through (habits) of action." Habits are, in my view, close to *life-genres*, patterned ways of communicating:

> As a relationship which is produced suprasubjectively across agents, space has objective properties. However, it is not an object per se, but a pattern. This pattern is tangible in the sense that it can be perceived – and can be acted upon as a sign. At this most primal level it is *a pattern of interaction*. As an artefact, formed through an organism's capacity to affect and manipulate its environment, space is further objectified. The definitive manifestation of physical space is thus an artefact, which embodies the spatiality of the organism that created it. (Ireland 2015, 384/SO's italics)

Conclusions can be cut short. With Ireland, based on Lefebvre (1995, 2013), it can be argued that space is *mentalised* (as a sign). This semiotic idea seems in line with the framework's integration of space both on the utterance and the genre level. Ongoing and evolutionary semiotic and communicative processes are mapping physical, lived, and mental space(s). Besides, his key triad mental/physical/social can be associated with Habermas' lifeworld-aspects person/world/society (Habermas 1981), which may indicate crucial systemic compatibilities. Moreover, animal mental spaces can therefore even be perceived *as patterned interaction*, which supports the view that animal spatiality is a constitutive aspect of utterances and life-genres (in his terms habits), much in line even with Nomura et al.'s shared E-series time. Finally, the overall thinking is in both cases basically communicative, as Ireland's approach is semiotic and the framework socio-semiotic.

However, my pinpointing of his work is a rather crude simplification. Other aspects in his description have dangerously been left out, such as proximity and different forms of organisation. Carefully summarised it might nevertheless be concluded that Ireland's Lefebvre-inspired perceptions of space seem quite compatible with the framework's assumption of space as integrated in utterances and hence life-genres.

5.5. Time & space - the chronotope perceived as internal and external context

Einstein problematised the intimacies between time and space scientifically. Today many therefore speak about spacetime (Nomura 2023). Also, literary theory has for centuries claimed time and space to be inseparable. Further, the Moser research teams have, as mentioned, shown place-and-time's inter-connectedness or proximity in rats' brains. Hence, after being inspected separately so far the two should now tentatively be seen as a spacetime/chronotope (Perrino 2020). Searches for sources claiming to theorise time *and* space led to a series of books and articles discussing the topic in relation to fields such as general philosophy, science, science history, media theory, and general semiotic theory. Some few focused on zoo-semiotics (Lefebvre 2013; Matsuno 2011; Romero 2011; Ramsay 2011). My aim for this fourth and last leg of the study however was rather modest – to trace empirical sources studying spacetime and conceptualise applied perceptions by means of the outlined framework. The outcome was rather lean as I eventually was left with three sources, two in a newly published collection of articles, one studying spatio-temporal dynamics in animal communication (Hoke et al. 2021).The other aimed at integrating space and time as new dimensions for animal communicational networks Reichert et al. (2021). The third was a study of hummingbirds' aerial courtship dives (Hogan, Stoddard 2018). Admittedly, two studies were theoretical aiming for application, not empirical though.

In Hoke et al.'s introduction article, they put emphasis on that to study how animals find their way through space and time is crucial to understand communication in general. Even minor deviations in positioning and timing can lead to missed connections. They argue that spatio-temporal dynamics are often left unnoticed, simplified, or even left as loose assumptions about animals' signalling. Therefore their aim is to outline "[…]

novel questions and approaches that will advance our understanding of spatio-temporal dynamics of animal communication" (Hoke et al. 2021, 783). They especially highlight evolutionary, neural, and technological aspects, maintaining that these issues call for cooperation between and syntheses across disciplines.

One of the contributions in Hoke et al.'s book aims at integrating space and time as new dimensions for animal communicational networks (Reichert, Enriquez, Carlson 2021). Based on the observation that communication and spatio-temporal aspects traditionally have tended to be kept separate in the past, they discuss spatial and temporal consequences of signalling in *networks*. They highlight the distinction between the physical location of the signaller and the spread of influence of its signals. They further study the effects of signal modality and receiver sensitivity on communication network properties taking into consideration potential for feedback between network layers, and approaches to analysing spatial and temporal change in communication networks. They conclude:

> We have emphasized throughout that the spatial and temporal characteristics of communication signals have interesting and often unexplored implications for the broader understanding of animal social networks, and that indeed communication likely plays a larger role in shaping social network structure than is currently appreciated. (Reichert, Enriquez, Carlson 2021, 820).

The third relevant source in the excerpt concerning spacetime and communication is Hogan and Stoddard (2018). They study *displays* in animal communication, which involve explicit use of time&space conditions (spacetime). For birds courtship display (which according to the framework is a life-genre) can be stationary, happen in flight, or be a combination of the two. Hogan and Stoddard argue that it is crucial to reveal birds' spatio-temporal organisation in order to understand how particular displays function and may have evolved. Multimodal displays are commonplace, but research is rare even here. They therefore studied the male broad-tailed hummingbirds' (*Selasphorus platycercus*) combination of rapid movement and dive-specific mechanical noises with visual signals from their iridescent gorgets in their aerial display.

In their study they did 48 series of advanced recordings in the wild of how males performed U-shaped courtship dives over females and found "[…] that the key physical, acoustic and visual aspects of the dive are remarkably synchronized – all occurring within 300 milliseconds" (Hogan, Stoddard 2018, 1). They concluded that speed and trajectory, and thus time and space, affect how multisensory signals are produced and perceived. Sound and color in hummingbird dives are highly dynamic, changing dramatically in time and space, also suggesting that *synchronisation* could be essential for the effective neural processing of complex stimuli (Hogan, Stoddard 2018, 5).

