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Experience counts: An introduction to frequency effects in language

1 Experience counts: Towards a unified account of frequency effects in language learning, language processing, and language change

> Frequency effects are ubiquitous in virtually every domain of human cognition and behavior, from the perception of facial attractiveness [...] and the processing of musical structure [...] to language change [...] and adult sentence processing [...]. [F]requency effects are ubiquitous also in children's first language acquisition. [...] We argue, very simply, that frequency effects constitute a phenomenon for which any successful theory must account. (Ambridge, Kidd, Rowland, and Theakston 2015: 240)

The mission statement by Ambridge et al. (2015) quoted above presents a very strong claim, supported by research from different fields, namely language acquisition, language change, and language production and perception (cf. Behrens 2009a, 2009b; Bybee 2010; Ellis 2002, 2012a, 2012b, 2012c; Pfänder et al. 2013; Diessel 2014; among others). Researchers across all these fields have argued that experience counts. This entails that the frequency of the experience of an item matters for learners, listeners, and speakers alike (for other recent surveys on frequency effects see e. g. the papers in Gries and Divjak (2012) and Divjak and Gries (2012); as well as Divjak and Caldwell-Harris (2015) and Hilpert (submitted)).

But what exactly does the term *frequency* ***effects*** refer to, given the controversies in the field about the role of frequency when linguistic structures are being learned or undergo language change? For the present volume, frequency is not argued to be the most decisive factor in language, nor do we want to argue that all processes are driven by the most frequent item(s). In some domains, type and/or token frequencies have a direct effect (see below), whereas in other constellations frequency interacts with other processing factors such as recency and salience. Frequency in terms of high transition probability, for example, leads to entrenchment and automatization (Diessel, this volume). High frequency can protect certain forms from errors because of their entrenchment, but it may also lead to errors in contexts where a lower frequency form is the target (Ambridge et al. 2015). In language change, the most frequent type may attract new items

and thus trigger change; but highly frequent tokens may also resist these attractor effects (conservation effect; Bybee 1985).

These seemingly contradictory effects can be reconciled if (a) we assume that frequency interacts with other processing factors such as recency or salience, and if (b) we make a clear distinction between type and token frequency effects. Token frequency or repetition alone does not lead to generalization but to entrenchment (cf. Bybee 2006, 2010; Ambridge et al. 2015). Type frequency or variation, on the other hand, is needed to provide the basis for possible schema formation and generalization (Langacker 1987; Bybee 2006, 2010; Ambridge et al. 2015). Last but not least we have to take into account that (c) frequency effects operate at different levels of representation, from small and concrete linguistic units like sounds[1], morphemes[2] or words[3] to more abstract and larger units such as multi-word phrases[4], sentential constructions[5] or even conversational structure[6]. Thus, if defined properly, and all other things being equal and controlled for, frequency can be shown to have a certain effect on the processing of linguistic units and ultimately on the language system itself. Consequently, the investigation of

1 Over the last five years, frequency effects have been shown, for example, in *phonetic reduction* (Hollmann and Siewierska 2011; Lorenz 2012, 2013a, 2013b; Schäfer 2014), in *phonological variation* (in a broader perspective, among others, Coetzee and Kawahara 2013), in *phonological height harmony* (Archangeli, Mielke, and Pulleyblank 2012), and in the area of *syllable frequency* (Cholin, Dell, and Levelt 2011).

2 In *morphology*, frequency effects have been shown ranging from morphemes in Dutch L1 (Verhoeven and Schreuder 2011) over inflectional morphology in L1/L2 Spanish (Bowden, Gelfand, Sanz, and Ullman 2010) to more complex linguistic units such as compound constructions (Baayen, Kuperman, and Bertram 2010; Dye, Walenski, Prado, Mostofsy, and Ullman 2013).

3 *Word frequency* has been investigated in areas as diverse as experimental psychology (Brysbaert, Buchmeier, Conrad, Jacobs, Bölte, and Böhl 2011), speech recognition (Dufour, Brunellière, and Frauenfelder, 2013; Johns, Greuenfelder, Pisoni, and Jones 2012), discriminative learning perspectives (Baayen 2010 and Baayen, Hendrix, and Ramscar 2013), L2 corpus linguistics (Crossley, Salsbury, Titak, and McNamara 2014), reading tasks for dyslexic children (Grande, Meffert, Huber, Amunts, and Heim 2011), and sociolinguistic approaches to syntactic variability (Erker and Guy 2012).

