Frequency and iconicity revisited. Towards an integrative ecological perspective

1. Introduction: the usage-based approach to grammatical knowledge

The aim of this paper is to reflect on the role of frequency as an explanatory concept in usage-based construction grammars. Since frequency has been successfully invoked as an explanatory concept in many linguistic studies, and not only constructionist ones[1], my intention is not to generally deny the efficacy of frequency for us gaining knowledge about language competence and use. Rather, I will point to some difficulties in the way of explanation and propose a number of distinctions that may help to determine the possibility and scope of frequency as an explanatory concept. In particular, I will justify the following three theses concerning usage-based linguistic explanations:

1. Explanations by recourse to frequency run the risk of overstretching its explanatory scope in usage-based construction grammar theories.
2. The overestimation of the role of frequency as an explanatory concept is the result of narrowing down the functions of language in research praxis, despite theoretical or programmatic tenets.
3. Consequently, in order to come closer to a fair evaluation of the explanatory scope of frequency, the view of language competence must be broadened (again) beyond certain opinions related to cognition held by Cognitive Linguistics.

I will flesh out these theses in what follows. In order to set the stage for the discussion, I will briefly outline the basic tenets of usage-based construction grammar theories in the tradition of Cognitive Linguistics in the next section. They will be relevant to the subsequent sections 3, 4 and 5 in which the claims above will be considered one after the other.

Throughout the later chapters I will dedicate much space to outline the long-term goal of an "ecological" perspective on language in which iconicity has a place alongside frequency. This ecological perspective is characterized by the embedment of knowledge and use of language in a broader field of tension as usual, including general cognitive *and* practical aspects of human engagement in the world.[2] In doing so I will touch on a number of concepts that are closely related to frequency, namely economy and two types of efficiency. The concept of markedness will not be discussed here (but see Haspelmath 2006, 2008; Bybee 2011 on this topic). Furthermore, I will delve into theoretical questions about language knowledge and use to some degree, since an adequate assessment of the role of frequency as an explaining concept (*explanans*) crucially depends on the nature of what is to be explained (*explanandum*).

[1] To name but a few, see the volumes by Barlow & Kemmer (2000) and Bybee & Hopper (2001), and the works by Bybee (e.g, 2006, 2010), Fenk-Oczlon (e.g. 1991) and Haspelmath (e.g. 2006, 2008). In the narrower context of construction grammars see Tomasello (2003), Langacker (2000b, 2002), Diessel (2015), Diessel & Hilpert 2016).

[2] "The subject-matter of "human ecology" is the relationship between the human organism, including his physical and cognitive makeup, and his natural and cultural environment, as well as the way they shape each other. As such, it is essentially an interdisciplinary effort. The term "ecological" is intended here to indicate a broader scope for the roles of frequency and iconicity, which are typically discussed from a purely cognitive perspective; however, from an ecological perspective, cognition is only one factor among others.

2. Cognitive Linguistics and usage-based construction grammars

With respect to the questions for which they offer answers, construction grammar theories seem very close to other theories of grammar:

> "What is the nature of our knowledge of language? How do learners acquire generalizations such that they can produce an open-ended number of novel utterances based on a finite amount of input? Why are languages the way they are?" (Goldberg & Suttle 2010: 468).

As regards their basic assumptions and their methods, the construction grammar theorists relevant here commit themselves to the Cognitive Linguistics enterprise.[3] Cognitive Linguists view Linguistics as a cognitive science alongside other cognitive sciences each of which "seeks to explain different […] aspects of human cognition." (Evans & Green 2006: 16).

Cognitive Linguists approach language from the perspective of what it accomplishes for its users. Hence, they emphasize the symbolic and interactive functions of language (cf. Langacker 1999). The former consists in the expression of meanings by means of forms. Characteristically, meaning is identified with conceptualization (plus construal). It shows, then, that "[i]n attempting to formulate a conceptualist semantics, one is soon led to ponder the role of spatial and visual experience in shaping other aspects of cognition." (Langacker 2000a: 202). This leads them to a view in which "[c]oncepts […] derive from percepts" (Evans & Green 2006: 7). The other, interactive, function consists in communicating meaning. "This involves a process of transmission by the speaker, and decoding and interpretation by the hearer, processes that involve the construction of rich conceptualizations […]" (Evans & Green 2006: 9).

The whole of the involved aspects of cognition, i.e. perception, conceptualization, construal, association, automatization, categorization, schematization, instantiation and elaboration (cf. Langacker 2008: 16–17) is viewed to be embodied in the sense that "human concepts are not just reflections of an external reality, but […] they are crucially shaped by our bodies and brains, especially by our sensorimotor system." (Lakoff & Johnson 1999: 22). Accordingly, the "Cognitive Commitment" asserts that

> "principles of linguistic structure should reflect what is known about human cognition from other disciplines, particularly the other cognitive sciences (philosophy, psychology, artificial intelligence and neuroscience). In other words […] language and linguistic organization should reflect general cognitive principles rather than cognitive principles that are specific to language" (Evans & Green 2006: 40–41).

It follows from the experiential basis of cognition that knowledge of language, or competence, must be acquired by the same mechanisms as any other type of knowledge. Due to the very empiricist nature of Cognitive Linguistics, this leads to a usage-based perspective on competence, according to which "usage events are the source of all linguistic units" (Langacker 2008: 220). Speakers' knowledge of language consists of a vast network of nodes

[3] The term is borrowed from Langacker (2000). The capitals at the beginning of the words are borrowed from Geeraerts (2006), indicating – neutrally speaking – an identifiable scientific movement.

linked via "categorizing relationships" (Langacker 2002: 266) the most important of which are schematization and specialization along the vertical dimension and different kinds of extensions along the horizontal dimension in the network (see also Goldberg 1995: 67–100). Each node in the network represents a linguistic unit, i.e. a form–meaning pair (if Langacker's "content requirement" is acknowledged). These units are categorized and abstracted from actual usage events (cf. Langacker 2002: 261–288) via general mechanisms like perception, association, categorization and schematization. One central aspect setting apart usage-based construction grammars from the rest of Cognitive Linguistics relates to the fact that the former consider the nodes in the network to stand for constructions (cf. Goldberg 1995, 2006; Langacker 2002, 2008; Croft 2001). This is accompanied by the assumption of a lexicon–grammar continuum.

Frequency plays crucial roles at least in Goldberg's (later) Construction Grammar (CxG), Langacker's Cognitive (Construction) Grammar (CCG), and Croft's Radical Construction Grammar (RCG). They all subscribe to the *frequency principle*: "The frequency principle asserts that the frequency of occurrence of a linguistic unit in a speech community correlates with the degree of its cognitive entrenchment in the linguistic knowledge of the community members" (Ziem & Lasch 2013: 103; my translation). Langacker discusses entrenchment under the heading of automatization:

> "Automatization is the process observed in learning to tie a shoe or recite the alphabet: through repetition or rehearsal, a complex structure is thoroughly mastered, to the point that using it is virtually automatic and requires little conscious monitoring. […] [A] structure undergoes progressive entrenchment and eventually becomes established as a unit." (Langacker 2008: 16).

