

Hans-Jörg Schmid, Ludwig Maximilians University Munich, Germany.
hans-joerg.schmid@lmu.de

Draft of the introduction to the volume

*Entrenchment, memory and automaticity.
The psychology of linguistic knowledge and language learning.*

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1. A framework for understanding linguistic entrenchment and its psychological foundations in memory and automatization

Hans-Jörg Schmid

1. Introduction

Linguistic communication is among the most highly automatized forms of human behaviour. Effortlessly and with stunning speed, speakers and hearers access and retrieve linguistic knowledge from memory and apply lower-level and higher-level cognitive abilities such as perception, attention, categorization and inferencing while producing and comprehending utterances. For this to be possible, linguistic knowledge must be organized in maximally and immediately accessible and retrievable formats. In the wake of Chomsky's claim in the 1960s that language is a highly specialized and largely autonomous cognitive module, linguists and psychologists lost sight of the psychological foundations shared by language and non-linguistic cognition. While most linguists focused their attention on the description of linguistic structures and structural principles of language, most psychologists studied behaviour and its cognitive and neuronal basis without worrying too much about potential influence of language and its representations in the mind.

Over the past 20 years, this division of labour has begun to crumble. With the advent of cognitive-linguistic, usage-based and complex-adaptive models of language, linguistics has begun to emancipate itself from its self-imposed isolation and has found a foothold in the cognitive sciences alongside cognitive psychology, neuropsychology, social psychology and other related fields. Many linguists have developed a keen interest in the role played by domain-general neuro-cognitive abilities and processes in the emergence and storage of linguistic knowledge. In contrast, many psychologists have not yet ventured very far into linguistics, partly because what is still perceived as 'mainstream' linguistics, i.e. Chomskyan autonomous linguistics, did not seem to offer much that would have made that effort worthwhile. Potential effects of the omnipresence of language and linguistic thought on human behavior, input processing and learning are frequently not considered as falling within the remit of psychological inquiry.

The notion of *entrenchment* epitomizes like no other the opportunity to establish a new meeting ground for psychology and linguistics. It captures the idea that linguistic knowledge is not autonomous, abstract and stative, but is instead continuously refreshed and reorganized under the influence of communicative events in social situations. Linguistic entrenchment can essentially be regarded as a lifelong cognitive reorganization process whose course and quality is conditioned by exposure to and use of language, on the one hand, and by the application of domain-general cognitive abilities and processes to language, on the other. Memory, categorization, analogy and abstraction as well as perception and attention are crucially involved in entrenchment, as are routinization and automatization, and imitation and emulation.

The aim of the present volume is to bring together expertise from linguistics, psycholinguistics, neurology, cognitive psychology and social psychology in order to develop a joint vision of entrenchment, memory and automaticity in linguistic and non-linguistic cognition, and to provide a realistic picture of the psychological and linguistic foundations of linguistic knowledge and language learning.

2. Entrenchment – a multifaceted concept

The main elements of the concept of entrenchment have a long history dating as far back as the 19th century (cf., e.g., Blumenthal-Dramé, 2012, p. 11; Bybee, 1985, p. 117; Paul, 1898, e.g., pp. 12-14, 49-50, 94-95; Saussure, 1959, e.g. pp. 122-127, 177; Wray, 2002, p. 8). The credit for introducing the term *entrenchment* into linguistics, however, goes to Ron Langacker (1987, p. 59), one of the founding fathers of cognitive linguistics. According to him, there is a

continuous scale of entrenchment in cognitive organization. Every use of a [linguistic, HJS] structure has a positive impact on its degree of entrenchment, whereas extended periods of disuse have a negative impact. With repeated use, a novel structure becomes progressively entrenched, to the point of becoming a unit; moreover, units are variably entrenched depending on the frequency of their occurrence.

Langacker's description rests on two key assumptions which are still associated with entrenchment today: firstly, repetition and rehearsal increase the **strength of representations** while disuse may cause decay (cf. also Langacker, 1987, p. 100, 1991, p. 45); and, secondly, repeated usage of a given linguistic structure causes it to be processed as a **holistic unit**. While Langacker's account portrays both facets in terms of degrees, their characters seem to differ: the understanding in terms of strength of representation evokes a purely quantitative, gradual, potentially asymptotic trajectory, whereas the understanding in terms of a holistic chunk promotes the picture that a qualitative change from analytic and declarative to holistic and procedural processing takes place at some point (cf. Blumenthal-Dramé, 2012, pp. 67-69, 186-187). From a psychological point of view, the first facet can be explained in terms of memory consolidation, while the second one involves a chunking process which can find an end-point in a gestalt-like chunk that is emancipated from its component parts and defies analytical processing.

In a more recent publication, Langacker relates both facets of entrenchment to the process of automatization, understood in terms of a reduction of conscious monitoring:

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. In CG [Cognitive Grammar, HJS] parlance, a structure undergoes progressive **entrenchment** and eventually becomes established as a **unit** (Langacker, 2008, p. 16; original emphasis)

As a first rough approximation, then, entrenchment can be understood as referring to a set of cognitive processes – mainly memory consolidation, chunking and automatization – taking place in the minds of individual speakers. In addition, as is typical of nominalizations, the term *entrenchment* has been used to denote not only these cognitive processes, but also the effects they have on the representations of linguistic structures, i.e. their products or resultant states. It is in this sense that we can talk about *degrees* or *strengths of entrenchment* and about *entrenched linguistic structures*. The main determinant of entrenchment identified in early work (cf. Bybee, 1985, p. 117; Langacker, 1987, p. 59) and much researched subsequently is frequency of exposure to and use of linguistic structures.

