Frequency and iconicity revisited.
Towards an integrative ecological perspective

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1. Introduction: the usage-based approach to grammatical knowledge
The aim of this paper is a reflection on the role of frequency as an explanatory concept in usage-based construction grammar theories. Since frequency has been successfully invoked as an explanatory concept in many linguistic studies, my intention is not to generally deny the efficacy of frequency for our gaining knowledge about language competence and use. Rather, I will propose a number of distinctions that may help to determine the possibility and scope of frequency as an explanatory concept. Therefore, 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 on language competence must be broadened beyond certain opinions related to cognition held by Cognitive Linguistics.

In order to set the stage for the discussion, I will 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, respectively.

Throughout the discussion I will go a rather long way to outline the long-term goal of an “ecological” view of language in which frequency and iconicity have their respective places. As will become clear, this ecological view is characterized by the embedment of knowledge of language in a broader field of tension as usual, including general cognitive and physical functions in humans. In doing so, I will touch on a number of concepts that are closely related to that of frequency, namely economy and efficiency. The concept of markedness will not be discussed (but see Haspelmath 2006, 2008; Bybee 2011). 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).

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.1 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). “In 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 2000: 202). This leads to a view in which “[c]oncepts […] derive from percepts. (Evans & Green 2006: 7). The 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). However, the very cognitivistic aspect of the program leads Cognitive Linguists to view the interactive function as depending on its symbolic function.

The whole of the involved aspects of cognition, i.e. perception, conceptualization, construal, association, automatization, schematization, instantiation, categorization and elaboration (cf. Langacker 2008: 16–17) is viewed to be embodied, i.e., “human concepts are

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1 The term is borrowed from Langacker (2000). The capital initials are borrowed from Geeraerts (2006), indicating – neutrally speaking – an identifiable scientific movement.
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 concept. 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 linked by “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 (see also Goldberg 1995: 67–100). Each node 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 the general mechanisms of perception and categorization.

One central aspect setting apart usage-based construction grammars from the rest of Cognitive Linguistics relates to the fact that the latter 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 [Verfestigung] 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 – in dependence of frequency – that constructions enter the network representing speakers’ linguistic knowledge. “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 […]” (Ziem & Lasch 2013: 103; my translation). Besides its explanatory potential for the emergence and change of constructions the entrenchment of construction types “directly
correlates with the productivity of a construction” (Ziem & Lasch 2013: 106). The frequency of a construction token also contributes to the determination of productivity because “it determines [bestimmt] the degree of cognitive entrenchment of particular constructions.” (Ziem & Lasch 2013: 106; my translation). Bybee (2006) extends the significance of the frequency/entrenchment principle 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). 2

However, attributing frequency such a huge degree of explanatory value as indicated in the foregoing quotations, especially in the frequency/entrenchment principle, is not easily compatible 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 processing demands, and processes of categorization.” In particular, the so-called “Scene Encoding Hypothesis” seems of the utmost importance because it places the structure of constructions in a wider context than the mere relationship between language input and language competence. 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 this does not tell us what makes specific experiences “basic”, it indicates, firstly, that our cognitions are not exclusively shaped by language input; secondly, that in order to explain the structure of constructions one has to take into account our experience of non-lingual events; and, 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 structure,

2 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, “In 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).
emergence, change etc. of constructions (as so-called “motivations”), and theories of grammar should be clear about their respective roles in explanations in relation to the role of frequency.

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 and entrenchment principles (henceforth “frequency/entrenchment principle”) state?

For an explanation we need, firstly, something to be explained (explanandum), i.e. a description of an 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 statements asserting the occurrences of certain events” 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.3

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. 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 speaker is high, then this leads to the entrenchment of this construction in his/her network-like grammatical knowledge. If constructions become entrenched, they are easily accessible (in contrast to non-entrenched constructions). The observations (i.e. statements asserting the occurrences of certain events) could be: There has been a high type frequency of the caused-motion construction in the input of speaker S. Speaker S neither perceived nor uttered this particular sentence before. He sneezed the napkin off the table is an instance of the caused-motion construction.

Obviously, there is no logical conclusion or causal connection leading from the “laws” and observational statements above to the conclusion that speaker H uttered this sentence. We can deduce that the construction is easily accessible for him/her, but we can neither deduce that he/she (conceptually) “fused” sneeze with the caused-motion construction nor that he/she actually uttered the corresponding sentence. For this we would have to add premises to the explanation-argument. For the discussion of frequency as an explanatory concept this need not trouble us at the moment. Without evidence to the contrary we can assume for now that

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3 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 latter for discussions concerning the notoriously difficult notion of “explanation”.