Thus, it is from usage events depending on frequency that constructions enter the network representing speakers' knowledge of language. Entrenchment links the frequency of bits of language in the environment to the presence of constructions in the knowledge of language users. It should be noted here that usage-based cognitive construction grammarians slightly disagree in what is necessary for a pattern to be or become a construction. Sufficient frequency/entrenchment is one of the most prominent criteria. However, Langacker (2008: 220) acknowledges that "[u]nder some conditions a unit […] can be learned from a single exposure". Nevertheless, it is entrenched units that produce certain important effects. Ziem & Lasch (2013: 103; my translation, my italics) point out the theoretical importance of entrenchment. "The *'entrenchment' principle* is very important for cognitive approaches to construction grammar because it lends itself to a psychological (and neuroscientific) explanation of the emergence and change of constructions […]". But entrenchment is not only invoked to explain the emergence and change of constructions. The entrenchment of construction types also "directly correlates with the productivity of a construction" (Ziem & Lasch 2013: 106). The frequency of a construction token contributes to the determination of productivity because "it determines the degree of cognitive entrenchment of particular constructions" (Ziem & Lasch 2013: 106; my translation). Bybee (2006) extends the significance of the frequency/entrenchment principles to processing and storage. She states that

> "[h]igh-frequency sequences become more entrenched in their morphosyntactic structure and resist restructuring on the basis of productive patterns that might otherwise occur. […] My proposal to explain this tendency […] is that frequency strengthens the memory representations of words or phrases, making them easier to access whole and thus less likely to be subject to analogical reformation. This effect applies to syntactic sequences as well, allowing higher-frequency exemplars to maintain a more conservative structure" (Bybee 2006: 715).[4]

One example for how this set of assumptions is put to work theoretically is Barðdal's (2009) treatment of the development of case in Germanic languages, which have suffered a loss of case distinctions throughout their histories. Barðdal argues – I have to simplify here for reasons of space – that in their historical stages these languages had many argument structure constructions differing from each other mainly in the case categories of their arguments (e.g. Nom-Acc vs. Nom-Gen patterns). Apart from these differences, many of the constructions were similar in meaning, but differed in semantic restrictedness. The type frequencies of constructions stand in an inverse relation to their semantic restrictedness. Where the one is high, the other is low. Now case was lost either because constructions with high type frequencies "attracted" verbs from constructions with low type frequencies, resulting in the loss of the latter and the case patterns they exhibited, or by merging synonymous constructions, where those pairings of cases and syntactic functions were retained which were the most frequent in the language in question. In other words – and fully in line with Bybee's quote above – the higher frequency exemplars turned out to have a more conservative structure, at the expense of the lower frequency exemplars.

However, attributing frequency such a huge degree of explanatory value as indicated by the *frequency/entrenchment principles* cannot be easily reconciled with further theoretical assumptions of construction grammar theories. For instance, Goldberg & Suttle (2010: 468) assume that "constructions are learned on the basis of the input, together with domain-general processes including attentional biases, principles of cooperative communication, general

[4] The frequency/entrenchment principle is not new, although its contemporary applications are. Hermann Paul already formulated many aspects of today's usage-based theories, among them the role of frequency ("repetition"), abstraction/schematization and entrenchment ("impressed […] upon the memory"), but also analogy and association. I think much of today's appeal of frequency-based explanations comes from their neglect in the tradition of mainstream Generative Grammar. As Paul (1891: 99–100) put it,

> "[i]n the process of naturally mastering one's mother-tongue no rule, as such, is given, but only a number of examples. We hear gradually a number of sentences which are connected together in the same way, and which hence associate themselves together into one group. The recollection of the special contents of the single sentences may grow less and less distinct in the process; the common element is always strengthened anew by repetition, and it thus comes about that the rule is unconsciously abstracted from the examples. It is precisely because no abstract rule is laid down that no single example suffices, but only a group of examples whose special contents appear a matter of indifference. For the idea of the general applicability of the examples cited, which gives each individual the feeling that he is authorized to compose sentences on his own account, becomes developed only by this process."

> "And besides, much that occurs in the usage of language stands isolated and alone, and neither fits in with any consciously abstracted rule, nor with a group that has unconsciously arisen. But all that part of language which lacks the support of an environing group, or which enjoys it only in a limited measure, proves, unless impressed by repeated usage intensely upon the memory, not strong enough to withstand the power of the larger groups" (Paul 1891: 100).

processing demands, and processes of categorization." In particular, the so-called "Scene Encoding Hypothesis" seems of the utmost importance in the context of these domain-general processes, because it places the structure of constructions in a wider field of tension than just the simple relationship between language input, cognitive processes like categorization and schematization, and output. According to this hypothesis "[c]onstructions which correspond to basic sentence types encode as their central senses event types that are basic to human experience" (Goldberg 1995: 39). Although we are not told what makes specific experiences "basic", this hypothesis implies, firstly, that cognition is not exclusively shaped by language input. It implies, secondly, that in order to explain the structure of constructions one has to take into account our experience of non-lingual events, and it implies, thirdly, that there is something that makes some experiences more basic than others. If taken seriously, these factors also have explanatory potential with respect to the very same phenomena for which frequency and entrenchment have been put forward as explanations, namely the structure, emergence, change, productivity, and processing of constructions. Moreover, it is explanations along these lines which predominated in the theoretical discourse before the usage-based "turn" in Cognitive Linguistics in the 2000s. Such explanations are illustrated by Talmy's (2000), Goldberg's (1995), Langacker's (e.g. 2002) and Croft's (1991) works. In these works, the structures of argument structure constructions (or whatever their designation) were explained primarily by recourse to notions like Figure and Ground, force dynamics, conceptual archetypes, and frames.

As a consequence, we have *quantity-based explanations* (frequency) and, say, *quality-based explanations* for the same phenomena. Before the usage-based turn, the latter predominated, now the former do. It is my impression that both should have their place in seeking answers to the question of why languages are and are used the way they are, but that the zeitgeist now seems to favor quantity-based explanations at the expense of quality-based explanations.

3. Frequency in (need of) explanation

How is it that one can explain the emergence, change, productivity, and processing of constructions by recourse to frequency, as the frequency/entrenchment principles state?

For an explanation we need, firstly, something to be explained (*explanandum*), i.e. a description of some observed event or situation. Secondly, we need something that explains the coming about of this event or situation, an *explanans*. It usually consists of a set of antecedent conditions and a set of universal hypotheses (i.e., "general laws"; Hempel 1942: 36) in the form *Always if…, then…* or, if no such laws can be formulated, statements of a probabilistic kind with "sufficient" high probabilities (cf. Hempel 1965). Both kinds of statements function as premises. If the statements furthermore satisfy certain formal and semantic conditions, the occurrence of the event or situation in question can be deductively concluded (and thus explained), given that the premises, i.e. the two sets of statements of the

explanans part of the argument, are accepted/true/not falsified.[5] I will now briefly discuss three applications of a frequency-based explanation. It should be kept in mind, however, that these serve only illustrative purposes and that they are not actual applications in every case. My goal is to take the frequency/entrenchment principles at face value and push explanations beyond plausibility by way of thought experiments in order to isolate the point where they become implausible so that we can talk about what they lack.

1. The observations underlying the questions raised by Goldberg and Suttle at the beginning of section 2 provide examples of such *explananda*. An utterance like *He sneezed the napkin off the table* is (or, for linguists, once was) a novel utterance, having newly emerged "based on a finite amount of input" (Goldberg & Suttle 2010: 468). So the *explanandum* can be described in this way: Speaker S uttered *He sneezed the napkin off the table* with the meaning of caused motion, or, from the perspective of the hearer, hearer H understood *He sneezed the napkin off the table* as meaning caused motion. Turning to the *explanans*, several matters related to the basic tenets of usage-based construction grammar theories enter the respective statements. Statements pertaining to general laws or statistically probable statements would be: If the type frequency of the caused-motion construction in the input of a language user is high, this leads to the entrenchment of this construction in his/her network-like grammatical knowledge. If constructions become entrenched, they become easily accessible in production and categorization (in contrast to non-entrenched constructions). The antecendent conditions could be: There has been a high type frequency of the caused-motion construction in the input of S (and H). S (and H) neither perceived nor uttered this particular sentence before. *He sneezed the napkin off the table* is an instance of the caused-motion construction.