3. Empirical evidence for entrenchment

Empirical evidence for entrenchment processes and their determinants and effects comes from four main sources: psycholinguistic and neurolinguistic experiments, quantitative corpus-linguistic investigations, studies of language change, and patterns of language use in context. In what follows, the major insights and claims from these sources will be summarized, divided into work on frequency effects on entrenchment in terms of strength of representation (Section 3.1.), frequency effects on entrenchment in terms of chunking and holistic units (3.2.), effects of repetition in linguistic, situational and social contexts on entrenchment (3.3.), and other determinants of entrenchment (3.4.). The superscript letters given in Sections 3.1 to 3.4 serve as cross-references to the framework for the study of entrenchment proposed in Section 5.

The cognitive and linguistic effects of discourse frequency undoubtedly constitute the most intensively researched field relating to entrenchment. Recent surveys of frequency effects from a range of different perspectives are provided by Blumenthal-Dramé (2012, pp. 27-65, *et passim*), Bybee (2003), Diessel (2007), Divjak and Caldwell-Harris (forthcoming), Divjak and Gries (2012), Gries and Divjak (2012), Jurafsky (2003), Krug (2003), and Lieven (2010).

3.1. Frequency effects on entrenchment in terms of ‘strength of representation’

Psycholinguistic experiments on lexical frequency effects in production and comprehension arguably have the longest tradition. In general, lexical decision tasks as well as reading-time and eye-tracking experiments have shown that frequent words are recognized, accessed and retrieved faster, with less effort^a and with less interference from paradigmatic neighbours than rare ones^b, and that the same goes for frequent meanings of lemmas as opposed to rare meanings^c (Dell, 1990; Forster, 2007; de Vaan, Schreuder, & Baayen, 2007; Giora, 2003; Gregory, Raymond, Fosler-Lussier, & Jurafsky, 2000; Hauk & Pulvermüller, 2004; Jescheniak & Levelt, 1994; Jurafsky, Bell, Gregory, & Raymond, 2001; Just & Carpenter, 1980; Knobel, Finkbeiner, & Caramazza, 2008; Rugg, 1990; Sandra, 1994). For morphologically complex words such as compounds (e.g. *lifecycle*) and derivations (e.g. *undress*, *happiness*), additional effects of the frequencies of the constituents on processing and storage have been demonstrated (e.g. Blumenthal-Dramé, 2012; Bybee & McClelland, 2005; Hay, 2001). Frequent compounds and word pairs (e.g. *car accident*) and multi-word expressions (e.g. *call it a day*) are activated faster than rare expressions of these types^d (Jurafsky, 2003, p. 62). While the effects of frequency on larger syntactic constructions are less well supported by experimental evidence (Jurafsky, 2003, p. 63), it has been shown that frequency affects sentence parsing and the resolution of ambiguous syntactic structures^e (e.g., Diessel, 2007; Hare, McRae, & Elman, 2004; Jurafsky, 1996; Roland & Jurafsky, 2002). For example, the verb *remember* is more frequently complemented by a noun phrase (*he remembered the problem*), while the verb *suspect* favours clausal complements (*he suspected the problem was serious*). Sentences which meet the expectations arising from this probabilistic tendency are processed with less effort than those that do not, e.g. *he remembered the problem was serious* and *he suspected the problem* (Diessel, 2007, p. 113; Jurafsky, 1996).

Evidence for frequency effects has also been found in research on first-language and second-language learning from a usage-based perspective (e.g. Childers & Tomasello, 2001; Cordes, 2014; Ellis, 2002; Gries & Divjak, 2012; Kidd, Lieven, & Tomasello, 2008, 2010; Lieven, 2010; Lieven & Tomasello, 2008; MacWhinney, 1999, 2004; Redington, Cater, & Finch, 1998). While it is uncontroversial that frequent words are acquired earlier than rare ones^f, it has been shown that both children and second-language learners seem to be able to

use more nuanced probabilistic information about co-occurrence tendencies while building up their lexicon and constructing a grammar (Diessel, 2007; Ellis, 2006; Saffran, 2001; Saffran, Aslin, & Newport, 1996).

A fundamental insight, which is paralleled by evidence from the study of language change (see below), is that the repetition of identical tokens in the input (known as *token frequency*) results in increased entrenchment in terms of the strength of the corresponding specific representation^g, while repetition of varied items sharing commonalities of form and/or meaning (*type frequency*) facilitates categorization, abstraction, generalization and the emergence of variable schemas^h (Abbot-Smith & Tomasello 2006; Goldberg, 2006, 2009; Lieven & Tomasello, 2008, p. 174; Matthews, Lieven, Theakston, & Tomasello 2005; Tomasello, 2003, pp. 173-175). For instance, the repetition of a fixed sequence such as *what's that* strengthens the representation of this form-meaning-function complex, while the repetition of expressions like *give me* (or *gimme*) *the doll*, *give me the book*, *give me the cup*, etc., encourages the formation of a variable schema 'give me X'. The process of schematization requires an intricate interplay of an emerging symbolic association between forms and meanings/functions, of syntagmatic associations between the component parts of a schema (e.g. *gimme* + X) and of the paradigmatic associations between the elements that can fill the variable slot in a schema (*the doll*, *the book*, *the cup*)ⁱ. These paradigmatic associations, which are based on the psychological processes of comparison and analogy, also make up the starting point for the emergence of grammatical categories such as word-classes and clause constituents^j (Lieven, forthcoming; Tomasello, 2003, pp. 169-173) and for the paradigmatic dimension of lexical networks, e.g. word-fields and sense relations^k. With regard to the productive use of such schemas and their slot-fillers by children, it has been demonstrated that their frequency distribution encourages entrenchment of certain combinations and thus constrains over-generalizations^l (Ambridge, Pine, Rowland, & Young, 2007; Braine & Brooks, 1995; Brooks & Tomasello, 1999; Theakston, 2004). For example, children are less likely to over-generalize complementation patterns for frequent verbs (e.g. *read me a book*) than for rare ones (*examine me a book*) in production, and are also more willing to accept frequent ones than rare ones as grammatical. Ambridge, Pine, Rowland, and Chang (2012) show that this effect persists in adult language.

