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Linguistic paradigms as cognitive entities: A domain-general approach

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Abstract: The concept of *paradigm* has been used extensively in many areas of linguistics throughout the past century, such as language education or historical linguistics. It is therefore quite surprising that paradigms have mostly been disregarded when it comes to cognitive language theories. Recently however, more and more researchers have started to advocate for the introduction of paradigms into cognitivist frameworks to be able to account for certain phenomena in language that would be hard to explain otherwise. But whilst there is agreement on which phenomena could best be explained through the notion of *paradigm*, there is a lot of disagreement regarding the way in which paradigms would be mentally represented, and how they would relate to the rest of the mental lexicon. This paper will discuss a few reasons to believe that paradigms are part of our grammar, present two previously proposed examples for modelling paradigms from a cognitivist perspective, highlight possible issues regarding their psychological plausibility, and explore how further research on modelling paradigms could be aided through an alternative domain-general approach which proposes that paradigms are cognitively equivalent to non-linguistic categories.

Keywords: paradigm; categorization, word and paradigm, construction grammar, morphology

1 Introduction

The concept of *paradigm* has played a significant role in science and society for centuries. Perhaps its most familiar use is in language education where teachers often approach the teaching of inflectional forms in languages with rich morphology by having their students learn inflectional paradigms (also known as inflection tables) by heart. Paradigms are also central to descriptive grammars where the concept is used to describe a set of words with a common morphological or grammatical feature, e.g. the nominal paradigm of German *Hund* ‘dog’ (Table 1):

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Table 1: Nominal paradigm of *Hund*

	SG	PL
NOM	Hund	Hunde
GEN	Hundes	Hunde
DAT	Hund	Hunden
ACC	Hund	Hunde

However, it is still a matter of debate whether linguistic paradigms are only relevant for educational and descriptive purposes or whether they also have a cognitive basis. This issue is amplified by the fact that linguists often have different views when it comes to the exact nature of what a *paradigm* is, making it even more difficult to discuss cognitive implications. To illustrate this, let us look at a few definitions for the term *paradigm* that have been proposed so far.

For instance, Stewart (2006: 206) considers a *paradigm* to be a “morphological term that refers to an organised space of potential words or word-forms related to a common base element”. This statement may seem uncontroversial as it provides only a loose definition and leaves space for interpretation. However, Stewart’s definition does limit the paradigm to the area of morphology, thereby excluding paradigms that may have distinct morphophonological features but share semantic or grammatical features. A similar view is provided by Lieb (2001: 1613):

x is the paradigm of y [...]; meaning, very roughly: x is the set of forms of y, possibly arranged on the basis of their function; or else, is the set of relevant form/function pairs.

This definition agrees with Stewart’s view insofar as paradigms are seen as a collection of linguistic forms that share a common feature, although Lieb does not limit the notion of paradigm to morphological forms and also includes “function”. However, since Lieb wanted to reflect the most common conceptions of what a linguistic paradigm is, he also provides a second definition in the same paper (2001: 1613):

x is a [...] paradigm for all y in z, where “y” ranges over entities such as lexical words or ‘lexemes’ and z is a class of such entities; meaning roughly: x is an example of, or a [...] pattern for, all y in z with respect to the way in which any form of any y in z may be obtained, taking into account its function.

Here, the paradigm is not the set of forms itself, but rather a singular representative or exemplar that serves as a prototype for a larger pattern and is closer to

the meaning of Ancient Greek παράδειγμα ‘example’ where the word *paradigm* stems from. While this definition differs quite significantly from the previous two, it still reflects the same idea of some linguistic items belonging together based on a common element. However, all three definitions refrain from making any claims about whether and how paradigms play a role in cognition. Of course these definitions for *paradigm* are not the only ones that have been proposed (for a more in-depth discussion of definitions, see Politt 2022), but they serve quite well to show how there is not only a tendency among linguists to avoid a clear-cut conception of what a paradigm can or cannot be, but they also avoid the question of whether the concept has any use beyond language description and education. Recently however, researchers have started to become more concrete about their claims on the cognitive status of paradigms and have offered suggestions of how paradigms can be modelled as cognitive items to be able to account for certain phenomena in language that would be hard to explain otherwise (Booij 2010; Blevins 2016; Jackendoff & Audring 2020; Diewald 2020; Politt 2022).

Aiming to contribute to this debate, this paper will discuss the question of whether paradigms have cognitive representations, and how these representations could be modelled in a psychologically plausible way. For this purpose, section 2 will first present typological evidence of certain language phenomena that speak in favour of paradigms being stored as distinct entities. The following two sections will then address the question of how paradigms can be modelled in existing language frameworks, with section 3 presenting two previously proposed approaches, which are couched in the traditions of word and paradigm as well as Construction Grammar, and section 4 suggesting an alternative domain-general approach which proposes that linguistic paradigms are cognitively equivalent to non-linguistic categories. And lastly, section 5 will summarize the general findings and discussions that were presented. Note that this paper will be of mainly theoretical nature and offer no quantitative or experimental data at this point. It will however explore how the discussed approaches for modelling paradigms could be tested through the use of experimental methods.