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even an extended explanation-argument would not undermine the close relationship between input frequency and, roughly speaking, competence of this type of construction.

Many deductive explanation-arguments can also be “turned around” and used for predictions. 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. Assuming that more frequent constructions in the input of a language user are easier for him/her to process, because they can be easily accessed by a prompt in the input in online comprehension and be predicted with some probability, this would allow us to 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. Indeed, 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).

Turning to a last observation that underlies Goldberg’s and Suttle’s questions again, the following table of data taken from the World Atlas of Linguistic Structures (WALS) illustrates data about “the way [languages] are” (Goldberg & Suttle 2010: 468).

<table>
<thead>
<tr>
<th></th>
<th>APV</th>
<th>AVP</th>
<th>VAP</th>
<th>VPA</th>
<th>PVA</th>
<th>PAV</th>
</tr>
</thead>
<tbody>
<tr>
<td>565</td>
<td>488</td>
<td>95</td>
<td>25</td>
<td>11</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1148 (83.4%)</td>
<td>40 (2.9%)</td>
<td></td>
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</tr>
</tbody>
</table>

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. What does the frequency principle offer us here? Obviously, these data reflect (generalizations over) 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 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 {V} A {V} P {V} constructions by recourse to the fact that instances of {V} A {V} P {V} constructions form a more frequent input for these speakers than instances of the other constructions. 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

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4 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.
constructions in speakers’ knowledge are not analytical truths but may in principle provide new insights, if combined with actual observations.

The three sketchy explanations given in this section are meant to exemplify the logical structure of explanations based on the frequency/entrenchment principle. They concerned the explanation of the structure of a construction (He sneezed the napking off the table), the predicted correlation between frequency and ease of processing, and typological homogeneity or variation. To my impression, explanations of this type lack depth and simplify the picture, if they overly rely on the causal role of frequency. 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 frequency, explanation is actually abandoned at an early point.

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, entrenchment, categorization 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 an insightful explanation only in a very restricted sense, because 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.

![Figure 1: Communication model supposedly underlying the interactional function of language](image-url)
It turns out an explanation argument relying on the frequency/entrenchment principle can only explain the *structural relatedness* one some level of schematicity between outputs and inputs, e.g. the structural relatedness of the caused-motion construction with *sneeze* in the output and a caused-motion construction with, say, *put* in the input. But it cannot explain why both types of utterances got the structures they actually have. For that it would be necessary to explain frequencies themselves. This leads us to a second problem as a corollary of the first.

(2) The homogeneity problem:

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

This alludes to the WALS data above where I already stated that frequency-based explanations may be applied to them successfully, in a sense. But as the problem makes clear, such an explanation lacks depth because it does not allow to answer certain questions. 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). 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. As has been shown, these conditional statements contain basic tenets of Cognitive Linguistics and of cognitive construction grammars. And as the problems exemplify, this results in an overestimation of the explanatory scope of the frequency concept (*1*st thesis in section 1). The next section reflects on the possible sources of this observed overestimation (*2*nd thesis in section 1).

4. The body in the mind?

I have argued that the frequency/entrenchment principle cannot be used alone to explain why constructions are organized in the ways they are and why they are processed with or without difficulties. 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, as they are conceived, are, strictly speaking, merely 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 articulators, hearers and seers moving their eyes in order to (jointly) attend to something, but these are often their only connection to what is outside their heads, as if they needed no body at all – the programmatic claim of embodiment seems to be a claim concerning cognition alone. 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 physical action, i.e., certain branches of Anthropology, Sociology, Ethnology, (not only Cognitive) Psychology, Human Ecology, Philosophy?5

As has been shown, 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 cognitions. 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 acts to physical acts. 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 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

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5 Evans & Green list Philosophy as a cognitive science. Not few professional philosophers would be unhappy with such a classification. When listing Philosophy in my own list, I mean these. On the role of Philosophy in relation to the scientific disciplines see, for instance, Janich (2006) and Hartmann (2013).
Weltverhältnis”.\textsuperscript{6} (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 fulfilled with respect to language and to other physical 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 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 physical action and behavior. Starting with the practicalities of everyday life, we conduct our lives pursuing purposes and acting in order to realize these purposes.\textsuperscript{7} We constantly conceptualize eventualities (e.g. me having a coffee) and act methodically to realize them. In the course of action we encounter those 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. I will call these 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 wasn’t the result of my efforts). They are ineffective, if the purpose is not realized (I may have made coffee, but it isn’t stimulating me). What we do not expect because it is not part of our action plans happens to us, so our failures in acting, the action and behavior of others and natural events simply “befall” us. Especially when such events hinder the realization of our present purposes (a colleague speaks to me on my way to the coffee maker), they require our attention and our engaging in 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 our current action – salient. In other words, in order for us to remain capable of acting the former salient

\textsuperscript{6}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.