4 Frequency effects have been shown to be operative in *multi-word phrases* in Arnon and Snider (2010); Arnon and Priva (2013); Janssen and Barber (2012); Siyanova-Chanturia, Conklin, and van Heuven (2011), among others.

5 In *syntax*, frequency effects have been shown for tense/aspect (Ellis 2013), verb-argument constructions (Ellis, O'Donnell, and Römer 2014), and different sentential complements (for example, Kidd, Lieven, and Tomasello 2010).

6 *Conversational phenomena* such as hesitation (Schneider 2013, 2014, this volume) and repair (Kapatsinski 2010, Pfeiffer 2015) have only recently been investigated in relation to transitional probabilities and entrenchment.

frequency effects requires a very fine-grained analysis of the usage-conditions of linguistic structures, as well as the application of sophisticated statistical methods.

In the present volume we present research that was carried out in the context of the research training group "Frequency effects in language: Frequency as a determinant in usage-based models of language change, language processing and language acquisition" that has been funded by the Deutsche Forschungsgemeinschaft since 2009 (DFG GRK 1624). The goal of this group is to bring together interdisciplinary expertise relevant to frequency-related phenomena in language, to train cohorts of graduate students in the relevant linguistic and psycholinguistic theories and methods, and to stimulate research across disciplines by looking at topics that bear the potential for a transfer of theoretical insights and/or empirical methods (see also Ellis, this volume, for the common denominator for all the studies from the perspective of cognitive psychology).

In terms of theory we proceed from the central claim of usage-based linguistics that linguistic structures emanate from usage-events (Langacker 1987; Bybee 2006). The research training group's work tackles a central problem of usage-based linguistics, namely the question of how and to what degree frequency distributions in language use impact on the processing by speakers and hearers or on the emergence of linguistic structure in language acquisition, processing and change (for more results from this group see the articles in Franceschini and Pfänder 2013). The group investigates frequency effects at work in several areas. On the one hand research is being done in areas where frequency effects are to be expected, as, for example, in the phonetic reduction of high-frequency words or chunks (Lorenz 2013a, 2013b), in the resistance of morphological irregularities to analogical leveling (Krause, in progress), or in the speedy production and retrieval of compounds (Schmid, forthcoming). On the other hand research is also being carried out in areas where frequency effects have received hardly any attention so far, as, for example, in code-switching (see Hakimov, this volume), or where experimental investigation has faced considerable logistical obstacles, as in the calibration of input in instructed L2 acquisition in classroom settings (see Madlener, this volume).

Coming back to our motto from Ambridge et al. (2015), it has been demonstrated in many fine-grained empirical analyses that theories of language change, language learning, and language processing cannot ignore frequency effects. In our view, the time has come to start working on those topics that cross the boundaries of learning, processing and changing language, and to investigate whether similar processes are at work in these areas. Ellis (2008a) provides a compelling sketch of the interaction of processing, acquisition and change within a dynamic, emergentist concept of language: Language use leads to language change because frequency-induced processes like reduction lead to the erosion of

certain morphemes. Language change affects perception, and perception affects learning because reduced elements are less salient, and therefore harder to learn. This, in turn, affects the language system. In second language learner varieties, for example, non-salient elements are often omitted. Consequently we observe differences in, for instance, the grammar of the varieties referred to as "English as a second language" and the varieties of English spoken by native speakers. While first language learners have enough exposure to ultimately turn their attention to fine morphological details, second language learners often omit them because they are hard to perceive and functionally redundant, as the respective grammatical information is often also coded by other elements (Ellis 2008a).

For the present volume we have invited contributions that illustrate four possible lines of research for cross-domain studies of frequency effects:

- The role of entrenchment in language change, learning, production and processing (Section 2).
- The interaction of frequency with other processing factors such as recency and salience (Section 3).
- The differential impact of type and token frequencies in processing, learning and change (Section 4).
- The automatization of activation as a function of linear order (Section 5).

In the remainder of this introduction we will sketch out those strands of research and position the contributions to the present volume in the context of these overarching topics.