2 Why we need paradigms in language theory

Before we are able to discuss the psychological plausibility of approaches for modelling paradigms, it is important to first address the question of whether paradigms have in fact mental representations and can be considered “essential organisational forces, and thus cognitive entities” (Diewald & Politt 2022: 67),

or whether they might instead just be a descriptive tool created by linguists to be able to categorize and analyse surface structures, in which case paradigms would be “merely an epiphenomenon of other motivations and mechanisms shaping grammar” (Diewald & Politt 2022: 66). The necessity for this discussion becomes more evident if we look at how linguists have created other categorical devices, like the concept of *morphology* which is used to describe linguistic phenomena that happen purely on the word-level, even though a lot of typological evidence would suggest that a clear-cut separation between words and phrases is not possible and that a morphology-syntax continuum might be more plausible (Haspelmath 2017). This is of course not to say that all research suggesting the opposite is wrong, but the fact that idea of morphology being a separate module of language can no longer be taken for granted should serve as an impulse to also question the idea of the paradigm being a separate cognitive entity rather than just a surface phenomenon of associative relations between linguistic items. For this purpose, I will examine three different phenomena that indicate how paradigms can affect synchronic and diachronic processes in language. The first one is the concept of *paradigm levelling*, which is often discussed in historical linguistics but rarely mentioned in certain strands of cognitive linguistics, e.g. Construction Grammar. It refers to the diachronic process of reducing variation within a paradigm by means of analogy, thereby creating uniformity and reducing form-related complexity. For example, let us consider the phonological development of the Early Latin noun [hono:s] ‘honour’ (Table 2, left), which possessed a stem alternation [honor] ~ [hono:s] after intervocalic [s] became [r] in all case forms, except for nominative singular and vocative singular where [s] was word-final (Albright 2005).

Table 2: Nominal paradigms of Old Latin [hono:s] (left) and Classical Latin [honor] (right)

	SG	PL			SG	PL
NOM	[hono:s]	[hono:re:s]	→	NOM	[honor]	[hono:re:s]
GEN	[hono:ris]	[hono:rum]		GEN	[hono:ris]	[hono:rum]
DAT	[hono:ri:]	[hono:ribus]		DAT	[hono:ri:]	[hono:ribus]
ACC	[hono:rem]	[hono:re:s]		ACC	[hono:rem]	[hono:re:s]
ABL	[hono:re]	[hono:ribus]		ABL	[hono:re]	[hono:ribus]
VOC	[hono:s]	[hono:re:s]	→	VOC	[honor]	[hono:re:s]

In classical Latin (Table 2, right), the nominative singular and vocative singular form [hono:s] had changed to [honor] in order to reduce the morphophonemic

variation within the nominal paradigm.¹ If we wanted to assume that paradigmatic forms are stored separately and that there is no inherent knowledge of the paradigm as its own cognitive unit, we could then propose that the phonological change was motivated by analogy to morphophonologically similar words like Latin [soror] ‘sister’. This can be illustrated with a four-part analogy, (also sometimes referred to as *proportional analogy*, e.g. in Blevins & Blevins 2009), of the following form (Hock 1991; Albright 2005):

[soro:ris] : [soror] :: [hono:ris] : X = [honor]

Here, [soro:ris] is to [soror] as [hono:ris] is to X, yielding [honor]. Other paradigmatic forms are not needed. However, as Albright (2005) points out, using this four-part analogy alone would fail to explain why the opposite did not happen: [hono:ris] :

[hono:s] :: [soro:ris] : X = †[soro:s]

Instead, it is usually assumed that it is “the [collective] influence of a larger pattern” (Albright 2005: 18) that motivated the change, meaning that the basis for the analogy does not consist of only one pair of inflectional forms (e.g. the pair of [soro:ris] : [soror]) but instead a collection of forms with similar morphological structure (e.g. [soro:ris] : [soror], [cruo:ris] : [crur], ...), which in turn renders the change [hono:s]>[honor] more economic than the contrary. The idea of a collection of morphologically related forms also agrees with Stewart’s definition of a paradigm that we saw above.² Additionally, this change can only be attested for *honōs* in its non-derived nominal form. For example, the Classical Latin adjective *honestus* ‘respectable’, which goes back to the Early Latin form *honostus* and is derived from the pre-levelling *honōs*, was not subject to the levelling process, adding to the idea that the non-derived nominal forms must be in some way be more closely related.

The second phenomenon to be mentioned here is *suppletion*, which refers to the diachronic process whereby inflectional forms of the same morphological stem are being replaced by forms of a different stem. This phenomenon is well-attested in the diachrony of most Indo-European languages. For example, let us consider the inflectional forms of French *aller* ‘go’ (Table 3, left).

1 A second development is the shortening [o:]>[o], but this is a regular sound change in Classical Latin and therefore likely happened independently of the changes in the *honor* paradigm itself. Also, “there is some evidence for an intermediate stage in the late Pre-Classical stage in which [hono:r] with long [o:] was at least one possible variant of the nominative form” (Albright 2005: 17).

2 This idea is also being reflected in Booij’s (2010) *second-order schemas* and Jackendoff & Audring’s (2020) *sister schemas*. While they use these concepts for mainly synchronic analysis, they could also easily be applied on a diachronic level to explain analogical changes like the one discussed.

