To appear in:
Marianne Hundt, Sandra Mollin and Simone Pfenninger (eds.) (2016). *The Changing English Language: Psycholinguistic Perspectives*. Cambridge: Cambridge University Press.

10
The role of analogy in language acquisition

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10.1 Introduction

Analogical reasoning is a powerful processing mechanism that allows us to discover similarities, form categories and extend them to new categories. Since similarities can be detected at the concrete and the relational levels, analogy is in principle unbounded. The possibility of multiple mapping makes analogy a very powerful mechanism, but leads to the problem that it is hard to predict which analogies will actually be drawn. This indeterminacy results in the fact that analogy is often invoked as an explanandum in many studies in linguistics, language acquisition, and the study of language change, but that the underlying processes are hardly ever explained. When checking the index of current textbooks on cognitive linguistics and language acquisition, the keyword "analogy" is almost completely absent, and the concept is typically evoked ad hoc to explain a certain phenomenon. In contrast, in work on language change, different types of analogical change have been identified and have become technical terms to refer to specific phenomena, such as *analogical* levelling when irregular forms become regularized or *analogical extension* when new items become part of a category (see Bybee 2010: 66-69, for a historical review of the use of the term in language change and grammaticalization see Traugott & Trousdale 2014: 37-38).

In this paper, I will discuss the possible effects of analogical reasoning for linguistic category formation from an emergentist and usage-based perspective, and then characterize the interaction of different processes of analogical reasoning in language development, with a special focus on regular/irregular morphology and argument structure. The focus on language acquisition is chosen because in longitudinal studies on language development we can trace the effect of analogical reasoning on a certain linguistic state over time.

I will conclude with a discussion on the similarities and differences between acquisition and change.

10.2 Definition: What is analogy?

10.2.1. Analogical reasoning from a cognitive science perspective

Analogy is a domain-general form of structure mapping between a source and a target (Gentner 1983). Such mappings can be based on perceptual *similarity* when one notices the similarity between two blue objects, or they can be *relational* when one sees two rows of three different objects each and notices that two of these objects share the position as the middle one without being physically similar. Markman & Gentner (1993) demonstrate this with the example of two sets of three geometrical objects in a row (see

[1] I would like to thank Dedre Gentner, Marianne Hundt and Sandra Mollin for their thorough and insightful comments on the previous versions of this manuscript. My sincere thanks also go to Catherine Diederich for proofreading the first version of this chapter, and to Julia Voegelin for drawing Figure 1.

Figure 1). The squares in Set (a) are bigger than those in Set (b): The medium-sized square in Set (b) is identical in size to the smallest square in Set (a): They are object matches because they share the same perceptible attributes. By contrast, the analogy between the smallest square in Set (a) and the small square in Set (b) is a relational one: They are of different size, but they are both the smallest in their set (Markman & Gentner 1993).

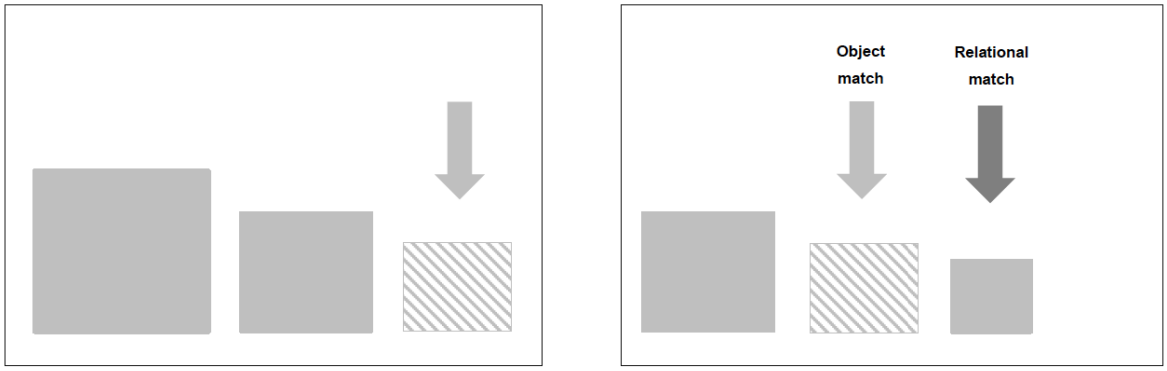

Figure 1: Perceptual similarity and relational analogy, the relevant squares are distinguished by their pattern.