2 Entrenchment in language change, learning, production and processing

If language use has an influence on how language is represented cognitively, then quantitative changes in one's language use will lead to changes in the language system itself. Repeated encounter leads to entrenchment, the strengthening of memory traces (cf. Blumenthal-Dramé 2012; Divjak and Caldwell-Harris 2015; Hilpert and Diessel, forthcoming; Schmid, forthcoming). The entrenchment of linguistic units gives rise to a number of interesting processes. This increases the stability of representation and facilitates retrieval because high frequency units are typically more readily accessible. The frequent co-occurrence of several units may result in chunking:[7] The larger, chunked unit is learned and/or processed as

7 This issue has been the subject of extensive debate in corpus linguistics (cf. for instance Stefanowitsch and Gries 2003; Geeraerts, Grondelaers, and Bakema 1994).

a whole. More complex processes have been identified as well, for example when co-occurrence likelihoods or transitional probabilities change. One of these more complex processes is grammaticalization, where lexical elements take on a grammatical function. Grammaticalization not only affects single words, but can also occur at the boundaries of previously independent items.

The highly frequent co-occurrence of independent items may cause their morphological boundaries to become blurred (phonetic reduction effect, see Bybee and Thompson 1997), resulting in the fusion, compounding and automatization of formerly separate elements. These types of fusion processes exhibit an increase in the occurrence of phonological processes across morphological boundaries, in particular in high frequency combinations. Palatalization at the morphological boundaries between verbs and the pronoun *you*, for example, occurs more frequently in *don't you* than in *good you (came)* (cf. Krug 2003; Bush 2001; Cooper and Paccia-Cooper 1980). This leads to an increase in opacity of the internal structure of high-frequency, morphologically complex expressions (cf. Bybee 1985; Krug 1998; Boyland 1996 for *you and I*; Bybee 2001 for the French form of liaison; Bybee 2010). This frequency effect goes beyond mere phonetic erosion. The eroded high frequency units will also increasingly be perceived as fused units and may become autonomous, meaning they are no longer perceived as consisting of the original units. This process can be illustrated by the change of the phrase *let's* in English, which – at least for some speakers – changed from the combination of an imperative and an object pronoun into an adhortative element. In this function, we observe double marking of the subject because speakers have fused the *'s* with *let* and do not see it as reduced form of *us*, as in the colloquial *let's you and him fight* (cf. Hopper and Traugott 2003: 12–16).

Recently, research in the area of language change has become considerably more corpus-based and frequency effects have been integrated into various models of language change. While frequency was mentioned only in passing in the first edition of Hopper and Traugott's (1993) authoritative compendium (for instance in connection with the phonological by-products of morphologization, p. 146), the new edition dedicates an entire chapter to it, discussing the issue in a much more differentiated manner (Hopper and Traugott 2003: 126–130). The role of frequency of usage in general and of entrenchment in particular has been studied with respect to the building and dismantling of forms and constructions – i. e. in the initial phase of processes of grammaticalization, especially those in present-day language (cf. the English allegro forms *gonna* < *going to* and *gotta* < *have got to* and their emergence in overseas varieties of English; Lorenz 2012, 2013a). Increases in frequency after grammaticalization processes are well attested, due to the fact that grammatical elements tend to be more frequent than lexical items (Zipf 1936). Is it possible, however, to find evidence for frequency as a *trigger* for grammaticalization processes? The work

of Rosemeyer (2013, this volume) suggests that such evidence exists. This type of research requires fine-grained statistical analyses of the time course of shifts in usage frequencies. The focus of investigation shifts from the expected increase in frequency as a *result* of grammaticalization, which occurs with a delay due to the predominantly written source material provided by corpora, to usage frequency as one of the possible *triggers* of grammaticalization processes (cf. Rosemeyer 2013, 2014, this volume).

In the present volume we present two studies that investigate frequency effects at work between or across linguistic units. Hakimov (forthcoming, this volume) provides a frequency-based account of code-switching and language change in multilinguals. Schneider (this volume) is concerned with the (non)-occurrence of hesitation phenomena as an indicator of planning processes and units in language production. Both Hakimov (forthcoming, this volume) and Schneider (2013, 2014, this volume) provide evidence for the existence of chunks not just in language learning but also in language production and processing. They show that code-switching and hesitation phenomena can be predicted by the degree of entrenchment of concrete multi-morphemic or multiword units. Their contributions also illustrate that the same theoretical model (usage-based theory) and empirical methods (cohesion and predictability measures) can be used to study language production phenomena in two previously distinct fields of research: hesitation phenomena in speech production and code switching in bilinguals. In both domains, frequently used multi-word sequences turn into chunks that strongly disfavor interruption, either by a code switch or by a hesitation marker. In addition, both contributions demonstrate that the phenomenon of chunking is not limited to being tested experimentally, but can also be investigated using appropriate statistics on corpus data.