Table 3: Inflectional forms of French *aller* (left), and Latin *vādere* (middle) and **alāre* (right)

SG				SG				SG		
PL				PL				PL		
1	vais	<u>allons</u>		1	vādō	vādimus		1	*alō	*alāmus
2	vas	<u>allez</u>		2	vādis	vāditis		2	*alās	*alātis
3	va	vont		3	vādit	vādunt		3	*alāt	*alant

While the majority of the inflectional forms of *aller* feature a morphological stem *v-*, which goes back to Latin *vādere* ‘go’ (Table 3, middle), the first and second person plural feature a different morphological stem *all-*, which presumably goes back to Early Medieval Latin **alāre* ‘go’ (Table 3, right).³ While we cannot pinpoint with certainty the exact underlying historical cause behind this development, the two initially independent inflectional paradigms appear to have lost full inflectional productivity for each of the two stems, thereby causing inflectional forms like **vez* or **allais* to become ungrammatical. To explain this, we could say that this was only possible because the semantic features of all inflectional forms are entirely identical, regardless of the phonological difference in their stems, allowing the formation of a single joint paradigm. Conversely, if we attempt to explain this development without using the notion of a paradigm, assuming that every form is stored and retrieved in isolation and no merging of paradigms has taken place, this would entail that some inflectional forms have simply become defective for no apparent reason. We would then have to assume that it is just a coincidence that both inflectional paradigms happen to complement each other in functional distribution, which seems rather unlikely. This becomes even clearer if we look at a case of categorical suppletion (Veselinova 2008) as it is attested for the English verb *go* (Table 4):

Table 4: Verbal paradigm of English *go* in its present tense (left) and past tense (right)

<i>present</i>			<i>past</i>		
	SG	PL		SG	PL
1	go	go	1	went	went
2	go	go	2	went	went
3	goes	go	3	went	went

³ Note that the infinitive form **alāre* and its corresponding inflectional forms have been reconstructed, are not attested, and should therefore be taken with a grain of salt. However, see Diamant (1968); Parker (1934) on the etymology of *aller* for arguments for the reconstruction of **alāre*.

Here, it was not just specific inflectional forms that were replaced by a different stem but instead the entire set of forms that belong to the grammatical category of PAST. It would be hard to explain how not even one of the present tense forms of *go* was replaced with *went* without presupposing a concept of a *paradigm* that separates the past tense forms from the rest, thereby serving as a sort of mental box that limits the spread of suppletive forms.

The third phenomenon to be discussed is the human ability for “deducing or interpreting new forms of an item, based on exposure to other forms of the item” (Blevins et al. 2018: 283). For example, consider the German loan word *downloaden*, which was borrowed from English towards the end of the 20th century. Native (and many non-native) speakers of German are able to effortlessly predict that the first person singular preterite form of *downloaden* would be *downloadete*. This is astonishing, as this form appears only 0.002 times per million tokens in the WebXL corpus on DWDS (Geyken et al. 2017, featuring German web corpus data from a broad range of different websites from 1995 to today, and containing more than 23 billion tokens), suggesting that this form is extremely rare in written and presumably also spoken German.⁴ Yet still, highly infrequent inflectional forms like *downloadete* can be produced almost instantaneously.⁵ We could again argue that this is merely a case of analogical formation to a more frequent weak verb form like *redete* ‘said’, in which case no knowledge of a larger paradigm would be necessary. However, if we wanted to derive a novel deverbal noun *Downloader* ‘someone who downloads’ from *downloaden*—in analogy to *Bäcker* ‘someone who bakes’ or *Lehrer* ‘someone who teaches’—the grammatical acceptability of this form would be more debatable as compared to *downloadete*. This points to the idea that knowledge about verbal inflection, i.e. knowledge about the inflectional paradigm of *downloaden*, is more readily available to language users than derivational patterns. Additionally, a recent study has shown that probability-based large language models like ChatGPT, while in theory able to use inflectional patterns productively on pseudo-words, are unable to mirror human behaviour accurately (Weissweiler et al. 2023), which could perhaps further support the idea that inflectional productivity cannot be explained by a purely syntagmatic approach based on next-word prediction alone and instead requires implicational knowledge of the entire paradigm and the relations between paradigm members.

4 Consider also the corpus-based evidence presented in Blevins et al. (2017) which shows that the inflected forms in a paradigm follow a Zipfian distribution in relation to the amount of instances encountered in a corpus. Based on this, they deduce that “speakers never encounter all the forms of a language and must be able to predict new forms from partial samples” (Blevins et al. 2017: 16).

5 The challenge of producing novel inflectional forms when they have not been encountered or stored previously is called the *Paradigm Cell Filling Problem* (PCFP) by Ackerman et al. (2009).

In conclusion, reflecting on the typological evidence presented, the claim that paradigms are mere surface structures and that humans possess no implicit or explicit knowledge of paradigmatic structures becomes difficult to uphold. Instead, it seems more reasonable to assume that paradigms are stored as categorical groups of linguistic items which can be retrieved to serve as the basis for phonological levelling, suppletive processes, and inflectional productivity.⁶ Furthermore, based on the fact that processes like phonological levelling and suppletion appear to be contained by categorical parameters, we can assume that the set of forms that belong to a paradigm is at least partially closed, meaning that paradigm members can be distinguished from non-members.⁷