Corpus-based studies of frequency effects have tested the assumption that the frequencies of occurrence of lexical elements and syntactic constructions in large corpora mirror degrees of entrenchment and strengths of representation^a (Arppe, Gilquin, Glynn, Hilpert, & Zeschel, 2010; Blumenthal-Dramé, 2012; Schmid, 2000). The rationale on which these studies are based is that frequencies of occurrence in large, balanced corpora can not only serve as an approximation of the kind of repetitiveness that the average speaker produces and is typically exposed to, but actually provide clues as to the potential effects of this exposure on the cognitive systems of individual speakers. In view of the methodological gap between corpus data and degrees of entrenchment (cf. Mukherjee, 2005, p. 225; Schmid, 2010, 2013), it is particularly important that some studies have attempted to produce converging evidence from different sources by relating corpus-based measures to behavioural data collected in experiments (Divjak, 2008; Gries, Hampe, & Schönefeld, 2005, 2011; Schmid, 2013; Wiechmann, 2008). Questions to be considered include the following: is relative or absolute frequency relevant for entrenchment or do the two have different effects on entrenchment (Croft, 2008; Haspelmath, 2008; Schmid, forthcoming); are different types of relative frequencies relevant for different facets of entrenchment, e.g. relative frequency to paradigmatic competitors, relative frequency to functional or onomasiological competitors, or relative frequency to relative frequencies of syntagmatic partners (cf. Geeraerts, Grondelaers, & Bakema, 1994; Divjak & Caldwell-Harris, forthcoming; Glynn & Fischer, 2010; Schmid, 2010; Schmid & Küchenhoff, 2013; Stefanowitsch & Gries, 2003); is the use of transitional or conditional probabilities su-

perior in explanatory power to relative string frequencies (Blumenthal-Dramé, 2012; Bybee & Scheibmann, 1999; Divjak, 2008; Jurafsky, 1996; Krug, 2003, pp. 33-39)?

The study of language change is another field in which entrenchment has been tied to discourse frequency. Again, this is in spite of the fact that there is a considerable methodological gap between collective language change (i.e. conventionalization), which provides the data and explananda, on the one hand, and individual entrenchment, on the other hand. Cognitive processes such as routinization and automatization (e.g. Bybee, 2003; Croft, 2000, pp. 72-76; Haiman, 1994; Krug, 2003; Paul, 1898, pp. 49-50) and cognitive principles such as economy (Bybee, 1985; Croft, 2008; Haspelmath, 2008) have been held responsible for frequency-based types of language change. The shortcut between conventionalization and entrenchment is explicitly discussed, for example, by Blumenthal-Dramé (2012, p. 24), Croft (2000, p. 162), Paul (1898, pp. 12-14, 94-95), Rohde, Stefanowitsch, and Kemmer (2000), Schmid (2013), and Zenner, Speelman, and Geeraerts (2012, p. 769).

Diachronic frequency effects have to be interpreted in a highly differentiated way with regard to whether they affect the phonological or the morphological forms or the meanings and usage conditions of constructions, whether the constructions are morphologically simple or complex, and whether they are formally fixed or include variable slots. In addition, as mentioned above, the distinction between token frequency and type frequency has to be taken into consideration. The main claims concerning the entrenchment aspect of ‘strength of representations’ (see Section 3.2. for chunking effects) are as follows: high token frequency of specific items, especially irregular ones such as *went*, *told* or *spoke*, has a conserving effect on their morphological form^m (Bybee, 2007, p. 10; Diessel, 2007), which makes them resistant to paradigmatic analogical pressure and changeⁿ; high token frequency of specific items also has a reducing effect on their phonetic form (e.g. Present-Day English *free* and *friend* both derive by fusion from the Old English diphthongal stem *freo-* or *frio-*), and a bleaching effect on their meanings^o (Bybee, 2003, 2006; Bybee & Thompson, 1997; Krug, 2000). Type frequency of variable schemas also shows seemingly contradictory effects: on the one hand, high type frequency combined with some degree of dispersion among the fillers of variable slots has the effect of facilitating the emergence of constructions^p (“constructionalization”; Traugott & Trousdale, 2013); this allows for productivity^q (*Mary baked me cake*), increases the potential for innovation^r (*Mary smiled me a kiss*) and provides the basis for change caused by analogical pressure^s (Hilpert, 2012, p. 234; Himmelmann, 2004; Traugott & Trousdale, 2013, p. 18). On the other hand, highly frequent fillers of the variable slot are strongly represented as compared to paradigmatic competitors^t and thus selected preferentially^u, almost by default (e.g. *give* in the ditransitive construction, *Mary gave me the book*); they function as analogical attractors for less frequent items^v and contribute to the resistance to change^r (Bybee, 2006, 2010a; Traugott, 2008).

3.2. Frequency effects on entrenchment in terms of ‘chunking’ and ‘holistic units’

Language change has also provided a massive body of insights into entrenchment in terms of ‘chunking’ and the development of composite structures into holistic units^w. The main type of evidence – which, as before, relies on a shortcut from conventionalization to entrenchment – comes from processes affecting the phonetic and morphological forms of repeated strings of words. High string token frequency, i.e. the repetition of identical sequences of elements, has been found to be conducive to the phonetic and morphological reduction of complex words and word strings^x. Fusion and coalescence have been interpreted as symptoms of an increasing holistic processing and storage of repeated multi-word sequences and other types of formulaic language (Bybee, 2003, 2007, p. 324; Bybee & Scheibmann, 1999; Haspelmath, 2008, 2011).

Whether these changes are the product of high relative frequency (Haspelmath, 2008) or absolute frequency (Croft, 2008), whether other measures such as transitional probabilities are more predictive (Bybee & McClelland, 2005; Hoffmann, 2005; Krug, 2003), and whether it is really frequency that is ultimately and solely responsible for formal reductions (Haspelmath, forthcoming) has yet to be determined.