3 The interaction of frequency with other processing factors such as recency and salience

Experience does count and, crucially, goes beyond the mere perception of usage frequencies. The strength and nature of our experience is also influenced by processing factors such as the *context* in which a unit occurs, its perceptual *salience*, and memory related factors such as *recency*. There are other factors beyond the ones relevant for processing of course, including but not limited to contextual factors such as the social setting or the attitude of the participants – these factors are not yet at the horizon of our empirical research, however.

Recency: frequency effects are dependent on the time frame in which they occur. A more recent speech event has a stronger influence on how a current

speech event is processed than one that is less recent. This effect can be derived immediately from the structure of memory and has been documented repeatedly in language processing (Szmrecsanyi 2006; Poplack and Tagliamonte 1996; Ellis 2012c). This is particularly relevant when two variants of a construction or category are in free variation in a particular context. Three factors are important here. Firstly, the amount of time that has elapsed since the last occurrence of the item: the more recently an item has occurred, the stronger its activation (Szmrecsanyi 2006). Secondly, the frequency with which an item has occurred in a specific amount of time: the more often an item has occurred recently, the stronger its activation. Thirdly, the overall frequency of the item: the lower the general token frequency of an item, the stronger its recency effects (Jacoby and Dallas 1981; Schwenter 2013; Rosemeyer 2014). Recency effects are boosted by low token frequency, because the occurrence of items with a low token frequency causes a higher rate of surprisal (see below) which leads to stronger activation.

Recency effects are also modulated by the timing of the exposure. There is a domain-general advantage of spaced learning over massed learning in memory retention. Exposure to a high number of tokens in a short period seems to be less effective than a more distributed exposure where the experience is re-activated (see the meta-analysis by Janiszewski, Noel, and Sawyer 2003; Ambridge, Theakston, Lieven, and Tomasello 2006; as well as Madlener, this volume, for acquisition). Schwarz (this volume) investigates frequency effects in the realm of phonological variation. According to him, recency can be defined as the tendency of the speaker to repeat identical phonological items within a speaking sequence. Speakers are more likely to repeat identical phonological items if the time span between two utterances is short. On the basis of a large corpus Schwarz is able to show that the variation between dialect and standard realizations of vowels in the Alemannic area are best described as an interaction effect of recency and frequency. In a nutshell, the less frequent variant has stronger recency effects, and vice versa. Schwarz concludes that recency does not explain why an innovative phonological item enters the repertoire of a dialect speaker, but it does account for its spread.

Salience: frequency effects are also influenced by the salience of the respective grammatical or phonetic unit (Tomlin and Myachykov 2015). Salience can, for example, be defined as *prosodic salience*. Prosodically more pronounced, i. e. more rhythmical, speech events activate words more strongly, for instance, than those that have less pronounced prosody. *Morphosyntactic salience* is studied primarily in research on dialect contact (Trudgill 1986; Kerswill and Williams 2000, 2002), in perceptual dialectology (Lenz 2010; Long and Preston 2002; Kerswill 2002) and in sociolinguistics (Elmenthaler, Gessinger, and Wirrer

2010; Patterson and Connine 2001)[8]. Ruette, Ehret and Szmrecsanyi (this volume) investigate the interaction of frequency, salience and surprisal. Using methods from sociolectometry they quantify lexical distances between varieties of English as a function of the number of different lexical encodings of one and the same semantic concept (such as *soda* and *pop*). Their quantitative lexical sociolectometry study does not find a frequency effect in favor of the most frequent lexical alternatives. The lexical distances between informative and imaginative corpora of American and British English remained similar when either the high-frequency or low-frequency variables were boosted in the statistical model. It must be noted that these models do not study human perception or processing. Overall, however, the impact of frequency of lexical items on distances between varieties studied in isolation seems to be very modest if not non-existent.

In this introduction we focus on recency and salience as competing factors. There are other factors, however, that also influence the processing of exemplars, especially the social context. Ambridge et al. (2015) show how situational, social and individual aspects of interaction affect the intake of the input. For future research we have to keep in mind that linguistic experience has many dimensions beyond the linguistic signal: "The cognitive neural networks that compute the associations binding linguistic constructions are embodied, attentionally – and socially – gated, conscious, dialogic, interactive, situated, and cultured" (Ellis 2012c).