Although there is no logical conclusion or causal connection leading from the law-like statements and antecedent conditions above to the conclusion that S actually uttered this sentence, we can deduce that the construction is easily accessible for him/her. We can assume that there is a close relationship between input frequency and, roughly speaking, competence of this type of construction, including the "readiness" to utter it on the side of the speaker and the competence to categorize it as meaning caused motion on the side of the H.

2. Many explanation-arguments of this type can also be "turned around" and used for predictions.[6] General "laws" retain their role, but the first set of statements takes the role of conditions, which, if satisfied, allow – in combination with the general "laws" – the prediction of the occurrence of an event or situation that has not yet occurred. If instances of more frequent constructions in the input of a language user are easier for him/her to process, because they can be easily recognized as instances of a construction by a prompt in the input in online comprehension and be predicted with some probability, this would allow us to

[5] This is obviously a simplified reproduction, but I must spare the details. See, for instance, Hempel (1965), Schwemmer (1987) and Mittelstraß (2004, Vol. 1, 578–584) and the references given in the last for discussions concerning the notoriously difficult notion of "explanation".

[6] One reviewer asked whether the usage-based cognitive construction grammarians addressed here actually subscribe to a type of argument including predictions, since a theory could only be measured by its own standards. Goldberg's (1995), Langacker's (2008) and Croft's (2001, 2012) respective versions of construction grammars do make many predictions throughout their works, although they do not explicitly discuss matters of philosophy of science (but see Langacker 2008: 9 for a metatheoretical comment).

predict that an instance of a construction should be more easily processed than another construction, if it has been more frequent in the input of a language user, all other things being equal. As an example, Reali and Christiansen (2007) found in their psycholinguistic (reading task) study on relative clauses "that the […] relative differences in processing difficulty consistently mirrored the distributional patterns found in the linguistic corpora" (Reali & Christiansen 2007: 18).

3. Obviously, frequency-based explanations work. But how far can they be pushed? Turning to a last observation the following table of data taken from the World Atlas of Linguistic Structures (WALS) illustrates data about the way languages are organized.

APV	**AVP**	**VAP**	**VPA**	**PVA**	**PAV**
565	488	95	25	11	4
	1148 (83.4%)			40 (2.9%)	
no dominant order: 189 (13.7%)					

Table 1: Dominant order of the more agent-like element (A), the more patient-like element (P), and the verb (V) in transitive clauses based on a sample of 1377 languages (cf. Dryer 2013)

One observation in need of explanation that can be drawn from Table 1 is that over 80 percent of languages analyzed show an A-before-P dominant order but only 3 percent show the opposite order.[7] What do the frequency/entrenchment principles offer us here, if we take them at face value?[8] Obviously, these data reflect (generalizations of) output frequencies. If the output reflects speakers' knowledge of language, and if knowledge of language correlates with the frequency of occurrence of a construction within a speech community, which in turn forms the input for users of that language, we would have to explain the fact that many speakers of many languages mostly produce instances of A>P constructions (VAP, AVP, APV) by recourse to the fact that instances of A>P constructions form a more frequent input for these speakers than instances of P>A constructions (VPA, PVA, PAV). Is this an explanation? It is, with respect to the logical form of an explanation-argument. The general "laws" that can be formulated about the relationship between frequency, entrenchment and, say, the accessibility of frequent and entrenched constructions in speakers' knowledge are not analytical truths but may in principle provide new insights, if combined with actual observations. This is also demonstrated by Barðdal's (2009) treatment of case in Germanic

[7] One should keep in mind here that these numbers are at least fourth-degree data: quantifications taken from descriptions based on reference grammars that contain generalizations over utterances of speakers.

[8] I am well aware that actual explanations would be more complex. As indicated above, my illustration has the character of a thought experiment.

which can be easily transformed into the above explanation argument and which yields deep insights.[9]

The three explanatory sketches are meant to exemplify the logical structure of explanations based on the frequency/entrenchment principles. They concerned the explanation of the accessibility of an instance of a construction (*He sneezed the napkin off the table*) in production and comprehension, the predicted correlation between frequency and ease of processing, and typological homogeneity or variation. In my eyes, these explanations become increasingly "flat", although they do indeed point to real correlations between frequency and the observed patterns. I will formulate three problems and explicate why they lead to a lack of depth or to simplification.

(1) The explanation problem:
If the structure, processing and emergence of constructions are explained by recourse to the frequency/entrenchment principles, explanation is actually abandoned at an early stage.

We have seen that language serves a symbolic and an interactive function in construction grammar theories. Illustrated by the schematic in Figure 1, the communication model mostly consists of a speaker and a hearer connected via joint attention (cf. Tomasello 2003) and communicating meaning by means of utterances. Frequency, categorization, entrenchment etc. play important roles for processing, knowledge of language, the lexicon–grammar continuum and constructions.

Most of the time, however, what is taken into view is what happens between utterances of someone (B in the figure) and the cognition of the hearer (D). And if the frequency of units in the hearer's input is conceived of as the cause of what happens in his/her mind, together with the general cognitive functions (C), this can serve as a basis for a deep explanation only in a very restricted sense: what figures as someone's input is the output of somebody else, and we can explain further that this output can again be explained by recourse to the input the respective person(s) received and his/her/their general cognitive functions, *ad infinitum*.

[Insert Figure 1 here]

Figure 1: Communication model supposedly underlying the interactional function of language[10]

Remember that grammatical knowledge is considered to take the form of form–meaning pairings in a network where the nodes stand in categorizing relationships with one another, especially those of schematization/elaboration along the vertical dimension. We can see now that an explanation argument relying on the frequency/entrenchment principles can only

[9] Outside usage-based construction grammars, Haspelmath (2008) is another example of how frequency-driven explanations offer new and deep insights.
[10] The similarity to de Saussure's speech circuit is intended.

explain the *structural relatedness* on some level of schematicity between constructions in the output and constructions in the input. But what it obviously cannot explain is why both types of utterances got the structures they actually have. For this it would be necessary to explain *why* a certain construction was frequent in the input in the first place – e.g. the caused-motion construction or the A>P pattern. This leads us to a second problem as an extension of the first.

(2) The homogeneity problem:
If the processing, emergence (acquisition) and structure of constructions are explained by recourse to input frequencies and the effects of entrenchment, but where input frequencies themselves are not explained without an infinite regress via inputs and outputs, typological homogeneity across (unrelated) speech communities cannot be further explained.

This alludes to the WALS data above where I already stated that quantity-based explanations (frequency) may be applied to them successfully, but with a flat outcome. This is only an extreme example for the common observation that languages which are not genetically related to each other share structural features. The third problem does not concern the depth of an explanation but the simplification of causal or logical connections.

(3) The performance problem: Where the ease of processing and the well-formedness of a construction are explained by recourse to frequency, this neglects the fact that input frequency does not always correlate with ease of its processing and well-formedness.

Although the results from the study of Reali & Christiansen (2007) point to a correlation between frequency and ease of processing, there are also studies indicating that this need not be the case (e.g. Bornkessel, Schlesewsky & Friederici 2002, Ferreira 2003). In other words, strong correlations are considered to hold between relative frequencies and entrenchment and between entrenchment and ease of processing, but this does not exclude that ease of processing may correlate even stronger with a third factor that is different from both frequency and entrenchment. What is also possible is that the alleged correlation between frequency and entrenchment is not as strong as has been assumed, and the effects of entrenchment may also be due to factors other than frequency. The same is true for the correlation between perceived well-formedness and corpus frequencies (cf. Bader & Häussler 2010).