The overall picture is again quite complex: on the one hand, formal reduction, fusion and coalescence^y, as in *bye* from Early Modern E. (*God*) *be wy you, because* from Middle E. *by cause*, *lord* from Old E. *hláfwearð* ‘loafkeeper’ or, more recently, *gonna* and *wanna* from *going to* and *want to* are interpreted as indicating the emancipation of emerging holistic units from their component parts and their paradigmatic relations^z (Blumenthal-Dramé, 2012, p. 20; Bybee, 2007, p. 301; Peters, 2009); these effects are regarded as contributing to an increasing autonomy of representation (Blumenthal-Dramé, 2012, 4, *et passim*; Bybee, 2003, pp. 617-618). On the other hand, while strengthening their internal syntagmatic bonds^{aa}, chunks with grammatical function tend to reduce their external syntagmatic autonomy, thus becoming more dependent on their grammatical cotext (Lehmann, 2004, p. 155). As far as semantic aspects are concerned, long-term diachronic fusion is typically accompanied by a reduction in the semantic specificity of sequences with grammatical function^{ab} (e.g. *going to* from ‘locomotion’ to ‘future intention’; cf. e.g. Bybee & Pagliuca, 1985) and by semantic changes leading to a loss of compositionality for sequences with lexical meanings such as compounds (e.g. *lord*, see above; cf. e.g. Brinton & Traugott, 2005).

While fixed multi-word chunks like *what’s that*, *more milk* or *gimme hug* also play a key role in the early phases of first-language acquisition (Tomasello, 2003, 2009), these holophrastic units are not the result of a gradual chunking process, at least not in the minds of the child learners, but are learnt and processed as chunks to begin with. It is only later that they are decomposed and can form the basis for early pivot-schemas (*more milk*, *more tea*, *more toast* > ‘more X’) and more complex and variable schemas, e.g. ‘give X Y’ (Tomasello, 2003).

Experimental studies on adult language have pursued the idea that frequent chunks (*good morning*) and more or less fixed formulaic sequences (*many happy returns*, *all the same*, *if you know what I mean*) are processed in a holistic manner, i.e. by means of an access-and-retrieval rather than an online, computational procedure^w (Pawley & Syder, 1983; Wray, 2002, 2008; see Conklin & Schmitt, 2012, for a recent survey of experimental work). Such single-step memory retrieval can be interpreted as a symptom of the routinization and automaticity of processing (Logan, 1988). A second feature of chunk processing that is commonly associated with automaticity (Bargh, 1992; Moors & de Houwen, 2006) is autonomy in the sense that once started, the processing is completed without further monitoring^{ad}. The frequent co-occurrence of linguistic elements sequentially ordered in running text is assumed to have both a lexical and a syntactic priming effect^{ae} (Hoey, 2005; Pickering & Branigan, 1999; Pulvermüller, 2010), which presumably uses neuronal sequence detectors. As a consequence, the later portions of fixed and semi-fixed expressions are to some extent predictable. Lexical items have been shown to act as primes for both lexical items (Jones & Estes, 2012) and for syntactic structures (Newman, Ratliff, Muratore, & Burns, 2009; Segaert, Kempen, Petersson, & Hagoort 2013). The outcomes of these experiments crucially depend on the types of sequences tested, however. Variables to be taken into consideration include frequency (of parts and chunks), length, fixedness, idiomaticity, discourse function and other pragmatic constraints. The elements tested range from more or less fixed and non-compositional idioms (e.g. *shoot the breeze*, *pull someone’s leg*; cf. Conklin & Schmitt, 2011; Gibbs, 1980; Siyanova-Chanturia, Conklin, & Schmitt, 2011; Swinney & Cutler, 1979; Underwood, Schmitt, & Galpin, 2004), phrasal verbs (*heat up*, *slow down*, cf. Capelle, Shtyrov, & Pulvermüller, 2010), semi-prefabricated phrases (e.g. *don’t have to worry*, *why don’t you*; Arnon & Snider,

2010; Tremblay & Baayen, 2010; Tremblay, Derwing, & Libben, 2009; Tremblay, Derwing, Libben, & Westbury, 2011) and irreversible binomials (e.g. *bread and butter*, *law and order*; Siyanova-Chanturia, Conklin, & van Heuven, 2011) to less strongly connected but still to some extent predictable collocations (e.g. *run a shop*, *crack a joke*; Jurafsky, 1996; McDonald & Shillcock, 2003; Sosa & MacFarlane, 2002). The evidence collected so far seems to be quite conclusive as regards the holistic storage and processing of prototypical, i.e. non-compositional idioms. In contrast, the extent to which other less fixed and more transparent combinations are indeed processed as chunks and the role played by discourse frequency for chunking has turned out to be much less easy to determine^y. One of the many remaining riddles is that the best candidates for holistic processing, idioms, belong in general to the least frequently occurring formulaic sequences.

Collocations and collostructions, i.e. associations between grammatical constructions and lexical elements filling variable slots (e.g. *give* in the ditransitive NP-V-NP-NP construction) have been in the focus of corpus-based research on entrenchment for some time (see Evert, 2004, for a survey, as well as Ellis & O'Donnell, forthcoming; Schmid & Küchenhoff, 2013; Stefanowitsch & Gries 2003; Wiechmann, 2008; Zeschel, 2012). While collocations can be explained from a psychological perspective as a loose form of chunking based on syntagmatic co-occurrence tendencies, collostructions involve schematization and are conducive to the emergence of paradigmatic relations between the lexical items that are more or less likely to occur in the variable slot. Typically, grammatical constructions show the tendency to attract one or two lexical items particularly frequently. This skewed distribution facilitates the acquisition of schematic constructions in first-language (e.g. Casenhiser & Goldberg, 2005; Childers & Tomasello, 2001; Goldberg & Casenhiser, 2006) and second-language acquisition (Ellis, 2009) and contributes to the role of these anchor words as prototype-like analogical attractors^q (see above). Recently, the problems in measuring frequency and in exploring the relation between different types of frequency counts and hypothetical degrees and types of entrenchment have been highlighted (e.g., Blumenthal-Dramé, 2012; Arppe et al., 2010; Lieven, 2010; Schmid, 2010; Schmid & Küchenhoff, 2013).