To give a linguistic example, mappings can be based on physical similarity or on abstract relations: In morphology, we find patterns based on physical similarity in allophonic variation, where a stem with a certain coda is inflected with a particular allomorph.

Gentner & Smith (2012: 131) state that **analogical reasoning** involves three processes:

- **Retrieval**: Given some current topic in the working memory, a person may be reminded of a prior analogous situation in the long-term memory.
- **Mapping**: Given two cases present in the working memory (either through analogical retrieval or simply through encountering two cases together), mapping involves a process of aligning the representations and projecting inferences from one analogue to the other. The mapping is *structure consistent* and *systematic* because it concerns large relational systems.[2]
- **Evaluation**: Once an analogical mapping has been done, the analogy and its inferences are judged.

10.2.2 The effect of analogy on perception

Analogical reasoning is not just triggered by the situations we perceive, but it is an active process that can shape our perception. The ability needed to draw comparisons is *structural alignment*, i.e. to notice the correspondences between elements. Alignment has three cognitive effects (Gentner et al. 2016):

(a) It makes the similarities more salient and leads to abstraction and transfer (Gentner

[2] Dedre Gentner (personal communication) explains mapping as follows: The mapping is *structurally consistent (that is, it has one-to-one correspondences and parallel relational structure). It favors larger and deeper common relational systems over isolated matches (the systematicity* principle).

& Markman 1997).

(b) It promotes the noticing of alignable differences. For example, most people are not aware of a basic principle in engineering, namely that diagonal braces render a construction more stable. Gentner et al. (2016) had adults and children construct skyscrapers, most of which collapsed when they had reached a certain height. In one experimental condition, children were asked to tell which of two buildings (one with and one without diagonal strengthening) was stronger: first by just looking at them, then by shaking the building. In the subsequent observational study of their building activities, they had aligned the perceptual difference without explicit instruction: The building with diagonal braces was more stable than that without. This effect was even stronger when the critical difference was the only difference between the two constructions.

(c) It invites the projection of inferences from the base (or source) domain to the target domain, and is thus instrumental for the understanding of metaphors, for example.

Hofstadter & Sander (2013) argue that the potential for analogical reasoning is indeed unbounded, which makes them the "fuel and fire of thought". They demonstrate the versatility of analogical reasoning for words, many of which (like *band* or *chair*) carry multiple meanings and many associations from their contexts of use with them. In dictionary approaches to meaning, such associations and meaning extensions cannot be considered, yet they are relevant for our understanding of these words in context. Hofstadter & Sander argue that the flexibility in using linguistic units and in understanding such flexible usage would not be possible if meaning was fixed:

> And the fact is that ordinary words don't have just two or three but an *unlimited number* of meanings, which is quite a scary thought; however, the more positive side of this thought is that each concept has a limitless potential for variety. (Hofstadter & Sander 2013: 5)

What follows from these cognitive approaches to analogy is that analogical reasoning is not only unconstrained in principle, but also happens "on the fly" (Skousen 2002, see Section 10.3 below). But if alignment is so flexible, how can we predict or ascertain which analogies are actually drawn in language processing? At least two questions arise:

(a) Do we draw all possible comparisons? At least in language acquisition research it seems that children generalize rather conservatively. How relational and abstract are the generalizations we make? Do we draw on abstract relational principles or rules to generate new sentences, or do we exploit constructional patterns with some degree of surface regularity and lexical specificity as well as semantic grounding?
(b) What guides or constrains the comparisons we make? There is evidence that we "overlook" a lot of possible analogies. What influences the likelihood with which we make a particular comparison?