\textsuperscript{7}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 (2003) and Janich (2014).
object must be transferred into a pertinent object (cf. Kasper 2015: 127–143, 167; on the introduction of 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 execute it (a stone flying in our direction). Instead, they trigger reactions – which are not acts 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 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. 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:

\[
\text{(4) perception–behavior efficiency} = \frac{\text{effort : economy} \mid \text{cognitive & physical resources}}{\text{function fulfillment}}
\]

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 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 in order to respond in a functionally appropriate way (cf. Allport 1954: 20–21). This is especially true for movement with respect to visual perception.

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8 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, Ridderikhof (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.

9 The colon indicates a ratio; the vertical bar ("|") sets this ratio ‘against the background of’ what comes after the vertical bar.
To our sensorimotor apparatus, salient objects afford reactions, so that moving objects like flying stones afford evading.\textsuperscript{10}

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 the automatic behavior from routinized action (cf. Hartmann 1998).\textsuperscript{11} 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. 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), 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 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).\textsuperscript{12} Consequently, purposeful action is too varied and free to pin down to a definite function (for an influential anthropological proposal cf. Gehlen 1986, 1997).\textsuperscript{13} 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.

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

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

\textsuperscript{10} The concept of affordances was originally introduced by Gibson (especially Gibson 1986). For its significance in the present context, cf. Kasper (2015: 143–153).

\textsuperscript{11} 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.

\textsuperscript{12} 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 at chairs to sit on them, pedals to pedal them), thereby utilizing formerly 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).

\textsuperscript{13} The description of action and behavior can actually be unified in systems theoretic and/or evolutionary theory proposals; cf. Bülow (in print) 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)).
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 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 or no attention the more frequently they are coupled. 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, thereby neglecting the potentially infinite phenomenal features which are neither salient in relation to a function nor pertinent for a given purpose, respectively. This has consequences for their efficiency.

Taking the degree of efficiency in perceiving and reactively evading a flying stone as a reference point, 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 next 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. Knowing the cause of, for instance, a saliently moving object, means identifying the “front end” of the event, thus allowing a prediction of its probable outcome and the probability of its repetition. 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 (e.g. flying stones). In other words, there remains some uncertainty as to whether the causal chain is sufficiently “closed” at the front end. 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 others’ actions and therefore the most reliable and most effective way of planning (or re-planning) our own further course of action. 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 their automatic and routinized (= system 1) strife for (responsible) cause(r)s, people favor efficiency in the sense of (4) and (5) over accuracy. Their 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. If “giving in to” the RCP, i.e. identifying a (responsible) causer cognitively, may be an instance of action, then it does not invariably 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.

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. It concerns, secondly, the cycles as wholes in dependence on the type of learning or acquisition involved. While instinctive behavior and reflexes (through imprinting) need not rely on high frequencies to develop, conditioned behavior (classical and operant) does 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 a crucial role 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 neither frequency in in- and output, nor automatization/routinization, nor entrenchment provide insights in 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 forms of behavior or action require explanations for frequencies, and these may benefit from ecological considerations, i.e. from hypotheses like the RCP.

I will discuss in the following section how these considerations can be successfully applied to the form of action exemplified by language and to knowledge of language.

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 (*Christoph, could you pass me the Moccachino, please?*) and must 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. Person A wants the Moccachino. Person A sees the Moccachino. Person A does not act to get the Moccachino, but speaks to Person B. Person B understands the utterance, sees the Moccachino, grabs it and passes it to A. The speaker’s utterance is thus an instruction for the hearer to do something. 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). What we get, then, is the embedded structure in Figure 2, in which perception–action sequences (ii) and (iii) occur within a perception–action sequence (i) distributed among two actors, A and B.

![Figure 2: Utterances as instructions from an ecological point of view](image)

Figure 2: Utterances as instructions from an ecological point of view
The perception–action sequences (ii) and (iii) can be evaluated with respect to their efficiency along the lines of the equation in (5) above. We can also state that (ii) initiates (iii) and that (iv) is an important step with respect to the efficiency evaluation of the mediated perception–action sequence (i) as a whole, since step (iv) 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.

Figure 2 represents my “ecological” reframing of the situation in Figure 1 and of the relationship between B, C and D in this Figure in particular. 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 (iv), i.e. the structure of utterances, and (iii), i.e. how the interlocutor perceives utterances and acts upon it.