3.3. Effects of repetition in linguistic, situational and social contexts on entrenchment

The evidence reviewed so far indicates that frequency of occurrence – no matter how it is measured and operationalized – at least partly conditions both types of entrenchment processes. However, frequency as such is no more than an idealized and mechanical approximation of repeated use and exposure by individual speakers taking place in concrete situations. What pure frequency counts can certainly not inform us about are the manifold ways in which repeated exposure can affect the cognitive and linguistic system depending on the linguistic, situational and social contexts of specific usage events. Frequency counts also overlook the fact that entrenchment as a repetition-conditioned cognitive process can only become effective if the traces of processing events “survive”, as Pickering and Garrod (2004, p. 218) put it, a particular communicative event and are carried over to the next. In addition, it is only in communicative situations that replication and subsequent propagation, i.e. spread of communicative knowledge among speakers, can take place (Croft, 2000, p. 38). In fact, experimental work on diverse types of linguistic structures suggests that frequency as such may be a less good predictor of behavioural measures than context-related variables such as contextual diversity (Adelman, Brown, & Quesada, 2006; McDonald & Shillcock, 2001) and dispersion across text types (Baayen, 2011). This is in line with basic tenets of usage-based models (Kemmer & Barlow, 2000: xxi) and exemplar-based models (e.g. Bybee, 2006, pp. 716-718;

Bybee & McClelland, 2005; Pierrehumbert, 2001), which also assume rich storage of contextual information relating to previous linguistic experience^{af}.

Effects of the wider linguistic context on syntactic choices have also been investigated under the label of syntactic or structural priming^{ag} already mentioned above. The focus in the present context, however, lies not on the immediate linguistic environment but instead on the tendency to repeat syntactic structures used or heard in preceding sentences and to comprehend them faster and with less effort (Bock, 1986; Chang, Dell, & Bock, 2006; Reitter, Keller, & Moore, 2011; Segaert et al., 2013; Snider, 2007). Whether the observed persistence effects (Szmrecsanyi, 2005) are to be explained in terms of transient residual activation in short-term memory or as an early form of implicit procedural learning (Bock & Griffin, 2000) remains controversial.

Lexical and structural priming across sentence boundaries and particularly across speaker turns is conducive to repetition and imitation and is therefore likely to influence the routinization and memory consolidation underlying entrenchment. The tendency of speakers in conversation towards processes known as replication (Croft, 2000), accommodation (cf. Auer & Hinskens, 2005; Giles, Coupland, & Coupland, 1991; Giles & Ogay, 2006; Trudgill, 1986, p. 138), alignment (e.g. Jaeger & Snider 2013; Pickering & Garrod, 2004) and co-adaptation (Ellis, 2009, p. 91) can also be related to these effects. This takes us to a higher, interactional level of situational aspects of entrenchment, where imitation, emulation and joint activity come into play as determinants of repetition and memory consolidation (Auer & Hinskens, 2005; Garrod & Pickering, 2009). Interestingly, according to Garrod and Pickering (2007), the sociocognitive process of alignment is largely automatic. The claim that joint activity and joint attention in concrete situations contribute to repetition and entrenchment in first-language acquisition is well supported by research in the usage-based framework (Tomasello, 2003, 2009).

Context effects become visible in terms of both increasing strengths of representation and of chunking, each both on the individual cognitive micro-level and the collective macro-level. New and increasingly more strongly entrenched meanings associated with existing forms can arise by means of absorbing existing or new pragmatic associations from context^{ah} (Boye & Harder, 2012, p. 17; Bybee, 2003, p. 618; Croft, 2000, pp. 130-140; Heine, Claudi, & Hünemeyer, 1991: ch. 3; Kuteva, 2001, p. 150; Nicolle, 2011; Traugott & Dasher, 2004, 34-41). Well-known examples include the addition of causal meanings to originally temporal conjunctions such as *after*, *since* or *as* on the basis of the common inference *post hoc ergo propter hoc* (König & Traugott, 1988). If it is assumed that context-dependent, pragmatic information is retained in episodic memory, while knowledge of concepts and words is stored in semantic memory, these changes can be interpreted as involving a shift or transfer from episodic to semantic memory^{ai}. The same process can be held responsible for gradual connotative enrichment of meanings^{aj} and knowledge about the register-specificity of words and expressions^{ak}, which are also derived from rich experience of exemplars in specific situations (Schmid, forthcoming). Finally, the study of language acquisition (Behrens, 2009; Tomasello & Rakoczy, 2003), conversational patterns (Auer & Pfänder, 2011; Günthner, 2011; Hopper, 1987; Nattinger & DeCarrico, 1992) and language change (e.g. Bybee, 2010a, 2010b; Traugott, 2008) strongly indicate that formulaic sequences are supported by pragmatic associations and patterns in discourse (cf. also Schmid, forthcoming).

3.4. Other determinants of entrenchment

Frequency and repetition in context are not the only factors affecting entrenchment processes and their outcomes. Instead, a wide range of other variables play a role, partly by acting di-

rectly on entrenchment processes and partly by indirectly influencing repetition and thus frequency. Theoretical models of entrenchment should be informed about these factors, and empirical work investigating entrenchment must keep an eye on them as potential confounding variables. The following brief overview is divided into linguistic factors, processing-related factors other than frequency and repetition, speaker-centred factors and other context-related factors.

The main linguistic factor influencing the outcome of entrenchment processes is the grammatical structure of the language in question. Although entrenchment processes as such are arguably universal (Bybee, 2003, p. 622), the specific ways in which they affect first the representations of individual speakers and eventually the conventional system of the language will differ depending on the basic typological (isolating, agglutinative, fusional) and other structural characteristics. The nature of the linguistic units subjected to entrenchment processes differs considerably across language types, and so, presumably, will the outcomes of entrenchment. For example, since string chunking is largely a process involving elements in linear sequence (Bybee, 2002), it is likely that the outcome of chunking differs depending on whether the language has fixed or flexible word order. The length of potential chunks – which is partly influenced by typological factors as well – is also likely to affect degrees of entrenchment (Blumenthal-Dramé, 2012, p. 40).