The findings from psychology suggest that the analogies we draw spontaneously are rather limited and often based on surface similarity. First, there is evidence that children are strongly surface-oriented even when comparisons are directly presented to them

(Gentner 1988). For example, if a 4-5-year-old is asked to interpret "How is a cloud like a sponge", they say 'both are round and fluffy'. A 9-year-old or adult will say 'both hold water and later give it back'. Gentner (1988) used the term "relational shift' to describe this shift from property-based interoperation to relational interpretation. Second, in research on analogical transfer in adults, we find that remindings are strongly based on overall similarity, especially surface similarity. Even adults fail to notice and use past analogs that only share relational similarity (Gentner, Rattermann & Forbus 1993; Gick & Holyoak 1980), unless they are frequent enough to form a schema. Bybee (2010, Chapter 4) supports the importance of local and similarity-based generalizations when reviewing research on the acquisition of syntax that shows that children's 'new' utterances differ only slightly from the constructions they have produced before.
In the following, I will focus on analogical processes in morphology and syntax. The studies reviewed here focus on category internal changes (e.g., spread of regular morphemes). The focus will be on theories and studies in language acquisition

10.3 Analogical processes in language

Analogical processing is needed when assigning new exemplars to a category, or when extending the range of a category. While some theories make a sharp delineation between symbolic and rule-based processes that rely on binary category assignment (see Section 10.4.1 below), others assume that categories are emergent, dynamic, and – importantly, also malleable. Such frameworks include connectionist models (Skousen 1989, 2002; Skousen, Lonsdale & Parkinson 2002), exemplar models (Pierrehumbert 2001), some versions of construction grammar (Croft 2001), and usage-based or constructivist models of language (Beckner et al. 2009; Bybee 2010; Langacker 1987; Tomasello 1998). They describe how categories are formed when a new item is associated with an existing category. Analogical relationships play a crucial role in this process:

> Analogical modeling, on the other hand, does not have a training stage except in the sense that one must obtain a database of occurrences. Predictions are made "on the fly", and all variables are considered apriorily equal (with certain limitations due to restrictions on short-term memory). The significance of a variable is determined locally – that is, only with respect to the given context. Gang effects are related to the location of the given context and the amount of resulting homogeneity within the surrounding contextual space. (Skousen 2002: 3)

The internal structure of such categories can be seen as one of more or less closely related items:

> In an exemplar model, each category is represented in memory by a large cloud of remembered tokens of that category. These memories are organized in a cognitive map, so that memories of highly similar instances are close to each other and memories of dissimilar instances are far apart. (Pierrehumbert 2001: 140)

This clustering of related exemplars can give rise to prototype effects for those members that are most central to the category because they share the most features (Ibbotson 2013), or – in non-feature-based terminology – are high-frequency representatives of

the typical function of a category (O'Donnell, Römer & Ellis 2013). Prototypes facilitate the association of new members with a particular category, and may serve as models for the extension of that category (Goldberg 2006; Ibbotson & Tomasello 2009). For example, *give* is the most frequent verb used in the ditransitive double object-construction (*give John a book*), and it denotes transfer of possession, while *get* is the most frequent verb used in ditransitive constructions with prepositional objects, and denotes caused motion/change of location (*get the ball over the fence*). Corpus analyses as well as association experiments and language development data show that this relationship holds, although it is not completely deterministic, since it is possible to encode transfer in a prepositional construction (*give the book to John).* Goldberg (2006: 89) calls this the *Cognitive Anchoring Effect*, where one high-frequency exemplar can serve as the salient standard for comparison.

10.3.1 The role of analogy in category formation and extension

Analogical reasoning leads to *learning* in terms of categorization, abstraction and category extension. Langacker (2000) describes these processes as follows:

> The cognizer needs the ability to compare two structures and notice discrepancies as well as similarity or overlap. When source and target (the new item) match in the relevant respects, the target is categorized as an item belonging to the source category. (Langacker 2000:4)

This definition entails that each comparison allows for multiple mappings, which in turn leads to categorization in multiple dimensions. For example, when interpreting a novel verb form like *gorped*, it can be classified as a past tense verb based on its position and meaning in an utterance, as well as by its overlap or surface similarity with the –*ed* suffix of other past tense forms. Another form like *glam* can also show analogy with other past tense forms in terms of its position and meaning, but not in surface similarity with the regular past tense suffix, but with a smaller pattern of irregular forms (e.g. *swim-swam-swum)*. Such slight mismatches between source and target lead to an *extension* of the category. Ultimately, the past tense category should encompass all forms and the analogical mappings that hold between them. Moreover, such a category should be flexible because new markers can be integrated, and the weight of the mappings can change. Such a dynamic model of categories and categorization is proposed by so-called exemplar models (Barsalou, Huttenlocher & Lamberts 1998)**.** The example of the past tense category also shows that analogical mapping goes beyond surface similarities even if they are available in that speakers make choices between different possibilities (*glum* vs*. glimmed).*