The problems above arise, if the conditional statements in (1) to (3) are met. In section 2 I have given the relevant quotes showing that these conditional statements contain basic tenets of Cognitive Linguistics and, more specifically, of cognitive construction grammars and they follow from the frequency/entrenchment principles. The problems arise, I believe, because the explanatory scope of the frequency concept (1st thesis in section 1) gets overestimated in these basic tenets. The next section reflects on the possible sources of this observed overestimation (2nd thesis in section 1).

4. The body in the mind?

I have argued that the frequency/entrenchment principles can be applied insightfully (e.g. Barđdal [2009]), whereas in other cases it would lead to flat or false explanations of why constructions are organized in the ways they are and why they are processed with more or less difficulty. I suppose the reason for this is that the relationship between input and competence/use of language is not sufficiently constrained by the processes that are supposed to mediate between them (C in Figure 1), most notably automatization, association, categorization and schematization.

This, in turn, might be due to the very cognitivistic nature of Cognitive Linguistics. Language users are, strictly speaking, conceived as mere cognizers, doing things and undergoing happenings not as bodily, moving, acting persons, but only in their heads or even "in their minds". Sometimes these cognizers are also envisioned as articulators, hearers, seers and as moving their eyes in order to (jointly) attend to something, but this is often their only connection to what is outside their heads, as if they needed no body at all – the programmatic claim of an embodied cognition seems to be accompanied by a neglect of the fact that it is by our bodies that we are connected to our environment. Symptomatically, the scientific disciplines invoked for converging evidence in the Cognitive Linguistics enterprise are themselves only *cognitive* sciences (cf. Evans & Green 2006: 40–41; see above) concerned with ("natural" and artificial) minds and brains. Where are the disciplines concerned with bodily action and practical lifeworld matters, i.e., certain branches of Anthropology, Sociology, Ethnology, (not only Cognitive) Psychology, Human Ecology, Philosophy?[11]

According to this diagnosis, verbal interaction, one of the main functions of language according to Cognitive Linguistics after all, is practically, though not theoretically or programmatically, reduced to the transfer of meaning from one mind to another, leading eventually to statements about "minds" or even "brains communicating" or "interacting with each other". Minds and brains do not interact, persons do. Verbal interaction is more than transferring meaning from one person to another. Considerable parts of everyday discourse serve the organization and coordination of nonverbal action, and thus require the corresponding competences (*Could you please pass me the salt?*). Neither minds nor brains describe the way to the train station if asked, nor are interchanges of this kind confined to cognitive activities. In order to judge a description of the way to the station not only as successful but also as effective, one has to broaden the perspective from cognitive to physical activities. The conditions of our successful and effective acting in the world have to be sought in the way we are cognitively *and* physically engaging in the world. As Schwemmer (1997: 103; my translation) puts it,

> "We are not only brain-creatures, but also bodily creatures, and we are creatures in a technical and symbolical culture. An anthropological examination and one in terms of Cultural Philosophy would have to consider and envisage as phenomena at least these three worlds – the world of

[11] Evans & Green list Philosophy as a cognitive science. Many professional philosophers would be unhappy with such a classification. When including Philosophy in my own list of disciplines contributing to linguistic theories, I am addressing these philosophers excluded by Evans & Green. On the role of Philosophy in relation to the scientific disciplines see, for instance, Janich (2006) and Hartmann (2013).

> mind [*Bewußtsein*], the world of action and our cultural world, especially that of symbolic expression."

With respect to the world of action in particular he states that "factors of our organizing and structuring action [and behavior – SK] enter the structure of our conceptualizations [*Vorstellungen*]. These factors are not grounded in our mind, but in our relation to the world [*Weltverhältnis*]"[12] (Schwemmer 1997: 110; my translation). If we take this into account, we find that automatization, association, categorization and schematization – mental phenomena – are phenomena that enter a broader field of tension, as they also prove relevant where no one is talking, i.e. in the relationship between what we perceive and how we act or behave in the face of it. From such a rather ecological (or anthropological) perspective, what we perceive can be described as standing in the service of our capacity to act and behave, and how we act and behave prepares what we perceive. On the basis of these mutual "service" functions it is possible to derive constraints on the way basic cognitive functions (e.g. those in C in Figure 1) can be carried out with respect to language and to other bodily activities, and to assign frequency a more circumscribed role in the logic of linguistic explanations, so that solutions to the three problems above become possible. At the same time, an ecological perspective would be very much in the spirit of what I dubbed quality-based explanations (e.g. the Scene Encoding Hypothesis and related concepts).

5. An ecological perspective on cognition and language

5.1 Cognition from an ecological perspective

In explicating the 3rd thesis from section 1 I cannot do more here than roughly sketch an ecological perspective, broadening the perspective to include bodily action and behavior. Starting with the practicalities of everyday life (and not with categorization or another cognitive process), we conduct our lives *pursuing purposes* and *acting* in order to realize these purposes.[13] We constantly conceptualize eventualities (e.g. me having a coffee) and act methodically to realize them. In the course of action we confront ourselves with the objects which are parts of our action plan (door, water, cup, coffee, coffee maker etc.) and act on them in the conceptualized way, eventually leading to the realization of the purpose (me having coffee). I will call such objects *pertinent* in relation to a given purpose.

Our acts may also fail and they may be ineffective. They fail, if the result that is necessary for the identity of the act does not occur ('making coffee' was not the action schema I realized, if coffee was not the result of my efforts). They are ineffective, if they are successful but the purpose is not realized (I may have made coffee, but it is not stimulating me). Things we do not expect because they are not part of our action plans happen to us, so our own failures in acting, the action and behavior of others and natural events simply

[12] This has far-reaching implications for the philosophy of mind, especially for the relationship between mind, brain and language (or symbolic forms in general). Schwemmer (1997, chapter II) is dedicated to these implications.

[13] A far more detailed version of the following action theory and its relationship to perception and conceptualization can be found in Kasper (2015: 83–94, 100–192). Motives for starting with a description of the lifeworld can be found in Schütz & Luckmann (2017) and Janich (2014).

"befall" us. Especially when such events hinder the realization of our present purposes (a colleague addresses me on my way to the coffee maker), they require our attention and our dealing with them by conceptualizing a subordinate purpose which must be realized before the original purpose can be pursued further. I will call those objects that grab our attention – in general or away from those that are pertinent at the time – *salient*.[14] In other words, the salient objects must be transferred into pertinent objects in order for us to remain capable of acting (cf. Kasper 2015: 127–143, 167; on the distinction between salience and pertinence, see Purschke 2011).

Some salient objects require activity on our side before we are able to integrate them purpose-rationally into our action plan and to execute it (a stone flying in our direction). Instead, they trigger reactions – which are not instances of action but "mere" *behavior*, despite their name – and they may be life-sustaining in that they save us from harm (cf. Kahneman 2012: 35). One characteristic of such reactions is that they exhibit a much quicker transduction from what we perceive to what we do than deliberate action. On the other side, reactions, alongside other types of behavior, are highly *automatized*, which makes them virtually impossible to desist from and to interrupt. What we (cognitively) perceive and how we (physically) react is linked here in a highly efficient way.[15] We could say that the link between the function of safeguarding our well-being and the effort invested in fulfilling this function in consideration of our resources expended is efficient. Less effort (less movement) would result in being hit, more effort (e.g. deliberately planned action) would also result in being hit. For the perception–behavior cycle we could state the following formula:[16]

$$\text{(4)}\quad \text{perception–behavior efficiency} = \frac{\text{effort : economy | cognitive \& physical resources}}{\text{function fulfillment}}$$

Two consequences deserve mentioning. Firstly, the economy of a particular form of behavior can only be estimated, if the other variables in the equation are also taken into account. Secondly, the very same behavior in relation to the very same perception can be viewed in relation to a different function, resulting in different economy (and efficiency) ratings.