Other processing-related factors, besides repetition and rehearsal, include the perceptual salience of linguistic forms and of extra-linguistic referents as well as the cognitive salience of concepts (Geeraerts, Grondelaers, & Bakema, 1994). The relation between attention, salience and entrenchment is far from trivial (cf. Schmid, 2007). On the one hand, since salient forms and referents are more likely to attract attention and therefore invite repeated processing, they are also more likely to become entrenched. Once entrenched, these routines are activated more quickly and with less effort and are therefore more likely to be repeated. Obviously, this gives rise to a feedback loop in which frequency comes to serve as both a cause and an effect of entrenchment^{al} (Barlow & Kemmer, 2000, p. x). While this seems to involve the danger of a circular argumentation (Blumenthal-Dramé, 2012, p. 43), feedback loops of this type are very common, not only in cognitive processing, but also in diffusion processes in social systems. On the other hand, while entrenched form-meaning pairings are unlikely to attract attention, less entrenched constructions, for example rare words, are highly salient. This is shown in the inverse frequency effects reported from experiments on structural priming, in which low-frequency combinations of verbs and constructions emerge as more likely to be repeated than high-frequency ones (e.g. Snider, 2007, p. 96).

Processing mode may have an effect as well. Since chunking processes are usually traced back to articulatory economy (e.g. Bybee, 1985), it is often assumed that individual entrenchment and long-term collective conventionalization of this type are fostered more by frequency in speech than by frequency in written text (Krug, 2003, p. 32). Whether the processing of spoken language is also more conducive to entrenchment in terms of strength of representation and schematization than the processing of written language has yet to be shown. The fact that many speakers are highly aware of the appropriateness of words and constructions in specific situational context supports the assumption that contextual information is stored alongside formal and semantic aspects. Blumenthal-Dramé (2012: 40) reviews studies which suggest that the potential for mental imagery and emotional arousal may have an effect on entrenchment.

If entrenchment relates to the minds of individual speakers, it is – more or less by definition – subject to individual, speaker-related differences (Barlow, 2013; Dąbrowska, 2012; Street & Dąbrowska, 2010). Most of these are very hard to grasp and control methodologically, since their sources are hidden in the exposure and usage histories of individual speakers which, in turn, are not only influenced by familiar social variables such as region, gender,

education, training and social roles (Geeraerts, 2005), but also by very personal routines and experiences. In addition, individual preferences for analytical and holistic perceptual processing may well have an effect (de-Wit & Wagemans, forthcoming). Age undoubtedly plays a key role, since neuroplasticity and with it the potential for cognitive reorganization decreases over time (Blumenthal-Dramé, 2012, pp. 44-47; Seidenberg & Zevin, 2006). Even if entrenchment is conceived of as a lifelong learning process, there can be no doubt that linguistic reorganization is particularly dynamic during the so-called *critical* or *sensitive period* (Lenneberg, 1967), i.e. before the age of around fourteen. Furthermore, entrenchment processes and their outcomes crucially depend on whether speakers are acquiring and developing their first, second or a later language, since entrenched first-language routines have a strong transfer and interference effect on the learning of later languages (MacWhinney, 2008). Feedback effects of languages learnt later on the first language and especially on other non-native languages learnt earlier are also well attested (cf. Cenoz, Hufeisen, & Jessner, 2001).

Finally, as entrenchment is subject to the use of language in social situations, key social parameters of the other interlocutors are likely to play a role, both directly and mediated by other variables such as salience. The extent to which accommodation, imitation and alignment take place and can have an effect on short-term and long-term entrenchment depends on the social roles and the (overt and covert) prestige of the interlocutors vis-à-vis the speaker. Research in communication accommodation theory (Giles, Coupland, & Coupland, 1991) has shown that speakers are more willing to converge in their use of language if they feel solidarity. Finally, the prestige of sources and media that provide input, e.g. newspapers, magazines, TV, Internet, etc., and the speakers and writers, respectively, also influence entrenchment.

4. Consequences for understanding the psychological foundations of entrenchment

The discussion so far has demonstrated that entrenchment processes can be made responsible for a very wide range of cognitive and linguistic effects. Before a proposal integrating these effects will be made (see Section 5), it is important to summarize the psychological foundations of entrenchment and point to missing links between insights on linguistic entrenchment and the underlying psychological processes.

Firstly, entrenchment in terms of variable strengths of representations suggests memory-based interpretations: rehearsal effected by repeated exposure and use results in memory consolidation, disuse causes decay and attrition (Langacker, 1987, 57). While a single exposure may leave memory traces strong enough to persist (de Vaan, Schreuder, & Baayen, 2007), it has to be assumed that memory consolidation requires repetition, ideally in different communicative situations, and the retaining of memory traces from one communicative event to the next. Sleep has been shown to be conducive to memorizing new words (Dumay & Gaskell, 2007). Automaticity could come into play here as an effect of increasingly routinized reactions to communicative demands in social situations by means of implicit statistical learning. For example, for most people, it is a highly automatic routine requiring little monitoring and conscious effort to greet family members or colleagues when they see them for the first time in the morning. As a large proportion of everyday conversation is formulaic (cf. the references provided in Conklin & Schmitt, 2012, p. 46), automaticity may well complement memory consolidation as an important cognitive process. The boundary between stored knowledge of linguistic routines and the automatic skill of applying them in the right context does not seem to be clear-cut.