5.3 Language between perception and action

Naturally, we do not only act in consequence of perception which either confronts us with salient stimuli or where we confront ourselves with pertinent stimuli, but oftentimes we act on the basis of conceptualizations that happen to us due to others’ actions (they say something and this triggers a conceptualization by us) or on the basis of “free” conceptualizations which are construed on the basis of 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, especially because conceptualization can be characterized as simulated perception. Phenomenally, cognitively and neuronally, 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). What utterances do, then, is instruct us to simulate perceptions (cf. Kasper 2015) in a way that can be described as orderly, and whose order can be called grammar. These simulated perceptions happen to us and, at least initially, they have to be described as behavior, most probably as some kind of conditioning. This is part of step (iv) in Figure 2.

However, one implication of an ecological view is that simulated perceptions on the basis of utterances are, as simulated perceptions, not different from other types of (simulated) perception, and that they too stand, as (simulated) perceptions, in the service of action. This means step (iii) in Figure 2 fits perfectly in (4). This has consequences for the central cognitive processes that mediate (simulated) perception on the basis of utterances on the one hand, and action on the other hand. 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.

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14 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).
Modeled on Cognitive Linguistics’ Cognitive Commitment (see section 2, Evans & Green 2006: 40–41), but broadening it to include physical activity, too, we can state that 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, 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 context of the “unmediated” perception–action/behavior cycles in section 3 I proposed the Responsible Causer Preference (RCP) in (6) as some kind of disposition increasing the efficiency of these cycles in humans. According to the “ecological commitment” (for lack of a better term) above, we would expect to find the efficacy of the RCP in language, too, because it presumably increases the efficiency of the “mediated” perception–action cycle (i) in Figure 2. In particular, we would expect its effects in the structure of utterances and in the efficiency of the (simulated) perception–action cycle in person B in Figure 2 (i.e. in (iv) and (iii)).

How must an utterance be structured then, if a simulated perception on the basis of an utterance must be efficiently transformed into action? The answer would be: in conformance with the RCP, and this means as an iconic diagram of the event as it would be perceived, if language was not mediating, i.e. in an unmediated perception–action cycle\(^\text{15}\). 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 unmediated perception–action or perception–behavior cycles proceed from cause to effect, from purpose to action. The only difference is that when we have utterances as perceptual input we are geared to identify the (responsible) cause(r) in an event on the basis of the symbolically mediated perceptual simulations of these events instead of in the “real” events as perceived. But here, as there, an event can be most efficiently closed 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 mediated (simulated) perception–behavior cycle seems to work more efficiently with canonical sentences.

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).

\(^{15}\) On the notion of diagrammatic iconicity, see Peirce (1960) and Haiman (1980, 1985).
In neurolinguistic theories on language comprehension the RCP surfaces as an actor preference (cf. Bornkessel-Schlesewsky & Schlesewsky 2009b) which shows up cross-linguistically when a referent with low potential for responsible causation is accessed sentence-initially (e.g. inanimate objects), thereby violating the expectation of a potential 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 mediated perception–action cycle, the {V} A {V} P {V} constructions mediate someone’s (simulated) perception and somebody else’s action most efficiently.

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 symbolically mediated perception–behavior/action cycles, while the latter represent unmediated 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 principle for alternative explanations. However, as the explanation problem, the homogeneity problem and the performance problem in section 3 make clear, the frequency/entrenchment principle alone does not suffice for a certain depth of explanation and, with respect to the performance problem, even for adequate explanations.

The frequency/entrenchment principle 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 principle gets its 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. The ecological considerations above are an attempt at
specifying at least some of these factors. 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 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 principle.

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 to allows us going beyond explanations of input–output similarities towards the structure of constructions. The roles 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 principle 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 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 principle requires not only complementation by other factors but also partial replacement by them. In favoring certain structures over others independently of their relative frequencies (and hence of 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

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).
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. However, before what is possible in principle can be put into practice, several theoretical and empirical consequences of the fusion of 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, the RCP is also valid only 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 some 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 – apart from the next problem of how explanations of human action would have to look like.

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 conditioned forms of behavior relying on frequency and repetition on the other hand. Is the efficacy of the RCP an expression of an instinct and therefore independent of frequency effects? Can it be overridden through conditioning, eventually (re-)surfacing in other domains of action and behavior? 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 mediated perception–action cycle, most notably instances of the \{V\} P \{V\} A \{V\} constructions in Table 1 (the three columns on the right-hand side) and their analogues within particular languages. This points to the fact that the efficiency of a function A or a purpose B in (4) and (5), respectively, can be neglected in favor of the efficiency 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, for instance interpersonal, purposes 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 N (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 related to cognitive and physical processes related to language.

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