3 Examples for modelling paradigms in cognitivist frameworks

The previous section has argued that the concept of *paradigm* as a stored cognitive entity is in some way necessary to explain certain phenomena in language. The following two sections will go into more detail regarding what these mental representations might look like and how they can be integrated into existing cognitive theories of language. For this purpose, this section will first present two examples of previously proposed approaches to modelling paradigms in cognitive theories of language. The first example is couched in the tradition of *word and paradigm* (WP), which is said to have originated from the works of Charles Hockett and is inspired by the “traditional framework for the discussion of Latin, Greek, Sanskrit, and a good many more modern familiar languages” (Hockett 1954: 210). WP is considered a word-based theory where “words function as a primary locus of grammatical meaning” (Blevins et al. 2018: 267). Additionally, words are the “the smallest Saussurean ‘signs’ of a language” (Blevins 2016: 57), meaning that the grammatical meaning of words cannot be further analysed into smaller units by language users when it comes to everyday language use. This makes it stand in stark contrast to Hockett’s earlier work on the *item and arrangement* model, where

⁶ For additional arguments that paradigms are cognitive entities, see Diewald (2020); Politt (2022).

⁷ “At least partially” is used here, as we might also need to account for the emergence of new paradigms (e.g. in the case of the Germanic preterite-present verbs) or the extension of paradigm membership to novel inflectional forms (e.g. forms that have filled paradigmatic gaps, such as German *das Weihnachten* whereas *Weihnachten* was originally attested as a plural form only).

grammatical forms are seen as linear concatenations of grammatical morphemes, which is heavily influenced by the Bloomfieldian tradition (Hockett 1947, based on Harris 1942).

WP considers paradigms to be part of the “[word] acquisition process in which speakers place or locate forms within the paradigm of an item” (Blevins 2016: 56), thereby determining the function of a word not only by its own form but also in relation to the function of other forms in the same paradigm. Or, as Blevins puts it: “form variation serves a fundamentally discriminative function, so that the function of a morphological exponent is best understood in terms of the forms that it distinguishes in a system, not what discrete meanings or properties it expresses in that system” (2016: 197). This essentially puts the paradigm at the very centre of language acquisition and production processes by claiming that every grammatical form needs to be stored into and selected from a paradigm instead of being assembled on a morpheme-by-morpheme basis. Blevins et al. (2018) argue that this approach is also able to explain how some languages can be more morphologically complex than others by assuming that morphotactic structure (i.e. the internal structure of words) is irrelevant if the underlying cognitive process does not consist of arranging different morphemes based on rules but rather selecting the appropriate grammatical form from a paradigm. This is not to mean that language users are altogether unable to produce new forms from previously learned patterns, but that this process is based on the knowledge of the entire paradigmatic structure rather than a rule-based process involving morpheme arrangement.

Additionally, WP models argue that inflectional forms need to share the same lexeme to be part of the same paradigm, although *lexeme* in this sense is to be understood as an abstract representation of a larger set of morphologically related grammatical forms and it is to be distinguished from *paradigm* insofar as “the term ‘paradigm’ is reserved for the first, smaller, set of forms, and ‘lexeme’ is applied to the complete set of forms in the paradigms” (Blevins 2016: 65). However, this leads us to the first issue regarding the psychological plausibility of this WP approach:

While Blevins (2016) draws on psycholinguistic evidence when defining the formal criteria for paradigms in his WP approach, it is not clear how the claims he makes about the nature and limitations of paradigms can themselves be falsified via experimental methods. For example, as mentioned above, Blevins claims that variation in word forms serves to discriminate one cell in a paradigm from another. While this argument seems plausible, how can we test if this is indeed the case when speaker knowledge is activated? Or in other words, how can we find out if a word form is really selected from a paradigm rather than being assembled via

rule- or pattern-based processes?⁸ Moreover, Blevins et al. (2017) make it clear that in their WP approach, paradigms can only embed words and no syntactic phrases, meaning that periphrastic grammatical constructions like English *be going to* would be excluded and therefore paradigm size can be measured in morphological complexity only. However, this would also imply that languages with richer morphology make heavier use of paradigmatic structures than the languages with more analytic or isolating morphology, which in turn could lead to the controversial claim that the cognitive ability to form and extend paradigms is language-relative. Are there any further arguments to support this? And thirdly, we may also raise the question as to what extent WP can account for suppletion if paradigm membership is primarily defined by morphological features. Are *go* and *went* two different lexemes with two different paradigms? And if so, how can we explain their complementary distribution?

The second example is couched in the tradition of *Construction Grammar* (CxG) which, very generally speaking, assumes the fundamental building blocks of language to be form-function pairings, called *constructions*, that are stored in the mental lexicon, also called *Constructicon* (Croft & Cruse 2004; Goldberg 2013; Ungerer & Hartmann 2023). While CxG is not necessarily a cognitive theory of language per se and can also be applied on a purely descriptive level, most construction grammarians do see it as a goal to work towards a psychologically plausible model of how language might be represented in the human brain, increasingly making use of both quantitative corpus data and psycholinguistic methods (Croft 2010). Most CxG approaches also assume that stored constructions are organized in the shape of a hierarchical network with taxonomic relations that are represented through syntagmatic, paradigmatic, or symbolic links (Ungerer & Hartmann 2023). However, it is important to note that *paradigmatic* in this sense does not necessarily imply an underlying paradigm, but only that two patterns can “fill the same position in a piece of discourse” (Ungerer & Hartmann 2023: 29), thereby forming taxonomic “series of increasingly more abstract (or schematic) categories that generalize over the similarities of their subtypes” (Ungerer & Hartmann 2023: 33).⁹

⁸ Although experimental studies, such as Dąbrowska (2014), suggest that language users probably rely heavily on fixed expressions in everyday use rather than assembling them based on rule- or pattern-based processes, this does not necessarily imply the existence of a larger paradigm that these forms are selected from.