This leads to the second main facet of entrenchment: holistic processing and storage of complex chunks. As pointed out above, the autonomous processing of fixed chunks, in the sense of unmonitored completion once begun (Bargh, 1992), points towards an account in terms of high degrees of automaticity, as does the tendency to align linguistically with interlo-

cutors (Pickering & Garrod, 2009). However, language production as such (cf. again Pickering & Garrod, 2009) is of course clearly not an entirely automatic cognitive process, so memory and other higher cognitive abilities definitely have a role to play. If we want to understand how knowledge of language and linguistic competence can emerge by means of entrenchment, the details of how memory, learning and automatization work together have to be spelt out in greater detail.

This, thirdly, is not enough, however. As the discussions in sections 3.1 and 3.2 have shown, entrenchment in terms of strength of representation and entrenchment in terms of chunking are inextricably intertwined with schematization. As soon as entrenched routines involve variable forms or contain variable slots, schematization comes into play. If one accepts the reasonable working definition of Blumenthal-Dramé (2012, p. 4), which states that entrenchment denotes “the strength of autonomy or representation of a form-meaning pairing *at a given level of abstraction in the cognitive system*” (my emphasis), it becomes clear that schematization is an inevitable part of entrenchment, not least because constructional schemas undoubtedly lie at the very heart of language learning, linguistic knowledge and the generative capacity of speakers to form sentences. From a psychological point of view, the decision to include schematization as a key entrenchment process widens the agenda even further to include categorization, generalization and abstraction as relevant cognitive processes underlying schematization.

Fourthly, a model of entrenchment has to factor in the psychosocial processes mentioned in Section 3.3: imitation, emulation, accommodation, alignment and co-adaptation, as well as the range of social variables affecting their effects (see Section 3.4). A solid understanding of these processes is essential because they act as mediators between the cognitive processes taking place in the minds of language users and the communicative factors that lie behind frequency-based repetition and the way it affects speakers’ cognitive systems and the collective linguistic system. Models of language as a complex-adaptive system (Ellis & Larsen-Freeman, 2009; Frank & Gontier, 2010; The “Five Graces Group”, 2009) or as distributed cognition (Cowley, 2011; Cowley & Vallée-Tourangeau, 2013), as well as sociocognitive models of linguistic knowledge (Geeraerts, 2005; Geeraerts, Kristiansen, & Peirsman 2010; Kristiansen, 2008; Zenner, Speelman, & Geeraerts, 2012) target these aspects.

5. Towards an integrated framework for the study of entrenchment and its psychological foundations

In light of the preceding discussion, the following working definition of entrenchment is suggested:

Entrenchment refers to the ongoing reorganization and adaptation of individual communicative knowledge, which is subject to exposure to language and language use and to the exigencies of domain-general cognitive processes and of the social environment. Specifically, entrenchment subsumes processes related to

- a) *different strengths of the representations of simple and complex linguistic elements and structures,*
- b) *degrees of chunking resulting in the availability of more or less holistically processed units,*
- c) *the emergence and reorganization of variable schemas providing the means required for generative linguistic competence.*

The linguistic effects that can result from these basic entrenchment processes are numerous, diverse and in part seemingly contradictory. Conceptual and terminological confusion is increased because the term entrenchment has been used to refer to a variety of things: cognitive processes and their cognitive and linguistic effects, as well as collective processes and their long-term linguistic effects on the language system. Terms denoting more specific entrenchment processes such as *chunking*, *fusion* and *analogy* have also been used to refer to both individual cognitive and long-term collective conventionalization processes.

In order to demonstrate that entrenchment is nevertheless a valuable and coherent concept with considerable explanatory power, the remainder of this introduction will sketch out an integrative framework for the study of entrenchment and its psychological foundation. In this proposal

- cognitive processes taking place in the minds of individuals (entrenchment) are distinguished from social processes effecting long-term language change (conventionalization)
- cognitive processes are distinguished from cognitive effects
- cognitive effects are distinguished from linguistic effects
- determinants and predictors of entrenchment are distinguished from entrenchment processes and these in turn from cognitive and linguistic effects
- effects of repetition of specific tokens/exemplars (token frequency) are distinguished from effects of repetition of abstract types/schemas (type frequency)
- effects of entrenchment in linguistic forms are distinguished from effects on linguistic meanings

As a first step, the nature of the entities which serve as input to entrenchment processes is re-defined. Usage-based models usually assume that entrenchment operates over constructions and constructional schemas which are characterized as form-meaning pairings. Furthermore, they claim that these constructions and schemas are related to each other in a massive associative memory network organized mainly in terms of hierarchical relations. The present proposal diverges from this idea in two important ways: firstly, it rejects the distinction between constructions serving as nodes in the network and relations between nodes and instead assumes that linguistic knowledge is available in one format only, namely associations. These associations come in four different types: symbolic, syntagmatic, paradigmatic and pragmatic. Secondly, entrenchment processes are seen as operating over these four types of associations in the network rather than over constructions, which, in turn, are regarded as more or less strongly entrenched symbolic associations between forms and meanings (cf. Schmid forthcoming for more details). This decision is partly motivated by concerns (Schmid, 2013; cf. also Blumenthal-Dramé, 2012) that as soon as one claims that a “construction” is “represented” in a speaker’s mind, both the gradual and the dynamic aspects inherent in the concept of entrenchment are left behind. The four types of associations are defined as follows:

- **symbolic** associations link linguistic forms and meanings in language processing and thus afford the semiotic potential of linguistic signs and constructions
- **syntagmatic** associations link forms and meanings processed sequentially in language production and comprehension
- **paradigmatic** associations link associations during ongoing language processing to competing associations, i.e. to associations that could potentially enter the focus of attention in the given linguistic and situational environment
- **pragmatic** associations link symbolic, paradigmatic and syntagmatic associations with perceptual input garnered from external situations

While all four types of associations are portrayed as being activated in the course of ongoing language processing, entrenchment is brought about by the routinization effected by the repeated processing of identical or similar stimuli. This is exactly what is predicted by emergentist and usage-based models of language.