According to Langacker, analogy leads to categorization. For language acquisition, I will link the concept of analogy to the concepts of schematization and granularity as proposed by Langacker (1987). In this view, children need to direct their focus from detail to similarities on higher levels in order to discover schemas and more abstract relationships. Gentner & Medina (1988) trained children to make such *progressive abstractions* by drawing their attention to literal similarity matches first, and then highlighting similarities across dimensions.

In historical linguistics, two aspects of analogical reasoning are prominently studied, namely proportional analogies and analogical levelling (to my knowledge, these terms are not prominently used in the acquisition literature). *Proportional analogies* describe the induction by exploiting the parallelism of three examples to fill the gap of item 4 (*walk* : *walked* : *go* : *goed).* This regularization can also be an example of analogical levelling, when phonological or morphological distinctions are diminished due to a more general regularization process. Bybee & Beckner argue that these cases can be subsumed under frequency-induced processes of categorization. However, de Smet & Fischer (this volume) correctly point out that while analogy is part of any categorization process, it is a much wider concept because analogy allows for multiple mappings, not just mappings onto existing categories (see the discussion on relational analogies above). They follow Traugott (2011), who distinguishes analogy as a mechanism or process of thought, from analogization as the product of analogical reasoning that is visible as a new stage in language change.

While both historical linguistics and language acquisition deal with change in language use, they also differ in important dimensions: In language change, the linguistic conventions or structures themselves change as a function of changing preferences in the language community, whereas in language acquisition, the language use of the individual child changes as s/he gradually approximates the form-function correspondences of the ambient language(s). Hence, the outcome is quite different. Yet, some of the fundamental questions are the same. They concern the theoretical debate on when and whether speakers process language by "rule", which would allow them to make far-reaching generalizations, using relational analogies, or whether developmental change is a rather local and gradual abstraction. In the past decades, usage-based studies on acquisition have accumulated converging evidence from a number of different phenomena and languages to show how local generalizations can lead to a more wide-ranging, rule-like change. In the following sections, I will discuss the theoretical foundations for this research and demonstrate such a process with data from German plural acquisition. In sections 10.6 and 10.7, I will try to systematize similarities and differences between language acquisition and language change, and identify some open questions for further research.

10.3.2 Similarity matches versus relational matches

Linguistic relations can be complex, or – in the terminology of usage-based approaches to language development – 'abstract'. While 'concrete' relations are based on the (partial) physical identity of linguistic sequences, 'abstract' linguistic relations are underlying relations. Even infants are able to recognize recurrent patterns in nonsense syllables. Marcus, Vijayan, Bandi Rao & Vishton (1999) exposed 7-month-old infants to syllable sequences of the pattern ABB (e.g. *ga ti ti)* or ABA (e.g. *la ni la*). After two minutes of familiarization (that is, hearing the same pattern again and again) they were exposed to new stimuli with the same or a different pattern. Infants paid more attention to the new pattern. Experiments like these show that infants are able to recognize familiar patterns and distinguish them from new patterns, even if the concrete elements have changed.

In principle, syntactic rules could be based on such patterns. The following sentences do not share a single concrete realization of a morpheme, i.e. they have no surface similarity, but they have the same underlying structure, e.g. Agent Action Patient:

(1) *Kim loves Anna.*
(2) *Sophie kissed Jack.*
(3) *They see John.*

This example illustrates that relational analogies exist at various levels. One could also group the words by their part-of-speech category (pronouns, proper names, and verbs). Depending on the language, thematic roles like Agent, Action and Patient are systematically linked to grammatical functions like Subject, Verb, and Object. This openness makes analogy powerful but also unbounded. Since analogical reasoning relies on both the discovery of physical similarities as well as relational ones, multiple analogical mappings are possible between any set of items or structures. Consequently, one of the big debates in language acquisition, and to a lesser extent in linguistic theory and psycholinguistics, is at what level such structures are represented (see Section 10.4.1 below). In sum, Gentner & Colhoun (2010) and Gentner & Smith (2012) see analogy as an invitation to compare and to draw inferences from such a comparison.