Importantly, the fact that perception stands in the service of behavior (and action) illustrates that there must be more to categorization than just registering features, objects and movements, associating them, extracting invariants (schematization) and percept–concept

[14] "Salience" describes a relation between features of stimuli and neurophysical features of our perceptual apparatus. In the linguistic literature – and at odds with the cognitive psychological literature – *salient* can often be substituted for *significant*, *meaningful* or *relevant*, notions which clearly imply an active, top-down interest in the phenomenon by the cognizer. I want to exclude such top-down matters from the notion of salience entirely. As the original meaning of *salire* 'to jump at' indicates, what is salient "jumps at us", but we do not "jump at" what is salient. This latter case is what "pertinence" stands for.

[15] Many (though not all) distinctions made in this and the last section are also implemented in neuroscientific models concerning the link between perception and action including goal-directed action, e.g. Fuster (2004) and, also including forward modeling, Ridderingkhof (2014). On more general and explicitly ecological (though one-sidedly naturalistic) considerations regarding the interplay between perception and behavior, cf. Cisek and Kalaska (2010). Due to their scope, these models make far more fine-grained distinctions in respects which are not directly relevant for the aims of this article and which I must therefore neglect here.

[16] The colon indicates a ratio; the vertical bar ("|") sets this ratio 'against the background of' what comes after the vertical bar.

matching (categorization). If our organism treated everything in our visual fields as being similarly worth of registering, associating, extracting, schematizing and matching, our behavior could not efficiently fulfill vital functions. In other words, these central cognitive procedures are disposed, or adapted, to work in a particular way, namely *selectively* registering, extracting, associating, schematizing and matching things in our perceptual fields based on their being salient and to make a functionally appropriate response possible (cf. Allport 1954: 20–21). This is especially true for movement with respect to visual perception. To our sensorimotor apparatus, salient objects afford reactions, so that moving objects like flying stones afford evading.[17]

The abovementioned possibilities of interrupting an activity or to desist from executing it altogether characterize action in contrast to behavior. Although action may be *routinized* to a high degree, i.e. acts may be executed without attentional effort, they remain interruptible, if necessary (release the accelerator pedal while routinely driving and attentively talking). This distinguishes automatic behavior from routinized action (cf. Hartmann 1998).[18] Not at least because of this the efficiency of action has to be described differently, because no causal chain leads from what we perceive to what we do deliberately. As has been analyzed multiple times and from different perspectives, our capacity to act differs qualitatively from our (mere) behavioral capacities (e.g. von Uexküll 1926, Cassirer 2006, Gehlen 1997, Lorenz 2004), since the former is characterized by means–end rationality. It can be desisted from and it is based on reasons, which makes it impossible to predict with certainty, while behavior is caused, can be causally described and even predicted (cf. Hartmann 1993, Mittelstraß 2004, Janich 2014). In purposeful action, the things selectively attended to, registered and categorized are not primarily based on their salient features in a bottom-up fashion, but on their pertinent features in a top-down manner, being pertinent by virtue of their being part of an action plan which serves a purpose (cf. Corbetta & Shulman 2002, Kasper 2015: 100–162).[19] Consequently, purposeful action is too varied to pin down to a definite function (for an influential anthropological proposal cf. Gehlen 1986, 1997).[20] We could state, however, that an efficient perception–action relationship consists in expending no less effort than necessary and no more than suffices to realize a purpose.

[17] The concept of affordances was originally introduced by Gibson (especially Gibson 1986). For its significance in the present context, cf. Kasper (2015: 143–153).

[18] When Langacker (2008: 16), for instance, talks about "automatization", he blurs this distinction by meaning both automatization and routinization. However, this distinction is important because both "modes" involve different brain regions and can be dissociated in pathological cases with consequences for understanding language.

[19] For instance, many objects in our lifeworlds are artifacts, which are characterized by the fact that features affording action are intentionally built into them (handles on cups to grasp them, seats on chairs to sit on them, pedals to step on them), thereby utilizing former salient features affording reactions for the sake of our purposeful action within our lifeworlds. Most of the time, "acting out" these artificially built affordances is highly routinized (steering a car, eating with cutlery, typing texts). The specific difference in relation to automatic behavior based on salience becomes obvious when the respective objects are diverted from their built-in purposes, indicating their potential pertinence for a different purpose (e.g. using a knife as a screwdriver).

[20] The description of action and behavior can actually be unified in systems theoretic and/or evolutionary theory proposals; cf. Bülow (2017) and Keller (2003), respectively. For reasons which to explicate would go beyond the scope of the present article, I prefer to emphasize the difference between action and behavior (but see Kasper & Purschke [in print] and Kasper [2015: 29–35]).

(5) perception–action efficiency = $\frac{\text{effort : economy | cognitive \& physical resources}}{\text{purpose realization}}$

One characteristic that makes action especially effective by minimizing effort is the already mentioned routinization which allows us to attend to executing an act, while executing another act without attention (talking while driving, imagining the ocean while thumbing through a linguistic book). Behavioral automatisms and action routines cannot easily be distinguished, neither in everyday life nor in science. In fact, the minimization of effort, i.e. economy, is what unites the whole of automatic behavior and the routinized part of action. This led Kahneman (2012: 20) to distinguish, metaphorically speaking, "two systems in the mind, System 1 and System 2." For our purposes we can roughly equate System 1 with what I said about the theoretical complex "salience–behavior–automatism–vital functions" plus highly routinized action. Together, they serve the function of safeguarding and maintaining our capability to act, i.e. they make us free (or "unburden" us) to realize our purposes. System 2 corresponds to what I said about the theoretical complex "pertinence–planning–action–purposes".

With respect to the automatization and routinization of the respective perception–behavior and perception–action cycles, the linguistic frequency/entrenchment principle can be adopted to a large degree: the acquired behavioral responses to what we perceive, and learnt action in consequence of what we perceive require less effort, are more readily executed and need less to no attention the more frequently they are coupled with particular conditions. Crucially, the automatic bottom-up driven categorization and the highly routinized top-down driven categorization are geared to fulfill vital behavioral functions and to allow the realization of purposes by making possible the transit from specifically salient and pertinent phenomena to behavior and action, respectively. But here we find a first serious limitation to frequency: it is a relevant factor only for those phenomena which are either salient or pertinent to us. Selectively registering, extracting, associating, schematizing and matching things in our perceptual fields also means neglecting the potentially infinite phenomenal features which are neither salient in relation to a vital function nor pertinent for a given purpose. This has consequences for their efficiency.