4 The differential impact of type and token frequencies in processing, learning and change

The most basic distinction with regard to the concept of frequency is that between type and token frequency (cf. Ellis 2012c). Token frequency refers to the number of occurrences of a concrete form (or of a lemma) in a corpus or in the input in general: how often does, for example, the word form *played* appear in a corpus? High token-frequency does not typically lead to high productivity of a construction, but rather to the entrenchment of a particular instantiation of this construction.

8 It is noteworthy, however, that these studies have focused on phonology, i. e. that features of dialect grammar are largely excluded (with the exception of Cheshire 1996 and e. g. Kerswill's work), and that barely any systematic work has been done on either the relevance of (high or low) frequency in explaining perceptual salience (or non-salience) or the exact interaction of frequency and salience in various scenarios (but see Rácz 2012, 2013).

Type frequency, on the other hand, refers to the number of distinct items that can fill a slot in a particular construction: How many different lexical items can appear, for example, with the English Past Tense Construction VERB-*ed*? Measuring the type frequency of a construction is crucial for determining its productivity (Bybee and Hopper 2001; Barðdal 2008): high type frequency correlates with high productivity. The English VERB-*ed* construction, for example, can be said to be far more productive than the past tense construction which involves an *i-a* vowel change (as in *sink-sank*) since it appears with a far greater number of verbs and also readily extends to new verbs. In contrast, "irregular" and/or unproductive patterns of low type frequency may survive if their token frequency is sufficiently high, or if they are highly analogous to other forms.

We need to look at the different effects of type and token frequency in order to explain why high frequency units tend to remain stable due to their entrenched nature in some situations ("conservation effect"; Bybee 1985; Bybee and Thompson 1997) but seem to drive linguistic change in other situations. In morphology and syntax, forms that occur frequently have stronger cognitive anchoring than those that are less frequent and are therefore less affected by processes of regularization. Thus the strongest irregularities of verbal paradigms (i. e. apophonia, suppletion) apply to the verbs that are used most frequently, such as modal and auxiliary verbs (cf. for instance Croft and Cruse 2004: 293 on the verb *to be*; see also Nübling 2000; Lieberman, Michel, Jackson, Tang, and Nowak 2007).

In the field of morphosyntax, Hilpert (2008) shows that both the absolute frequency of adjectives (in the positive form) and the occurrence ratio of adjectives in the positive and the comparative form influence the usage of the analytical or synthetic comparative: while many adjectives occur in both forms (e. g., *prouder* and *more proud*), a frequent adjective such as *easy* is mostly inflected as *easier*, whereas the same does not hold for the low-frequency *queasy*. Likewise, some adjectives are used more often in the comparative than in the positive (e. g., *humble*). These adjectives are more likely to be used in the morphological comparative (*humbler*) than those adjectives that are mainly used in the positive (e. g., *able*). In a re-analysis of Poplack's (1992) corpus-based study of the *subjonctif* in Canadian French Bybee and Thompson (1997) suggest that the preservation of certain constructions can be traced to the high frequency of V + complement combinations in constructions such as *faut que je lui dise*, while the *subjonctif* form in general is becoming increasingly rare. We may also assume that the preservation of SVO syntax with negation and yes/no questions containing English auxiliary verbs is due to their high frequency in Middle English (Krug 2003: 29).

An underexplored area of research where the type-token ratio plays a crucial role is the *decrease* in frequency that occurs when grammatical constructions

disappear from the system (cf. Traugott 2012: 189). In addition to a theory of how grammar "emerges", a theory is needed that explains how grammar "disappears". In simple cases, inspections of type-token-relations may be sufficient: at what point are the tokens of a particular construction restricted to few enough constructional (sub)types that the construction can be called "unproductive"? The concept of "statistical pre-emption" may be useful here. Statistical pre-emption has been used to explain why speakers do not make generalizations they might be expected to make, i. e. how speakers learn "what not to say" (Boyd and Goldberg 2011). While the question of how speech communities learn "what not to say *any more*", is certainly slightly different, statistical pre-emption may be a helpful concept here as well. In any case, when looking at the decrease in frequency of a construction, the contexts a construction (still) occurs in are of crucial importance. Otherwise, the seemingly paradoxical relation of disappearance from the system and continuous existence in functional niches that can be found for a lot of "disappearing" grammatical constructions would not receive a principled explanation.