> Reasoning by analogy involves identifying a common relational system between two situations and generating further inferences driven by these commonalities. The commonalities may also include concrete property matches between the situations, but this is not necessary for analogy; what is necessary is overlap in relational structure. (Gentner & Smith 2012: 130)

10.4 The role of analogy in constructivist theories of acquisition

Usage-based, emergentist and constructivist theories of acquisition do not assume a genetic predisposition for linguistic categories, or *a priori* linguistic representations. Crosslinguistic research on adult linguistic categories has shown that there are no principled constraints on grammatical categorization (Slobin 1997). Crosslinguistic research has also shown that the influence of language on children's emerging categories starts early. While very general prelinguistic concepts or *biases* exist that influence children's early perception and categorization before language-specific categorization sets in (Mandler 2008), the process of "tuned attention" (Ellis 2006a,b; Freudenthal, Pine & Gobet 2009) leads children to discover the form-function relationships that are relevant in their target language(s). This entails that children's linguistic categories are emergent, malleable, and shaped by the input language (Bowerman & Choi 2003; Majid, Bowerman, Kita, Haun & Levinson 2004).

Construction Grammar has become the dominant syntactic theory for modelling such usage-based acquisition processes, and it is also applied to language change (e.g., Bybee & Beckner 2014). While there is typically no commitment to a particular version of construction grammar, acquisition research draws on the general assumptions that linguistic units are symbolic units with a phonological and a semantic side, and that similarities hold at these levels (Croft & Cruse 2004). Croft and Cruse distinguish between *phonological* alignment, *conceptual* alignment and *symbolic* alignment. Language learning, then, is based on generalization from one instance or a few instances

to many. It requires *intention reading* and *pattern finding* (Tomasello 2003). Pattern finding requires entrenchment or reinforcement of items based on their token frequency. This memorization is the prerequisite for noticing similarities between items. Conceptual and symbolic alignment require detecting the form-function alignment of symbolic linguistic units, as well as similarities between units on the conceptual level. Conceptual similarity does not require or entail formal similarity.

In the following, I will discuss two domains with a rich body of research in terms of analogical reasoning. First I will discuss the acquisition of regular and irregular morphology with respect to the power of analogical reasoning: Is it possible to acquire linguistic rules bottom-up based on analogy, or do linguistic rules require top-down declarative processing? Second, the acquisition of verb-argument structure will serve to demonstrate how different analogical mappings lead to a refinement of the form-function correspondences in syntax.

10.4.1 Linguistic rules without analogy? Learning the German plural

According to Langacker (2000: 219ff.), linguistic rules can be conceived of as schemas with few constraints. For schema formation, the resemblance of the new structure to the source structure is essential, it is a bottom-up process (Langacker 2008). Langacker (1987: 447) argues that if rules are conceived as schemas, and if the analogy is made explicit, there is no difference between rule-based and schema-based explanations, e.g. when generalizing from *search/searcher, lecture/lecturer* and so forth to *strive/striver* (cf. the relational shift in analogical reasoning in general cognitive processing discussed in Section 10.3.1 above).

This view contrasts with the top-down processing of symbolic rules, as proposed, for example, by Clahsen (1999); Marcus et al. (1992); Pinker & Prince (1988) and Pinker & Ullman (2002). In the so-called Dual Mechanism Model of inflection (DMM), symbolic rules apply to categories as a whole and are independent of other processing factors such as frequency or analogy (Pinker & Ullman 2002). This leads to a difference in the processing of regular inflection, where the regular affix or default affix is added to the root of the noun or verb to be inflected, and irregular forms, which are stored in memory. The DMM thus reduces the memory load by generating regular forms through the generation of the intended form by a symbolic, top-down rule. In order to explain why not just every noun will receive the regular plural, an additional memory component is needed in which all irregulars are stored. Due to their holistic storage, irregular forms are subject to associative processing and show frequency and analogy effects, whereas frequency and analogy are irrelevant in the processing of regular morphology, if there is a strict distinction between holistic processing by memorization for irregulars, and combinatorial processing for regular forms ("item and process model" or "words and rules"; cf. Pinker 1999; Huang & Pinker 2010). Supposedly, the human language processor is innately set up to process symbolic rules by different means than irregular items (Clahsen, 1999: 1007).