⁹ It has been suggested by Neels & Hartmann (2022: 272) that paradigms are “higher-level schemas and the ‘horizontal’ associations between the constructions sanctioned by these schemas”. However, as Neels & Hartmann also point out, this idea may not be compatible with or insufficient for CxG frameworks that include “different conceptions of nodes and vertical as well as horizontal links in constructional networks” (2022: 272, referring to Smirnova & Sommerer 2020). For this reason, it has also been proposed that (at least some) paradigms and/or their paradigmatic relations might not be part of the constructional network at all (c.f. Diewald 2020; Politt 2022).

When it comes to paradigms, construction grammarians have initially paid little attention to them, which is partly due to the fact that CxG had originally been developed as an alternative to generative approaches that consider syntax and lexicon to be independent from each other (c.f. Chomsky 1957). Construction grammarians, on the other hand, assume that syntactic structures are inherently tied to meaning (see for example Goldberg 1995 on meaningful argument structure constructions). However, while paradigms were, and still are, usually associated with morphological phenomena of language, morphology has arguably been neglected in early constructionist approaches. The fact that there is now a greater interest for CxG to be able to account for both syntactic and morphological features (see for example Booij 2010; Norde & Trousdale 2023) may be one reason why researchers have recently started to advocate more strongly for the inclusion of paradigms in constructivist frameworks (see for example Diewald 2020; Politt 2022; Audring 2022; Leino 2022; Neels & Hartmann 2022).

One concrete suggestion for modelling paradigms in CxG is outlined by Diewald (2020). She proposes that paradigms are “hyper-construction[s] highlighting the categorical, non-gradient specifics of grammatical categories”, meaning that paradigms represent (and are limited to) grammatical categories such as TENSE or ASPECT, thereby excluding paradigms that are based on morphological features only. This makes Diewald’s definition of *paradigm* not only drastically different from the WP approach but also the traditional language-education-based conception of the term (see section 1). Diewald goes on to say that, in this regard, the “paradigm is seen as a complex, holistic construction of interdependent paradigmatic cells which are constructions themselves [and i]ts meaning/function is constituted by the sum total of all its inherent relations among the individual cells and their hierarchies” (Diewald 2020: 282–283).¹⁰ But although this proposition could indeed effectively tackle the issue of integrating paradigms into CxG, it would also lead to some problems:

For instance, if paradigms are constructions and represent nodes in a constructional network, how would they be linked to other constructions that are not part of the paradigm, and what would the nature of these links be? Are they inheritance links? If so, what features are being inherited?¹¹ Similarly to WP, there is also the issue of falsifiability as it currently appears questionable how

¹⁰ The idea of embedding constructions has also been proposed in Leino & Östmann (2005) as well as Leino (2022).

¹¹ Politt (2022) also criticizes the idea of paradigms being constructions, arguing that, while they are quite similar in nature to constructional schemas (as used in Booij 2016 for example) they are not the same and need to be modelled differently, with one reason being that constructional schemas are organized hierarchically while paradigmatic structures, although taxonomical, are not hierarchical. However, it could be argued that this might be equally difficult to falsify.

linguists would be able to prove or disprove the existence of hyper-constructions being stored in the Constructicon. And lastly, the fact that the concept of hyper-constructions requires an “a priori categorical distinction between grammar and lexicon” to be able to distinguish grammatical from lexical features (Diewald 2020: 283) can be seen as controversial if we consider that CxG was originally developed to overcome a strict division between the two. While Diewald’s view stems from the assumption that the formation of paradigms is tightly linked to grammaticalization and that clear cut-off points are required to be able differentiate paradigms from mere paradigmatic relations, it should be questioned if a cognitivist framework would really have to restrict paradigms to the dimension of grammaticalization in the first place. This will be elaborated upon further in the next section.

In conclusion, while both approaches clearly aim to explain similar phenomena, they nonetheless differ in their assumptions about the cognitive representation of paradigms in the mental lexicon. In the case of WP, paradigms are seen as units of implicit knowledge about the organization and functional distribution of morphologically related forms. This knowledge can be acquired, stored, and retrieved to allow the selection of the correct form from a paradigm or to allow the creation of novel inflectional forms that have not or rarely been encountered before. The latter aspect is of particular relevance, as this implies that paradigm knowledge does not depend on the completeness of the paradigm, i.e. not all forms of a paradigm need to be stored first, and empty paradigm cells can also be filled, which further shows that, in the WP approach, paradigms cannot be a mere surface phenomenon. Similarly, hyper-constructions, representing categorical knowledge, are also not dependent on the completeness of their paradigm members, although they differ from paradigms in WP insofar as that they represent grammatical categories only, leaving morphological features aside. Furthermore, unlike WP paradigms, hyper-constructions are to be seen as nodes in a constructional network, meaning that they are in some way linked to other form-meaning pairings. In WP, paradigms are part of lexemes, which are again part of larger morphological families, but no claim is made regarding their organization into a mental network. Additionally, it is also questionable how the claims about the internal structuring of the mental lexicon that both theories make can be falsified through the use of experimental methods. It should of course be noted that the approaches presented here—the WP approach and Diewald’s hyper-constructions (Diewald & Politt 2022)—do not represent the entirety of all linguistic approaches to integrating paradigms (for more approaches see Booij 2010; Jackendoff & Audring 2020; Leino 2022). However, the two examples still serve to illustrate the issue of a lack a common empirical grounding that these theories base their claims on. Therefore, in the

following section, I will explore one possibility of how such a common ground could be established, and how this could aid the further development of cognitive models for paradigms.