While all new processes start out with a first exemplar (token *and* type), the actual effect of this exemplar depends on our previous representation of related exemplars, as well as the nature of subsequent experiences of this unit. Whether this unit acquires high token *or* type frequency leads to different outcomes – stabilization in the first case, variation and possibly productivity in the latter. Madlener (2015, this volume) and Rosemeyer (2013, 2014, this volume) discuss these issues in language acquisition and in language change. Their studies are relevant also because they study the effect of the concrete timing of experience. In her training study of a productive, but lesser known German construction with advanced learners of German, Madlener found that depending on the learners' previous knowledge, different type-token ratios of input had different effects (learners with low previous knowledge profited more from increased token frequencies, for example). The temporal resolution of the input, however, mattered as well: Some learners profited from skewed input where they received the same number of types, but some types occurred with higher token frequencies. In particular constellations, a Zipfian distribution in type-token frequencies can also give rise to prototype effects (Ibbotson and Tomasello 2009; Ellis, McDonell, and Römer 2013).

A close investigation of both token and type frequencies has proven most fruitful for Rosemeyer's investigation of language change in Spanish auxiliaries (cf. Rosemeyer, this volume). As in other Romance language, there is a choice in compound tense auxiliaries between *haber* 'to have' and *ser* 'to be'. Conditions for the selection of the auxiliary have been changing from the Middle Ages until today. Rosemeyer models the general tendency towards the choice of

have with perfects and plu-perfects as an effect of type frequency. The fact that several verbs resist this general tendency can be explained by a conservation effect caused by the high token frequency of these lexemes. Both Madlener and Rosemeyer thus show that both type and token frequencies have to be considered as constitutive parameters in speakers' experience with language, both in language learning and in language change. Interestingly, both contributions show that the effects of type and token frequencies may be active at different, though overlapping, time spans. In a nutshell, then, different frequency effects will be modelled at different moments in time, and as separate processes that may converge over time.

5 The automatization of activation as a function of linear order

The assumption that both learners and fluent speakers build their knowledge on memorized exemplars is gaining acceptance in the field of usage-based linguistics. Diessel shows that the 'bare' exemplar model cannot account for the relations between lexemes and constructions though. In Diessel's view, "the central idea behind exemplar theory is that categories are emergent from individual tokens of experience that are grouped together as exemplars, i. e. clusters of tokens with similar or identical features, which are then used to license the classification of novel tokens. Since emerging token clusters can be more or less complex, exemplar representations vary across a continuum of generality and abstractness" (Diessel, this volume, 210). The exemplar model has first been developed in the field of phonetics and phonology (Pierrehumbert 2001, 2006). If applied to syntax, it should be able to account, for example, for the clustering of constructions as in:

(a) Peter gives John a letter / tells John a story.
(b) Peter brings / takes a letter to John.

All of the verbs illustrated in the examples above (*give/tell/bring/take*) can be used both in a ditransitive construction and with a prepositional phrase. There is a strong statistical bias, though. Both *give* and *tell* tend to be used frequently in ditransitive constructions, whereas *bring* and *take* are most frequently used with a prepositional phrase. Even if we do find semantic and/or pragmatic explanations for this tendency of use (Goldberg 1995; Haspelmath 2012), these options are still learned as such and not independently of probability. Nonetheless, Diessel argues, "irrespective of the fact that the speaker's choice of particular words is semantically and/or pragmatically motivated, there is evidence that the lexical

biases of verb-argument constructions are also represented in memory. Speakers 'know' that the ditransitive construction typically occurs with particular verbs (and particular nominals) because they have experienced this construction so frequently with certain words". Going beyond the 'bare' exemplar idea, Diessel claims that the way in which speakers have "experienced this construction" is intrinsically related to the sequential character of syntax. This can be best explained by citing yet another example from Diessel's paper. If we hear the sequence "Peter donated ..." online, in the real time course of conversation (Auer 2007, 2009), we expect or 'project' the sentence to continue with a direct object and a prepositional phrase (c) and not with the ditransitive construction (d):

(c) Peter donated money to the Red Cross.
(d) *Peter donated the Red Cross money.

Diessel argues that the general assumption of exemplar theory as it has been developed in phonetics and phonology, namely that categorization starts from particular items, can be transferred to syntax but needs to be modified. Syntactic constructions contain a lot of lexical information that speakers are aware of. Speakers know that verbs do not only have certain semantic and pragmatic properties but also tend to be used in certain types of constructions. As syntax unfolds in real time, the automatization of constructional strings does not only depend on speakers' experiences with lexically specific usage-patterns, but also on transitional probabilities. In other words, the specific strings expected after particular lexemes trigger syntactic projections in real time.