In contrast, as noted above, constructivist and usage-based approaches to acquisition rely heavily on the storage of forms for entrenchment, and automatization of the stored form, as well as for schematization: Comparison between forms is only possible when forms are stored. Dual mechanism accounts propose that learning can take the form of

top-down and memory-independent processing when the child can identify a regular affix.[3] The acquisition of German plural morphology provides a good testing ground for these processing models, because productivity and frequency are not confounded (Clahsen 1999; Clahsen et al. 1992). The low-frequency *-s* plural, one of eight plural markers, shows the fewest constraints in its occurrence and is productive with new and nonce nouns. And it is well attested that the German *-s* plural is overgeneralized early, despite its relative low frequency. To decide between the validity of the two proposals, the critical evidence is whether all German plural markers are overgeneralized by analogy, or whether there is a difference between the *-s* plural and the other affixes. If the *-s* plural is indeed a default marker that is applied whenever the child cannot rely on stored forms, *-s* should be overgeneralized to a wide range of noun stems and not be constrained by analogy.

As in many other languages, the plural system in German is determined by phonotactic features (syllable structure, final sound), and gender (Ravid et al. 2008). German has four plural affixes (-(*e*)*n*, *-e*, *-er*, and *-e*), which can be combined with vowel raising or Umlaut, as well as a substantial group of nouns that do not mark the plural (notably masculine and neuter nouns ending on *-el* and *-er*). The *-s* plural is taken by 16.5% nouns, mainly neuters and strong masculines, but rarely occurs with feminine nouns (Wegener 1999). Mugdan (1977) estimates that about 75% of German plurals are predictable by phonotactics, declension class and gender, but there is a certain degree of variation between possible markers, some of which also show up in dialectal variation.

The Dual Mechanism Model makes the claim that the *-s* plural is "morphonologically free" (Marcus, Brinkmann, Clahsen, Wiese & Pinker 1995: 229), and that it represents the elsewhere condition: it "appears when the phonological environment does not permit any other plural allomorph" (Marcus et al. 1995: 229; see also Bornschein & Butt 1987: 142). But do the linguistic facts of the *-s* plural really fulfil this condition? It turns out that the default conditions in their current formulation provide an insufficient characterization of the elsewhere condition. A review of the linguistic facts reveals that the *-s* plural alternates with other markers in all domains. The *-s* plural can occur in almost all phonological surroundings with ordinary nouns, but has two main sets of applications: First, a large group of mostly monosyllabic nouns that end in plosives (*Deck-s, Dock-s, Trick-s, Stopp-s, Tipp-s*; please note that these words are not borrowed from English, but are part of the common ancestry). In this phonological condition *-s* alternates with the (Umlaut)-*e* plural (e.g. *Zug > Züg-e* '*train-s*'; *Boot > Boot-e* '*boat-s*'). Second, the *-s* plural is commonly used when the noun root ends in an unreduced vowel which does not carry the main stress (e.g. *Oma-s* 'grandma-*s*'; *Auto-s* '*car-s*'; cf. Bornschein & Butt 1987: 141). However, feminine nouns ending with *-a* often take the *-n* plural, sometimes in alternation with *-s* (e.g. *Firma > Firm-en / Firma-s* '*company-s*'; *Diva > Div-en / Diva-s* '*diva-s*'). Such alternations are also found in default conditions like proper names (e.g. *Corsa > Corsa-s / Cors-en*; a product name of a car) or truncations (e.g. *Sozi-s* or *Soz-en* from *Sozialist-en 'socialist-s*'). Finally, when the noun root ends with a

[3] There is a rich debate on the exact nature of this process. Marcus et al. (1992) as well as Clahsen, Rothweiler, Woest & Marcus (1992) proposed that there are so-called default conditions which help the child to identify the default marker. In case of plurals, the default marker is applied, for example, to proper names and certain types of nominalizations or conversion, but see Goebel & Indefrey (2000) and Dąbrowska (2004: 116-158) for a rebuttal of the so-called default conditions.

stressed full vowel, the *-s* plural alternates with *-n or -e* (e.g. *Café-s* versus *Phantasie-n* '*fantasy-s*' versus *Knie-e* '*knee-s*'; cf. Köpcke 1993; Mugdan 1977; Wegener 1999).