4 Linguistic paradigms as categories

One of the cornerstones of modern cognitive linguistics is the assumption that the human ability for language is not the result of a single cognitive domain (cf. Hauser et al. 2002) but rather the result of an interplay of domain-general cognitive abilities, such as “neuromotor automation, chunking, categorization, inference-making, and cross-modal association” (Bybee 2011: 529). Therefore, according to Bybee (2011: 535), “it is preferable to assume that the ability to acquire and process language is based on domain-general abilities and to postulate abilities specific to language only when domain-general abilities cannot be identified”. If we apply this strategy to the investigation of the cognitive reality of paradigms and look for domain-general processes that might enable the emergence of paradigmatic structures, this could yield the advantage that our findings become more generalizable, more accessible to experimental methods, easier to falsify, and therefore offer a more solid empirical grounding that other linguistic frameworks can build upon. However, it appears that, so far, research on paradigms has been conducted mainly from a language-specific viewpoint and, considering the aforementioned issues regarding the falsifiability of the previous models, it would be worth venturing into an alternative strategy that is based on domain-general processes to justify their plausibility. One obvious domain-general ability involved in the formation of paradigms seems to be categorization, as it was also argued by Politt (2020). Therefore, paradigmaticization appears to be linked tightly to categorization. I would like to further propose that paradigms might also be cognitively equivalent to (i.e. stored and processed in the same way as) non-linguistic categories. This claim may seem redundant if we already assume that paradigmaticization is linked to categorization. However, it is still important to make this distinction, since categorization merely describes the process of forming a paradigm and could also result in the creation of paradigmatic links alone (c.f. Diewald 2020 on the distinction between paradigmatic relations and paradigms), while a category would be a concrete cognitive entity, meaning it can be stored and retrieved. The claim that paradigms are linked to both categorization and categories can be argued for as follows.

Firstly, it should be pointed out that existing definitions made for paradigms show a lot of similarities to definitions made for conceptual categories. For instance, Rouder & Ratcliff (2006: 9) summarize exemplar theories of categorization by saying

that “category membership of a novel item is determined by its similarity to previously encountered stimuli”. Let us think back to Stewart’s definition of *paradigm*: If “organised space” is equated with the concept of a category, then “potential words or word-forms” can be interpreted as novel items that are assigned to a category and “common base element” represents common features of previously stored stimuli, i.e. paradigm members, that are decisive for category/paradigm membership. Similarly, Lieb’s first definition also shows similarities to exemplar theory, since here the paradigm is described as a holistic unit (“set of”) of all exemplars (“forms of y”), where paradigm membership is defined by the common characteristics of each individual member (“on the basis of their function”). Lieb’s second definition, although different in nature, also shows similarities to prototype theory as defined by Goldstein (2011: 243): “According to the prototype approach to categorization, membership in a category is determined by comparing the object to a prototype that represents the category. A prototype is a ‘typical’ member of the category”. So, in this case the paradigm could also be seen as a prototype (“x”) for all members (“y”) in a category (“z”), whose “function” would be decisive for whether new stimuli (“any form of any y”) can be assigned to the category/paradigm.

In addition to having similarities in their definitions, paradigms also seem to achieve similar cognitive functions as categories. To illustrate this, let us consider the principle of *Cognitive Economy* which Rosch claims is involved in the formation and application of categories (1978: 28f., italics RSS):

The [principle of Cognitive Economy] contains the almost common-sense notion that [...] what one wishes to gain from one’s categories is a great deal of information about the environment while conserving finite resources as much as possible. [...] On the one hand, it would appear to the organism’s advantage to *have as many properties as possible predictable from knowing any one property*, a principle that would lead to formation of large numbers of categories with as fine discriminations between categories as possible. On the other hand, one purpose of categorisation is to *reduce the infinite differences among stimuli to behaviourally and cognitively usable proportions*. It is to the organism’s advantage not to differentiate one stimulus from others when that differentiation is irrelevant to the purposes at hand.

While the principle is aimed at explaining the cognitive purpose of (non-linguistic) categories, this can also easily be applied to paradigms. For instance, like categories, paradigms serve to derive as much information as possible from a sample of linguistic forms, as was made clear earlier when it was shown that paradigms enable the prediction of new forms by using information from partial samples. From a discriminative perspective, as outlined in Blevin’s WP approach, paradigms also help to reduce the differences between forms to such an extent that language users only need to know in what formal and functional aspect they differ, rather than having to analyse the entire morphophonological structure.