6 Summary and outlook

The usage-based model assumes that "grammar is held responsible for a speaker's knowledge, of the full range of linguistic conventions, regardless of whether these conventions can be subsumed under more general statements" (Langacker 1987: 494). About two decades later Joan Bybee (2006) coined the often cited passage on the impact that frequency, as one crucial factor of speakers' "experience" with previously heard utterances, has on language:

> A usage-based view takes grammar to be the cognitive organization of one's experience with language. Aspects of that experience, for instance, the frequency of use of certain constructions or particular instances of constructions, have an impact on representation that is evidenced in speaker knowledge of conventionalized phrases and in language variation and change. (Bybee 2006: 711)

This implies that we need to rethink the basis of the analysis of language structure or grammar: what de Saussure has been said to call *parole* is not just the instantiation of *langue* or the language system, but the very basis for its existence. The speakers' experience with acts of *parole* makes them develop probabilistic expectations. What speakers of any language or variety hear during their everyday interactions is what "counts" as their linguistic experience. Or, as Bybee continues in her argument that the language system is built from usage:

> The proposal presented here is that the general cognitive capabilities of the human brain, which allow it to categorize and sort for identity, similarity, and difference, go to work on the language events a person encounters, categorizing and entering in memory these experiences. The result is a cognitive representation that can be called a grammar. This grammar, while it may be abstract, since all cognitive categories are, is strongly tied to the experience that a speaker has had with language. (Bybee 2006: 711)

From our perspective, the contributions in this volume provide relevant insights towards an integrative and experience-based theory of language acquisition, processing and change. In addition they are examples of how recent linguistic research integrates insights and methods from cognitive psychology (see the afterword by Nick Ellis, this volume). The main results along the four lines of research outlined above show how frequency contributes to the emergence or stability of linguistic systems that are thought of as being temporary states in a dynamic process:

Firstly, one of the crucial concepts of an experience-based account of language acquisition, processing and change that several different fields agree on is the concept of entrenchment. Entrenchment relies heavily on transitional probabilities based on speakers' experiences with previously heard utterances. In language processing, entrenched units are less prone to be interrupted by hesitation phenomena (Schneider, this volume), and they may be used as chunks in language contact situations, which leads to chunk-based language mixing independent of morpho-syntactic boundaries (Hakimov, this volume).

Secondly, while the degree of entrenchment seems to directly affect certain processes in language learning and processing (for example, the conservation and reduction effects discussed above), other frequency effects are modulated by the interaction with processing factors such as context, recency and salience (cf. Ellis, this volume; Ruette, Ehret and Szmrecsanyi, this volume; and Schwarz, this volume). Schwarz investigates the variability in vowel production in Alemannic areas and finds that variability is best predicted by an interaction effect of recency and frequency: The less frequent variant has stronger recency effects, and vice versa. Ruette, Ehret, and Szmrecsanyi test frequency-based models in lexical sociolectometry and find no difference in the lexical distances between

varieties of English and different genres. Thus frequency does not seem to have an effect on lexical variation when the lexicon is studied in isolation, and in corpus data alone.

Thirdly, the way the linguistic system is shaped by usage depends on the distribution of types and tokens over time, in interaction with the speaker's current representation of the system. Madlener (this volume) shows that "input flooding is not the whole story". When learning a construction, beginning learners profit more from moderate type variation with statistical skewing that helps them to identify the function of a construction, while advanced learners are able to profit from increased type frequency that allows them to expand the category. Rosemeyer (this volume) traces such interactions over time in the historical change of the Spanish auxiliary system that is characterized by bursts in frequency of one construction and the fading off of the other. In order to establish the effect of frequency on a certain (intermediate) state we thus need to be precise not only in what is being counted, but also about when we count it.

Fourth, one of the central findings of usage-based linguistics is the importance of the lexical specificity of grammatical constructions. Diessel (this volume) argues that the linear order in which speakers process linguistic strings plays an important role in predicting which construction is activated. Diessel argues that the processing of concrete strings in their linear order does not become redundant when speakers have made more abstract generalizations because the automatization we observe is based on the bottom-up processing of the incoming information, rather than being rule-governed top-down.

We hope that the studies on language change, language learning and language perception presented here convince our readers that *experience counts*!

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