Most importantly, there is also a true phonological constraint for the *-s* plural: Because it is non-syllabic, it is blocked when the stem itself ends in sibilants like *-s*. This constraint holds in all default conditions like proper names (e.g. *die Thomas-se 'the Thomas-es'*; *der Klaus > die Kläuse 'the Klaus-es*'), loan words (*die Boss-e 'the boss-es'*), nominalizations (*die Etwas-se 'the something-s'*), or acronyms (*die MAZ-en;* see Goebel & Indefrey 2000: 194). Further exceptions to default processing are found with foreign words ending on the pseudosuffix *-er*. They do not receive *-s* marking, but are zero-marked as common for native nouns ending in *-er*. This holds even if they preserve their English pronunciation as in *Manager-0, Computer-0, Surfer-0* or *Jogger-0*.

The participant of this study is a monolingual German boy, Leo, who grows up in Leipzig, Germany. His parents have higher education and speak dialect-free, clearly articulated standard High German. Leo's language development was recorded from age 1;11.13 (age in years;months.days), the onset of multiword speech, until age 4.[4] Analyzed here are the transcripts of 317 one-hour recordings made between age 2;0.0 and 4;0.0, as well as the diary utterances from 1;11.15 to 3;0.00. The corpus contains 134,614 utterances from the child (including 6,249 diary utterances) with a total of 76,612 nouns. The MLU (mean length of utterance) in words increased from 1.1 at age 2;0 to 3.9 at age 3;11 (for comparison, the adults have an MLU of about 5). For the purpose of this analysis, all nouns were coded with respect to the plural class and number. In addition, errors were coded in terms of the target class and the error made. There is a total of 367 errors, 117 of which are errors involving the wrong use of the *-s* plural. The following analysis tests whether the *-s* plural shows the fewest constraints as predicted by the Dual Mechanism Model.

The second and major argument for the Dual Mechanism Model is that default markers should be freely generalizable and not be constrained by analogy like irregular markers. Furthermore, they should be used on default conditions whenever access to memory is blocked. In concrete terms this means that *-s* errors should apply to nouns of all other plural classes, and they should not be constrained by gender. The *-s* plural is indeed overgeneralized to nouns of several other plural classes, as predicted by Clahsen et al. (1992). However, this holds for *-en* and *-e* plurals as well. In order to show that *-s* has a special status, one needs to show that it is not constrained by analogy to existing *-s* plurals. This will be tested by analyzing the phonotactic properties of nouns with *-s* errors.

The 117 error-tokens with *-s* affect 44 different noun roots. It turns out that *-s* is not overgeneralized to all kinds of stems, but rather to four groups of nouns which can be characterized by their final sound (see table 1): nouns ending in liquids (1.a) or nasals (1.b), as well as nouns ending in stops (1.c) or unreduced vowels (1.d). In addition, there is an early isolated error on a noun ending in a sibilant, which had been transcribed with a question mark (1.e).

[4] For more detail, see Behrens 2006. The data are part of the public CHILDES archive: MacWhinney (2000).

(1) Distribution of *-s* errors with respect to the final sound of the noun root

(a) Nouns ending in liquids

-er *Bagger-s* 'excavator-*s*'; *Zimmer-s* 'room-*s*'; *Lautsprecher-s* 'loud+speaker-*s*', *Käfer-s* 'bug-*s*', *VW+Käfer-s* 'VW+beetle-*s*', *Marienkäfer-s* 'lady-bug-*s*, *Teller-s* 'plate-*s*', *Stopper-s* 'stopper-*s*', *Roller-s* 'scooter-*s*', *Koffer-s* 'suitcase-*s*', *Laster-s* 'truck-*s*', *Lokführer-s* 'engine+driver-*s*', *Tiger-s*, *Hänger-s* 'trailer-*s*', *Anhänger-s* 'trailer-*s*', *Eimer-s* 'bucket-*s*', *Container-s* 'container-*s*'; *Blinklicht-er-s* 'flashlight-*s*'