And lastly, paradigms might also exhibit cases of overlap, similar to category overlap, where there could be both morphological paradigms and grammatical paradigms, even though both theories from the previous section are limited to either one of the two types of paradigms. However, if we instead conceive of the paradigm as a *dynamic* entity that can allow for categorization of both morphological and grammatical features depending on usage-based criteria such as frequency, a strict division between the two approaches could be overcome. *Dynamic* in this case is to mean that paradigms are not fixed and pre-defined but can be formed and adapt depending on language use. We could then compare the paradigm to non-linguistic categories with overlap such as *red* and *bird*: Although there are animals that can be both red and birds, there are cases where the subcategory *red* would be more useful, e.g. when needing to differentiate red animals from blue animals, and in other cases *bird* would be more useful, e.g. when needing to differentiate birds from bats. Similarly, there are cases where a morphological paradigm is more useful, e.g. for phonological levelling within a nominal paradigm, and there are cases where grammatical paradigms are more useful, e.g. for analogy between different verbs in grammaticalization processes. By assuming that the common linguistic features used to determine paradigm membership are chosen based on efficiency and the communicative task at hand, this would also make the concept of paradigm more in line with other usage-based approaches to cognitive linguistics.

Another important aspect that has been briefly mentioned in this paper but deserves further discussion when talking about domain-general processes is the role of *analogy*. It should be noted first, however, that the largely synonymous use of the two terms *analogy* and *analogical change* (see examples discussed in section 2) can be problematic on an interdisciplinary level, since *analogy*, as used in cognitive psychology, does not usually mean diachronic change, but rather a synchronic comparison. Gentner (1983: 159), for example, describes analogy as a “comparison in which relational predicates, but few or no object attributes, can be mapped from base to target”. In this sense, analogy is essentially a mapping process and a change in the target is not necessarily implied. Therefore, strictly speaking, analogical change is to be understood as a continuation of an analogy in which the target is also adapted so that it subsequently shares more characteristics with the base. In linguistics, however, a distinction is rarely made between the synchronic process of analogy and the diachronic consequence of analogical change, because usually only the latter is of interest. The reason for this is that, although analogy is undoubtedly a prerequisite for analogical change, it is difficult to investigate in isolation as it is a user-internal process. Instead, the primary focus of linguistics is on the result that is produced in the form of a communicative utterance. Focussing now on the role of analogy in categorization, it can be said that—in both non-linguistic and linguistic categories—stored features can spread from one member of a category to

others, which is reflected by the concept of analogical change. In the non-linguistic domain, this process can also be observed, e.g. in stereotyping: Cardwell (1996: 227) defines the stereotype as a “generalisation about a particular group or class of people” which, conversely, is often attributed to social categorization (see Abrams 2001; Krueger 2001; Hugenberg & Sacco 2008). In other words, characteristics of a single member or subgroup are transferred to the totality of all members in a category.¹² This can also be transferred to the linguistic domain: Here, it is a process by which linguistic features of one or more forms are transferred or generalised to the other forms in the paradigm, as it was shown with the previous example for paradigm levelling. Analogical language change could therefore be understood as a kind of stereotyping at paradigm level. In contrast to the stereotyping of social groups however, analogical language change not only causes the entrenchment of a new or changed mental representation, but also enables the production of new forms, which in turn can be conventionalized through use in communication (c.f. Schmid 2020).¹³ It therefore makes sense to consider paradigms a catalytic base for particularly far-spreading cases of analogical change, which do not stop at individual forms, but can extend across all members of a paradigm—similarly to how social categories can enable stereotyping (see Politt 2022 who also proposes that paradigms serve as the basis for analogy).

In sum, based on the similarities between non-linguistic categories and linguistic paradigms, it would appear likely that both are stored and processed in the same way by the human brain. If this is correct, this would yield the advantage that, when modelling linguistic paradigms in existing language theory, we could test the psychological plausibility of these models by directly comparing them to their non-linguistic counterparts.

However, one important question remains: How can we test the claim that paradigms are categories? While no empirical data is available at this point that investigates the relationship between paradigms and categories in particular, I will list and discuss several options that could be employed to systematically test the assumptions about the cognitive status of paradigms outlined above. These options are based on previous experiments conducted to investigate non-linguistic

¹² Naturally, this only occurs at the conceptual level of an observing individual and does not automatically affect the individuals in the real world on which these mental representations are based.

¹³ It should be added that categories, and thus also paradigms, are not to be understood as a mandatory prerequisite for analogy or analogical change, and there are numerous case studies for analogical change that clearly do not require a cognitive concept of categories or paradigms (see for example Tomasello 2006; Sommerer 2015; Gillmann 2021). Nevertheless, it cannot be ruled out that categorization seems to play a central role in analogy (c.f. Smet & Fischer 2020).

categories and have been adapted to be able to focus on paradigms instead. This list is not exhaustive and could be supplemented with further propositions.

The first option would be based on a simple categorization task: Kogan (1979) investigated age categorization by showing participants photos of people of different genders and ages. The participants were then asked to estimate the age of each person and categorize them into an age group. The photos served as stimuli, the age groups as categories. With regard to linguistic paradigms, it would therefore be conceivable to set up an experiment in which people are shown different word forms that have different phonological, morphological and functional properties. Participants would then be asked to sort them into categories that seem logical to them. However, it would be important to ensure that the participants have as little metalinguistic knowledge as possible to prevent biased results. Similar studies testing categorical linguistic knowledge have already been conducted (see for example Kirby et al. 2014; Fehér et al. 2019), but so far without a clear focus on investigating linguistic paradigms. This way, it could be investigated if humans proceed similarly with categorizing linguistic items as they do with non-linguistic features, and whether the resulting categories align with what is traditionally considered a paradigm (e.g. the inflectional paradigm of a verb).