Hogan and Stoddard highlight the importance of synchronisation of modalities in time and space. What is intriguing, from the present inquiry's perspective, is the assumed interplay between the neural, inner, embodied and outer, physical context. They suggest that the signaller/utterer may try to obtain an optimal angle for a watching female and that this may be the case also for butterflies and peacocks. Hogan and Stoddard suggest that males position themselves to maximize the effect of their colours in the eye of the spectator.

Displaying can hence be regarded as uttering in a life-genre, internally incorporating *embodied* spacetime with the other main aspects for uttering, form, content, and act, happening in external spacetime. Although their study did not work from a more complex conception of utterances, it is by far the one in the excerpt that addressed this article's key issue, raised in the title, the delicate balancing of embodied and external contexts.

6. SUMMARISING AND CONCLUDING

The introduction pointed to the traditional habit in linguistics and text-studies to restrict research and theoretisation to certain communicational aspects such as syntactic, semantic, or pragmatic dimensions and rarely integrating time and space on *an equal footing* in utterances. Chronotope/spacetime most often was positioned as an external context in which uttering happens. The further discussion led to a (re-)quest for *empirical* studies of animal communication that actually investigate *how* time, space, or both (simultaneously) could be integrated with other key aspects of communication in context.

The final excerpted and prioritised nine studies were picked out from a provisional, larger set of studies. They were systemic studies expected to pose explicitly the problems with time, space and context in studies of animal utterances, to have a systemic perspective and contain keywords such as context, time and space/place. One of the criteria for a search for relevant studies was that studies should be explicit *systemic*, embracing or integrating many (or most) key aspects of communication. Studies should further be *empirical* or discuss or relate to empirical studies. The studies were grouped: Four restricted small sets of studies were forecasted: Systemic projects (two studies), research on complexity and contextual variations (two studies), time and space as separate phenomena in communication (two studies), and finally a focus on spacetime (three studies).

The projects were grouped and inspected in a certain order, to establish a trait between specific, interrelated epistemological challenges, reflected in the row of applied sub-titles. This orchestrated epistemological, textual travel between key points in the studies is hence basically conceptual and system-searching and not data-driven. It nevertheless asks for conclusions.

The study aimed at clarifying conceptions of context and especially time & space aspects in recent empirical studies of animal communication. The inquiry was based on an outlined framework that hypothetically saw

spacetime (time&space) as equally included in utterances and thus even in life-genres, by which the inquiry positioned itself as a conceptual, qualitative, and critical study. A main question was whether there could be found systemic studies which explicitly treated spacetime both within utterances and as external contexts, and if, how this was perceived and empirically researched. As this was only partly confirmed, the next question concerned the nature of temporal-locational sub-aspects, in other words how the next focused studies perceived complexities of animals' resources, their assumed communicational system for uttering *and* interpreting as a whole. These studies were sequenced according to epistemological traits that came to the surface, the nature of systemness, complexity and contextual variations, spacetime as theoretical phenomena, and finally the chronotope spacetime as possibly both embodied and external.

All studies concerned, in different ways, collectivity, simultaneity, synchronisation, joint activity, or sharing, in short, communicational *systemness* for a taxon/species. These patterns show compatabilities with a main assumption behind the framework – the reciprocal nature of the constitutive aspects of utterances. Taken together they can hence support two conclusions.

Firstly, certain internal/mental time-types and space-types are found both in utterances and open-ended life-genres. They seem able to connect with different time-types and space-types found in external/concrete contexts, by which communicating in ever *new* contexts is functionally possible in spite of restrictions given by biology (genes).

Secondly, any utterer/signaller is even always an interpreter/receiver. This double-role indicates that a shared, but yet hidden system may play a tacit, but major orchestrating role. Nevertheless, there are seemingly very few studies that integrate the following expectations into a whole:

- that they have an explicit systemic profile,
- that they treat form, content, and act both as a triad and simultaneously integrate these three constitutive aspects with the two integrated aspects of the spacetime/chronotope into a communicational (embodied) systemic 'pentagon', and
- that this double, internal, embodied integration is discussed in relation to spacetime as external.

Pessimistically, due to a somewhat 'lean' outcome, the framework might accordingly be inadequate as a roadmap for searching animal communication studies of the role of spacetime in utterances. Yet, a more optimistic interpretation could be that the field has not (yet) considered the complexity it implies to handle all aspects. Because there are recent indices that research is actually moving in that direction. A growing (but small number) number of projects seems to apply systemic and/or multimodal perspectives (Patricelli, Hebets 2016; Fröhlich et al. 2019). Researchers in the field are more often cooperating across disciplines. Joint research between researchers of nature and researchers of culture (matter and mind) are now commonplace. New technologically sophisticated tools enable precise measuring and registration of subtle structure of utterances. Studies of single aspects are often criticised for being restricted or one-sided. Finally, there is increased will and capacity to do long-lasting longitudinal and broad studies of animal communication.

Yet, there is even an unintended insight that could be gained from this conceptional meta-study of positioned conceptions in the field: As hinted to in the introduction the structure of animal utterances may seem simple at first glance. When related to other main communicational aspects/contexts, content, act, time, and space, they make up a *shared* functional system both for utterers and emitters, supporting the idea of a taxon-specific interrelated communicational, systemic system in which embodied spacetime has its integrated, specific place along with structured form, referred content, and addressed acts. Any system, model, or framework, has, by its own chosen epistemological focus, nevertheless external contexts as well. How embodied and external contexts relate is still to be revealed.

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