The precise ways in which these four types of associations are affected by entrenchment processes is summarized in Table 1. The table focuses on frequency and repetition as the main determinant of entrenchment and distinguishes between types of repetition, cognitive effects and linguistic effects. The entries in the two right-most columns are cross-referenced to the superscripts given in Sections 3.1 to 3.3 where more information about these effects can be found. In addition, the psychological affordances underlying entrenchment are listed. The table can be read from left to right; the first line, for example, states that the token repetition of identical word-forms and fixed strings increases the representational strength of the symbolic association between these forms and the corresponding meanings by means of memory consolidation and routinization, which has the numerous linguistic effects listed in the right-hand cell. The additional determinants of entrenchment discussed in Section 3 are not included in the table, but form part of the general framework of entrenchment. The goal of this proposal, in addition to highlighting the dynamic quality of entrenchment processes, is to show that the large diversity of entrenchment processes can be reconciled in a unified framework if types of inputs to entrenchment processes, types of determinants and types of effects of entrenchment are systematically distinguished. It would be exaggerated to claim that everything falls into place once this is done, but a small step forward may be accomplished.

While this proposal is bound to raise a lot of questions, it may still serve as a starting point for the investigation of entrenchment processes and the interpretation of empirical data and findings. The contributions to this volume will equip readers with everything they need to form their own ideas of entrenchment and its psychological foundations in memory and automatization.

6. The structure of the volume

The present book is divided into six parts, including this introductory section.

Part II (Linguistic perspectives on entrenchment) begins with two contributions detailing the role of entrenchment in Cognitive Grammar and Construction Grammar. The next paper looks at entrenchment from the diachronic perspective. The final two papers in Part II focus on corpus-based and experimental evidence.

In Part III, the psychological perspective dominates. The six papers assembled here deal with the psychological and psychosocial foundations of entrenchment. The first four contributions deal with the key cognitive affordances behind entrenchment: memory; automatization; categorization, generalization and analogy; and gestalt-formation and chunking. The two remaining papers discuss two major sets of psychological determinants of entrenchment processes, attention, perception and salience, on the one hand, and imitation, alignment and accommodation, on the other.

The five papers in Part IV investigate the role of entrenchment in first-language and second-language learning, statistical learning and language attrition, and discuss individual differences in life-long entrenchment.

Part V extends the discussion of entrenchment and its psychological foundations to include the social dimension. Three approaches which explicitly combine the cognitive and the social dimensions are described: language as a complex-adaptive system, language as distributed cognition, and the quantitative sociocognitive approach.

Part VI brings together the major insights provided by the papers.

Table 1: Survey of cognitive entrenchment processes and their cognitive and linguistic effects

repetition-related determinant	type of association affected	psychological affordances	cognitive effects	linguistic effects
token repetition of word-forms and fixed strings	symbolic association	<ul style="list-style-type: none"> - memory consolidation - routinization 	<ul style="list-style-type: none"> - increase in representational strength of symbolic association of specific form-meaning pairing^a 	<ul style="list-style-type: none"> - faster and more effortless processing of words^a and expressions^d with less interference from paradigmatic neighbours^b - faster resolution of lexical^c and syntactic ambiguities^e - early acquisition of words^f - “entrenchment” in a narrow sense (Brain and Brooks 1995) in acquisition^l - stability of morphological form^m - resistance to analogical pressure and change^{n,r} - reduction of phonological form and bleaching of meaning^o - increase in frequency of usage^{al}
type repetition of variable construction (lexical or grammatical)	symbolic association	<ul style="list-style-type: none"> - memory consolidation - routinization - categorization - schematization 	<ul style="list-style-type: none"> - emergence of and increase in representational strength of variable schema^h (in cooperation with paradigmatic and syntagmatic associations)ⁱ 	<ul style="list-style-type: none"> - constructionalization^p - productivity^q - innovation^r - new meanings, polysemy, partly under the influence of pragmatic associations^s
token repetition of identical sequence of elements	syntagmatic association	<ul style="list-style-type: none"> - memory consolidation - routinization - chunking - automatization 	<ul style="list-style-type: none"> - increasing holistic processing of specific sequence of elements^w - automatic processing of chunk once started^{ad} - priming effects between parts of sequence^{ae} or sequences of larger constructions^{ag} 	<ul style="list-style-type: none"> - fusion, coalescence, formulaic language (idioms, routine formulae, irreversible binominals), collocation^y - form: phonetic and morphological reduction^x - meaning: reduction of semantic specificity (grammaticalization)^{ab}, loss of compositionality (lexicalization)^{ac} - tightening of internal syntagmatic bonds^{aa} - loosening of paradigmatic associations of composite parts^z
type repetition of functionally identical sequences with variable slots	syntagmatic association	<ul style="list-style-type: none"> - memory consolidation - routinization - chunking - categorization - schematization 	<ul style="list-style-type: none"> - emergence of complex schematic constructions with variable slots (in cooperation with symbolic and paradigmatic associations)ⁱ 	<ul style="list-style-type: none"> - constructionalization^p - productivity^q - innovation^r
token repetition	paradigmatic association	<ul style="list-style-type: none"> - comparison 	<ul style="list-style-type: none"> - preferential selection^u 	<ul style="list-style-type: none"> - increase in strength compared to paradigmatic competitors^t - attractor for analogical change^v
type repetition	paradigmatic association	<ul style="list-style-type: none"> - comparison - analogy 	<ul style="list-style-type: none"> - emergence of complex schematic constructions with variable slots (in cooperation with symbolic and syntagmatic associations)ⁱ 	<ul style="list-style-type: none"> - basis for analogical change and pressure^s - grammatical categories (word classes)^j - word-fields, paradigmatic relation^k
token or type repetition in specific context	pragmatic association	<ul style="list-style-type: none"> - memory consolidation 	<ul style="list-style-type: none"> - rich memory of exemplars^{af} - from episodic to semantic memory^{ai} 	<ul style="list-style-type: none"> - semantic change caused by invited inference, context absorption^{ah} - emergence of connotations^{aj} - emergence of register-specificity^{ak} - support for chunking^{al}

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