Taking the degree of efficiency in perceiving and reactively evading a flying stone as a measure, we could ask how this relation could be even more efficient. Similarly, we could ask how even routinized action can be made more efficient. What comes to mind immediately is the ability to foresee what will happen on the basis of what we actually perceive. The most effective way of predicting what will happen is to look for the cause of what actually happens, i.e., for the origin of the event (Who or what set the stone in motion?). Let us call this causal origin the "front end" of the event. Knowing the cause of, for instance, a saliently moving object, means identifying the front end of the event then, thus allowing a prediction of its probable outcome and the probability of its repetition (it fell from a roof vs. someone threw it at me). Such information provides the basis for one's own capacity to act. However, as experienced actors in the world we know that inanimate objects do not move by themselves and depend on their setting in motion by persons most of the time. In other words, there

remains some uncertainty as to whether the causal chain is sufficiently "closed" at the front end. And if cognition has a hard time with anything, it is uncertainty. If, in contrast, we identify a person as the cause of an event, we must evaluate whether this person's activity was externally caused itself or whether he/she acted purposefully. As mentioned above, action is not caused in the way behavior and (other) "natural" events are. Both research in cognitive psychology on "inanimate" events and research in social psychology on events caused by persons show that our categorization performance is geared to the identification of the front end of an event we perceive (cf. Kunda 2003, Moskowitz 2005, Kahneman 2012). The ideal front end for effective perception–behavior and perception–routinized action cycles is a person that acts purposefully. That means when we, moving actively in the world pursuing purposes ourselves, encounter something salient, our attention goes to identifying its cause, and, if a person is the candidate cause, to attribute this person a purpose. Inferring this purpose is instrumental in predicting his or her actions and therefore the most reliable and most effective way of planning (or re-planning) our own further course of action. At the same time it removes uncertainty. Elsewhere (Kasper 2014, 2015) I have formulated this as the (Responsible) Causer Preference. In the present context, it can be stated as follows:

(6) (Responsible) Causer Preference (RCP):
Standing in the service of our capability to act, our (system 1) automatic and routinized categorization performances are geared to the respective salient or pertinent features of objects that most probably close an event at its front end by indicating its causer, or even more effectively, the responsible causer acting purposefully.

In our automatic and routinized (= system 1) strife for (responsible) cause(r)s, we favor efficiency in the sense of (4) and (5) over accuracy. Our categorization performance follows certain heuristics that need not result in an accurate concept of who or what caused an event. Favoring efficiency over accuracy is a hallmark of automatic behavior and highly routinized action (cf. Kunda 2003). Overcoming the RCP at the expense of speed but in favor of accuracy requires additional effortful reasoning (= system 2).[21]

We can localize the effects of frequency and entrenchment more properly now. They concern the effort: economy ratio in making a perception–action or perception–behavior cycle more efficient in relation to their purpose or function, respectively. This concerns, firstly, the motor skills in actualizing particular action and behavior schemas: repetition improves skill and in case skill regularly produces success in action and function fulfillment in behavior we can talk about a competence. We can secondly, by analogy to language input and knowledge

[21] If "giving in to" the RCP, i.e. identifying a (responsible) causer cognitively, may be an instance of action, then it does not invariantly result in a physical response or physical action. In such cases the bridge between an internal causal attribution satisfying the RCP and a subsequent congruent behavior or action can be overcome by effortful reasoning (= system 2), reasoning being an instance of action. Where initial attributions of (responsible) causation are "overruled" by effortful reasoning leading to "reasonable" action, the former can only be indirectly accessed via neuroscientific or other suitable methods. As long as we cannot experimentally distinguish automatic behavior from routinized action, the RCP cannot be reliably operationalized as a general law.

of constructions, talk about the emergence, accessibility and productivity of behavioral and action schemas. But we should, thirdly, take into account the types of learning or acquisition involved. While certain types of behavior, e.g. reflexes (through imprinting), need not rely on high frequencies to be "accessible", other types of behavior (e.g. classical and operant conditioning) do rely on them in order to become automatic. In acquiring action schemas by means of observational learning and learning-by-doing, frequency in observation and repeated execution also play crucial roles in making action more often successful and effective and at the same time less effortful by allowing routinization. All these processes involve categorization, association and schematization at some point or another. Frequency may lead to entrenchment, automatization or routinization. These in turn minimize the effort: economy ratio of a given form of action or behavior. But at the same time a severe limitation of frequency and entrenchment as explanatory factors shows up here. Neither frequency in in- and output, nor entrenchment, nor automatization/routinization provide insights into how and why a form of action or behavior is organized in a particular way to fulfill its purpose or function, and, more importantly, why it is not organized differently. This is especially true for forms of behavior which are acquired by imprinting or which are instinctive. In neither frequency plays a decisive role. Questions concerning the structure of such forms of behavior or action require explanations *for* frequencies instead of explanations *by* frequencies, and they may benefit from ecological considerations, i.e. from hypotheses like the RCP. Exactly these limitations are, as I would argue, also present in the three example explanations in section 3, although we dealt with linguistic phenomena there, while here we are talking about the relationship between perception and physical action/behavior.

In the following section I will make a proposal about how these considerations can be successfully transferred to the form of action exemplified by language and to the cognitive processes considered to be involved, namely those in (C) in Figure 1.

5.2 Bringing in language: constructions as efficient instructions

Basic cognitive processes are geared to mediate efficiently between what *we* perceive and how *we* (re-)act to(wards) it. Bringing in language complicates the picture. Speaking is a form of action and can be described using the abovementioned concepts of purpose, means, pertinence etc. The difference between a sole actor who realizes his/her purposes by acting in the face of perceptual input on the one hand, and communicative verbal interaction on the other hand is that the realization of the purpose of the speaker in response to some perception or conceptualization is dependent on the action of the interlocutor in the latter case. Whether a question is answered, a command obeyed or a statement acknowledged lies outside the speaker's power (except force is used). With respect to the efficiency of the perception–action cycle in (5) we can say that language allows the decoupling of the perception (or conceptualization) from the action that realizes the purpose. Utterances mediate them: I want a Moccachino. I see or imagine (conceptualize) a Moccachino. I do not act to get the Moccachino, but say to Christoph, *Could you pass me the Moccachino, please?*). Christoph understands the utterance, sees the Moccachino, grabs it and passes it to me. My utterance is thus an instruction for Christoph (a) to simulate the perception of him passing a particular

Moccachino to me, thereby using all the formal clues in the utterance to get the simulated perception right, e.g. syntactic categories, element order, case and agreement, and (b) to do something in consequence of the simulated perception, thereby using the clues that let him identify the utterance as a question. I conceive of speaking as a form of action which transforms, roughly speaking, someone's perception into somebody else's (verbal or non-verbal) action (cf. Kasper 2014, 2015).[22] What we end up with, then, is the embedded structure in Figure 2, in which each my (A) and Christoph's (B) perception–action sequence is embedded within an overarching perception–action sequence distributed among us.

[Insert Figure 2 here]

Figure 2: Distributed perception–action cycle mediated by language

The perception–action sequences in A and B can be evaluated with respect to their efficiency along the lines of the equation in (5) above. We can also state that A's perception–action sequence initiates that of B and that the link between A's action, i.e. his utterance, and B's perception of it is an important step with respect to the efficiency evaluation of the distributed perception–action sequence as a whole, since this link determines the success of A's utterance with respect to B's perception and subsequently its effectiveness, i.e. the possible realization of A's purpose by B's action. Note that with the link between A's utterance and B's perception of it we have returned to the cognitive processes involved in mediating utterances in the input and knowledge of language which were illustrated in the communication model in Figure 1: categorization, association, entrenchment, schematization etc. Figure 2 represents my "ecological" reframing of the situation in Figure 1 in that it embeds the linguistic input and its processing in the aforementioned broader field of tension: It includes non-linguistic events – the perception or conceptualization of something that has practical relevance for the speaker and the (re-)action of the hearer in consequence of his/her processing the utterance – and it allows us to embed the processes and activities considered to be involved in language use in a greater frame of human action and behavior.

Against this background I would like to rephrase the Cognitive Linguistics Cognitive Commitment (see section 2, Evans & Green 2006: 40–41) as an "Ecological Commitment", thereby broadening it to include physical activity, too.