A second option would focus on priming: One feature often associated with categories is the measurability of priming effects. Studies such as Ray (2008), Ray & Bly (2008) and Perea & Rosa (2002) also point out that the priming effects for semantic relations and associative relations appear to be of two different natures. It would therefore make sense to carry out experiments to test if priming effects can also be measured for members of the same paradigm and then compare them with results for priming effects in semantic and associative relations. If the retrieval of paradigm members shows priming effects similar to category priming, this would again indicate a cognitive connection between the two domains.

A third option would be related to the field of neuroscience: Hanson et al. (2005) were able to use neuroimaging techniques to identify brain regions that are activated when categorical knowledge is applied. Based on this, it could therefore be investigated whether brain activity during the application of paradigmatic knowledge, e.g. when producing novel inflectional forms, shows patterns similar to the application of non-linguistic categorical knowledge. If this is the case, this could further support the theory that paradigms are essentially treated like categories.

Of course, even if the results speak in favour of the claims made above, the issue would still remain that it cannot be determined with absolute certainty that paradigms are indeed stored as separate entities rather than being a surface phenomenon—a problem that is also true for non-linguistic categories in general. However, an interdisciplinary approach that is based on research involving categories might yield more generalizable results than if we treat paradigms as a purely linguistic phenomenon.

5 Conclusion

This paper has discussed the question of whether paradigms have cognitive representations, and how these representations could be modelled in a psychologically plausible way. For this purpose, I have first presented typological evidence for three language phenomena that speak in favour of paradigms being stored as distinct cognitive entities, namely paradigm levelling, suppletion, and the ability to produce novel inflectional forms. In the case of paradigm levelling, it was made clear that diachronic changes in language, such as the elimination of stem allomorphy for the Latin noun *honor*, would be hard to explain without assuming that the base for the analogical change involved was a set of similar grammatical forms with clear membership criteria. Regarding suppletion, it was shown that the loss of specific inflectional forms for two originally independent paradigms that complement each other in functional distribution can be better explained by assuming that two paradigms fused together into a joint paradigm, rather than analysing each form in isolation. And thirdly, it has been shown that humans are able to produce novel inflectional forms that have not, or rarely, been heard before, which suggests that we possess implicit knowledge about inflectional structures in a paradigm that is more readily available than derivational patterns.

In the following section, two previously proposed approaches for modelling linguistic paradigms were discussed which are couched in the traditions of word and paradigm and Construction Grammar respectively. The WP approach posits the paradigm at the centre of grammar by proposing that grammatical forms are always selected from a larger paradigm by comparing them to other functional forms in the same paradigm and not assembled in a linear morpheme-based manner. It thereby attempts to explain different degrees of morphological complexity in different languages by arguing that word-internal complexity plays no role in everyday communication. In this sense, WP considers paradigms to be abstract units of paradigmatic knowledge that serve to select the correct inflectional form in communication or create novel forms in the case of paradigmatic gaps. However, it is unclear how the claims made about the nature and limitations of paradigms can be falsified via experimental methods. Additionally, WP does not sufficiently justify the formal boundaries set for paradigm sizes, since the claim that different languages have differently sized paradigms could imply that the cognitive ability to form paradigms is relative to the specific language. And it also struggles to account for suppletion by postulating that a common lexeme must be the basis for paradigm membership. Diwald offers a constructivist approach to paradigms by proposing that paradigms are holistic hyper-constructions consisting of grammatical constructions that pertain to a specific grammatical category such as TENSE or ASPECT. This entails that paradigms represent nodes in the constructional network

and are linked to other constructions. However, it is still unclear what these links may look like in a construction grammar framework, or how this theory could be tested, although the latter issue certainly also applies to cognitive frameworks of linguistics in general.

Following the comparison of the two approaches, an alternative approach has been proposed that assumes the underlying cognitive processes behind paradigmization to be the domain-general capacity for categorization. It further suggests that paradigms are cognitively equivalent to non-linguistic categories, meaning that they are stored and processed in the same manner. This claim is supported by the fact that paradigms appear to follow the principle of Cognitive Economy, as on the one hand, they serve to derive as much information as possible from a sample of linguistic forms, and on the other hand, they help to reduce the differences between stored forms. Additionally, paradigms also exhibit cases of category overlap, if we assume that paradigms can form dynamically according to language use and are not limited to morphological or grammatical features only. While no empirical data was presented at this point to support this claim, a few suggestions have been made as to how this theory could be tested using experimental methods, namely by the use of categorization tasks, by measuring priming effects between inflectional forms, and by measuring brain patterns that occur during the application of paradigmatic knowledge and comparing them to patterns that occur during the application of categorical knowledge.

Ultimately, I hope that this paper has been able to show that, on the one hand, the concept of a paradigm is necessary to explain certain linguistic phenomena, but on the other hand, cognitive linguists should also be more precise about what they mean then use the term *paradigm* and elaborate on the exact nature of its cognitive reality in more detail, as we still lack common empirical grounding that everyone can agree upon.

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