(7) Ecological Commitment:
Principles of linguistic structure should reflect what is known about human action and behavior from all other disciplines concerned with human competences and activities (philosophy, psychology, artificial intelligence, neuroscience,

[22] One reviewer asks whether this means that "[i]n terms of Searlian speech act theory, […] all speech acts [are], ultimately, conceived of directives, then", and if so, "[w]hat is the difference between the directive illocutionary type and "instructions". I do not want to commit myself to Searlian speech act theory, but the answer to the first question is "yes": every instruction is directive, since it instructs the addresse to simulate a perception along the grammatically organized utterance. The answer to the second question is that illocutions operate "within" the directive character of instructions. The illocution might be commissive, for instance, but that does not change the directive character of the instruction as a whole.

anthropology, ethnology, sociology etc.). In other words, language and linguistic organization should reflect general action- and behavior-related principles rather than principles that are specific to language.

In the remainder of this section I will try to assess what makes an utterance efficient, evaluating it against the background of the complex interrelationships indicated in Figure 2. I will concentrate in particular on the relationship between A's utterance and B's subsequent perception–action sequence.

5.3 Language between perception and action

Naturally, we do not only act subsequent to perceptions which either confront us with salient stimuli (the colleague addressing me on my way to the coffee maker) or where we confront ourselves with pertinent stimuli (all the things I need to act upon in order to have coffee), but oftentimes we act on the basis of conceptualizations that happen to us because of others' actions (my colleague says *Hi, can I talk to you?* and this triggers a conceptualization in me of him talking to me). Similarly, we may act on the basis of "free" conceptualizations which we construe depending on what is pertinent to us at the moment (e.g. recalling a telephone number before dialing, conceptualizing a cake before baking). We can therefore also talk about conceptualization–action/behavior cycles. Such an ecological cycle is all the more plausible, if we characterize conceptualization as "simulated" perception. Both phenomenally and physiologically, perception and conceptualization share many features, the most important being their modal, in contrast to an amodal, character, i.e., their being image-like, to use a visual metaphor (cf. Shepard & Metzler 1971, Hartmann 1998, Barsalou 1999, 2005). Conceptualizing an event is as if we perceive an event. What utterances do, then, is instruct us to simulate perceptions in a way that can be described as orderly, and whose order can be called grammar (cf. Kasper 2015). These simulated perceptions happen to us when we perceive an utterance, and they have to be described as behavior, at least in the early phases, most probably as an instance of conditioned behavior. This is what lies behind the link between A's action (i.e. utterance) and B's perception–action cycle in Figure 2.

However, one implication of the ecological perspective is that simulated perceptions on the basis of utterances are, *as* simulated perceptions not different from (simulated) perceptions of "real" events, due to their modal character, and so they stand, *as* (simulated) perceptions, in the service of action, too. This means B's perception–behavior cycle in Figure 2 can be captured by the perception–behavior cycle in (4).[23] This has consequences for the central cognitive processes that link B's (simulated) perception on the basis of an utterance on the one hand, and B's subsequent action on the other hand. We saw that categorization, association and schematization are disposed, or adapted, to work in a particular way, namely *selectively* registering, extracting, associating, schematizing and matching pieces of language on the basis of their being salient and in order to make efficient responses possible. But

[23] In those special cases in which we are monitoring our own performance in understanding an utterance, it is possible to reflectively re-conceptualize something after an initial conceptualization on the basis of an utterance has taken place. These cases have to be described as action, and therefore by means of (5).

selective in what respect? In the context of the individual, i.e. "undistributed", perception–action/behavior cycles in section 3 I proposed the Responsible Causer Preference (RCP) in (6) as some kind of predisposition increasing the efficiency of these cycles in humans. According to the Ecological Commitment in (7), we would expect to find the efficacy of the RCP in language, too, because it presumably increases the efficiency of the overarching, distributed perception–action cycle in Figure 2. In particular, we would expect its effects in the relationship between the structure of A's utterance and in the way B uses it to simulate a perception and transduce it into action. Note that both aspects, the structures of utterances and their "processing", lie in the scope of explanations by recourse to frequency and entrenchment. If we find evidence for the efficacy of the RCP in the relationship between structures and processing, the explanatory scope of the frequency/entrenchment principles would have to be restricted, since they would have to give way to ecological factors.

How must an utterance be structured then, if a simulated perception in response to it can be transformed into action most efficiently? The answer would be: in accordance with the RCP, and this means as an iconic diagram of the expressed event as it would be perceived, if B perceived it in "real", in an undistributed perception–action cycle, and not in terms of mediating linguistic symbols.[24] The utterance is diagrammatically organized, if its earlier–later structure reflects the earlier–later structure of the event as perceived. The events we encounter in undistributed perception–action or perception–behavior cycles proceed from cause to effect, from purpose to action outcome. Where an utterance mediates, we are geared to identify not the (responsible) cause(r) of the "real" event, but the (responsible) cause(r) in the event we simulate to perceive on the basis of the utterance. But here, as there, we can "close" the event most efficiently at its front end, if the (responsible) cause(r) is identified as soon as possible. In the case of an utterance, this would be the first argument NP encountered.

There are several language phenomena for which the RCP and the preference for diagrammatically iconic constructions potentially figure as explanatory factors. For instance, Ferreira (2003) reports on the "misinterpretation of noncanonical sentences", which are characterized by their deviation from diagrammatic iconicity (passives and object-clefts). Compared to their "canonical" counterparts (actives and subject-clefts), they are comprehended more slowly and less accurately. Viewed in the light of the ecological efficiency considerations, the distributed (simulated) perception–behavior cycle in Figure 2, and the link of A's utterance to B's perception–action sequence in particular, seems to work more efficiently with canonical sentences, i.e. with sentences mirroring the earlier–later structure of the event as it would actually be perceived.

I would suspect that the same considerations can also account for the results of the study by Christensen & Wallentin (2011). They showed that the diagrammatically iconic construction of the locative alternation (agent > theme > goal) is comprehended faster and judged more acceptable than the non-iconic counterpart (agent > goal > theme).

In neurolinguistic theories on language comprehension the RCP surfaces as the so-called "actor preference" (cf. Bornkessel-Schlesewsky & Schlesewsky 2009b) which shows up cross-linguistically when a referent with low potential for responsible causation is accessed

[24] On the notion of diagrammatic iconicity, see Peirce (1960) and Haiman (1980, 1985).

sentence-initially (e.g. inanimate objects), thereby violating the expectation of a potent responsible causer. This does not necessarily lead to an overtly observable misinterpretation of an utterance but to a covert reanalysis of the utterance the occurrence of which can be induced by means of neurophysiological evidence (cf. Bornkessel-Schlesewsky & Schlesewsky 2009a).

As a last example for the potential efficacy of my ecological considerations I want to mention the WALS data from Table 1 again. From the perspective of the distributed perception–action cycle, the P>A constructions mediate someone's (simulated) perception and somebody else's action most efficiently because they are diagrammatically iconic.

In all "non-canonical" utterances the order of participants is not the order of how they would be perceived if the event was real. Thus, they violate the RCP. In order to transduce the perception which the utterance instructs us to simulate into a (re-)action, we must bring the event into its "natural" order first, since this is the way "real" events present themselves to us and to which we are adapted to (re-)act.

In illustrating the efficacy of the RCP, the results from these linguistic studies parallel those from social psychology concerning social attributions (on details see Kasper 2015: 162–206), although the former represent distributed perception–behavior/action cycles which are symbolically mediated, while the latter represent undistributed cycles. This points to the conclusion that an ecological perspective as proposed here may be fruitfully applied to linguistic questions.

5.4 Combining usage-based and ecological explanations

The attempt to explain (part of) the abovementioned phenomena by recourse to my ecological considerations is certainly not without alternatives. In fact, usage-based theorists would probably invoke the frequency/entrenchment principles for alternative explanations. However, the explanation problem, the homogeneity problem and the performance problem in section 3 show that the frequency/entrenchment principles alone do not suffice for a certain depth of explanation and, with respect to the performance problem, even for adequate explanations.

The frequency/entrenchment principles can account for certain similarities (on some level of schematicity) between inputs and outputs, for degrees of automatization and routinization regarding some kinds of cognitive and physical activities, and for the accessibility, predictability and productivity of items for language users. The frequency/entrenchment principles get their explanatory value by providing the possibility to formulate general laws or high probability statements in an *(Always) if…, then… (with x probability)* form. The universality of the *If…, then…* correlation aspired to is made possible by some kind of zero hypothesis of Cognitive Linguistics about how the cognitive processes mediating inputs and outputs, i.e. categorization, association, schematization etc. work. This zero hypothesis is characterized by the setting aside of the behavioral and action-related embedding of these processes. It does not take certain questions into view: What is (not) categorized/schematized/associated how and under which conditions? A cognizer thus conceived would not know what to attend to (and what not), what to categorize as what (and what not), what to associate (and what not) and what to schematize (and what not). These processes are virtually left unexplained. This is even true of Barðdal's (2009) explanation for

the changes in Germanic case. Her explanation is deep and insightful because it does not rely on frequency and entrenchment alone, but also on their inverse relation to the semantic restrictedness (or "coherence") of constructions and the semantic similarities between more coherent and less coherent constructions. So, if speakers begin to use verbs from coherent syntactic patterns with low type frequencies in semantically similar, but less coherent and more frequent syntactic patterns, or if they begin to merge coherent constructions with rare case patterns into semantically similar, but less coherent constructions having the most common case patterns, then the question arises what makes two different constructions similar or dissimilar in meaning in the first place. Similarity is the criterion restricting the possible "transfers" of verbs between constructions and restricting the possible merging of constructions. Similarity judgments are outcomes of categorization performances, so they constitute part of speakers' knowledge. Ultimately, these criteria deciding about similarity and dissimilarity cannot be extrapolated based on more quantities of something, i.e. on more frequencies, but have to refer to qualities, i.e. to what is categorized and to what purpose or what function. Categorization is all about making distinctions based on criteria, and at some point frequencies do not help any more. We need qualitative criteria of distinction.

The ecological considerations above are an attempt at specifying at least some of these criteria.[25] They are included in the perception–behavior/action cycles which also include the notions of salience and pertinence (what to attend to and what to categorize as what), of functions – the RCP, for instance – and purposes (what to categorize *for* what). If these distinctions are included in a frequency-based explanation of language phenomena, this adds "ecological" *If…, then…* statements to the *If…, then…* statements of the frequency/entrenchment principles, leading to linguistic explanations that are deeper than those explanations that rely on either qualitative or quantitative statements in isolation.

In principle, this provides solutions to the explanation, homogeneity and performance problems outlined in section 3. Concerning the first, the ecological view allows constraining the workings of the central cognitive processes (categorization, association, schematization) which mediate what language users perceive (input), know and do (output). The significance of salience and pertinence for behavior and action, respectively, and taking into account particular functions and purposes towards which perception–behavior/action cycles are tuned allows us to go beyond explanations of input–output similarities towards the structure of constructions. The effects of frequency and entrenchment remain intact along these parameters.

Concerning the homogeneity problem, the ecological considerations including the RCP and the central role of diagrammatic iconicity promises a deeper explanation of the WALS (and related) data than an explanation based on the frequency/entrenchment principles alone. Instead of explaining output frequencies on the basis of input frequencies and these in turn by recourse to other output frequencies and so on, the ecological view promises an

[25] Further constraints on these processes can be expected by investigating more closely the "cognitive & physical resources" component of the cycles in (4) and (5), and their role with respect to efficiency. For an influential theoretical proposal cf. Hawkins (2004) and for an overview over psycholinguistic aspects cf. Jaeger & Tily (2011).

answer to the question why relative input and output frequencies revolve around particular structural parameters (here: A > P) and not others.

In the case of the performance problem, the explanatory scope of the frequency/entrenchment principles requires not only complementation by other factors but also partial replacement by them. In favoring certain structures over others despite imperfect correlations with relative frequencies (and hence with their degrees of entrenchment) the disposition of basic cognitive processes to not treat every input as equal runs counter to a frequency/entrenchment explanation in certain cases. For these cases I suggested that the notions revolving around the perception–action/behavior cycle provides a more adequate explanation for relative degrees of processing ease and acceptability ratings. At the same time, there are actually strong correlations between frequency/entrenchment and ease of processing/acceptability ratings in other cases. One task for the future must be to clarify which factors contribute to which correlations and under which conditions.

6. Conclusion

In the last section I picked up the three problems from section 3 again in order to propose ways to their solution against the background of my ecological considerations in sections 4 and 5. With respect to the explanation and homogeneity problems I stated that factoring in general ecological statements in usage-based explanation–arguments can *in principle* deepen frequency-based explanations; factoring in ecological statements can restrict the application of the frequency/entrenchment statements, when it comes to the performance problem. I presume that these consequences are very much in the spirit of Cognitive Linguistics which need not throw its basic tenets over board in order to be open towards an ecological perspective. Instead, it would be a union of traditional quality-based explanations with prevalent quantity-based explanations. However, before what is possible in principle can be put into practice, several theoretical and empirical consequences of the fusion of the usage-based and ecological perspectives must be faced.

First, not only certain universal or statistical statements concerning correlations between frequency/entrenchment and performance factors need complementation or restriction to more circumscribed conditions, the same is true for the general "ecological" statements. Taken as a "law-like" statement, effects of the RCP can only be expected under certain circumstances. As has been mentioned, the efficacy of the RCP in a perception–automatic behavior or perception–routinized action sequence is a characteristic of Kahneman's system 1 cognitive activities. If we want to explain a given phenomenon by statements that come close to "general laws", we would have to exclude the possibility that we are actually investigating system 2 activities, i.e. planned action, since system 2 can "overcome" the bias constituted by the RCP. Apart from that, the next problem is how explanations of human action would have to look.

Second, another central theoretical and empirical task is determining the exact relationship between ecological concepts like the RCP and the preference for diagrammatic iconicity on the one hand and (presumably) conditioned forms of behavior relying on frequency and repetition on the other hand. Is the efficacy of the RCP the expression of an

instinct and therefore independent of frequency effects? Or can it be overridden through conditioning – there are after all languages with basic P>A orders. These questions point to an intricate causal relationship between repetition/frequency and entrenchment on the one hand and ecology-based considerations on the other, with significant ramifications for the possibility of explanations.

Third, not all types of behavior taken into view in usage-based linguistic explanations depend on frequency and repetition to be executed regularly by an organism. Which do? An answer to this question would delimit the scope of usage-based explanations even more.

Fourth, and finally, there are obviously structures in languages which are not efficient from the perspective of the distributed perception–action cycle, most notably instances of the P>A constructions in Table 1 (the three columns on the right-hand side). This points to the fact that the efficiency of a behavior or action with respect to a given function X or a given purpose Y in the equations in (4) and (5), respectively, can be neglected in favor of a function M or a purpose N. For instance, language must of course not only transform someone's perception into somebody else's action as fast as possible, but it must also be effective with respect to other, social purposes, for instance, and might therefore require face-work by means of politeness markers which may be inefficient with respect to purpose B but efficient with respect to purpose Y (cf. Goffman 1967, Matsumoto 1988, Turnbull 2003: 107–108, Haiman 2008). While this is familiar as "competing motivations" (cf. Haiman 2011), embedding some of these "motivations" in a wider ecological context may deepen our understanding of the factors involved in usage-based explanations and of the wider implications of certain distinctions regarding cognitive and physical processes related to language.

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