-el *Wirbel-s* 'swirl-*s*', *Pinsel-s* 'paint brush-es', *Onkel-s* 'uncle-*s*', *Löffel-s* 'spoon-*s*', *Kamel-s* 'camel-*s*', *Deckel-s* 'lid-*s*', *Äpfel-s* 'apple-*s*'

-r *Tür-s* 'door-*s*', *Stinktier-s* 'skunk-*s*', *Stör-s* 'sturgeon', *Dinosaurier-s* 'dinosaur-*s*'

-l *Ball-s* 'ball-*s', Wohnmobil-s* 'motor home-*s*', *Strahl-es* 'beam-*s*', *Steckerl-s* 'pin-*s* (in a game)'

(b) Nouns endings in nasals

-en *Gueterwagen-s* 'freight car-*s*'; *Kesselwagen-s* 'tank+waggon'; *Modellwagen-s* 'model car-*s*'; *Maenneken-s* 'little+men-*s*'; *Bilderrahmen-s* 'picture frame-*s', Düse-n-s* 'nozzle-*s*', *Buchstabe-n-s* 'letter-*s*'

-n *Strassenbahn-s* 'street car-*s*'; *Trambahn-s* 'street car-*s*'; *U+Bahn-s* 'subway-*s*'; *S+Bahn-s* 'street-car-*s*; *Modell+Eisenbahn-s* 'model railroad-*s*'; *Eisenbahn-s* 'railroad-*s*'

-ng *Verpackung-s* 'packaging-*s*', *Schmetterling-s* 'butterfly-*s*','

-m *Form-s* 'form-*s*'; *Muffinform-s* 'muffin form-*s*'

(c) Nouns ending in velar stops
Fabrik-s 'factory-*s*', *Zug-s* 'train-*s*',

(d) Nouns ending in stressed full vowels:
Papagei-s 'parrot-*s*', *Geweih-s* 'antler-*s*'

(e) Others
Bussas (?) 'busses'

Contrary to the hypothesis that *-s* errors should not be constrained to analogy, these phonotactic patterns correspond to existing *-s* plurals. In the plural nouns produced by the child, the *-s* plural is found with liquids (e.g. *Hotel-s, Onkel-s, Tunnel-s*), nasals (*Clown-s*, *Bonbon-s* 'candy-s', *Tram-s* 'street car-s', *Tandem-s*), plosives (*Lok-s*), or stressed full vowels (*Café-s)*. The only error pattern which apparently cannot result from analogy is the overgeneralization of the *-s* plural to nouns ending in *-(e)r*. However, the final *-r* is not pronounced [tyːʁ̩], and it is possible that children misanalyze the ending as a full vowel (Szagun 2001; for theoretical support see Vennemann 1972 and Wiese 1996: 252ff.). In sum, this rather narrow distribution does not suggest that *-s* is scattered across the whole morphonological space by rule, as claimed by Marcus et al. (1995: 245). Also, the data do not suggest that the *-s* plural instantiates the "elsewhere condition" of being used when no other marker can apply. Instead, *-s* errors are not exclusive in these conditions, but compete with *-(e)n* or *-e* errors (cf. 1a-e above).

It is also informative to look at the time course in which different types of *-s* errors appear. Initially, there are mainly errors on nouns ending on *-er* and *-el*, where *-s* errors alternate with *-n* errors. Errors on nasals, the second major group, come in only eight months later at age 2;8, and errors on plosives follow at 2;9. The gradual extension of error domains suggests that the child acquires the phonological freedom of the *-s* plural in a stepwise fashion.

The acquisition data presented here support claims that type frequency is not the sole determinant of productive inflection, but that analogy is another critical factor (cf. Goebel & Indefrey 2000 and Hahn & Nakisa 2000 for related results in connectionist modelling of the German plural; and Dąbrowska 2001, 2004, 2012 for analogical processes in acquiring the Polish genitive, as well as individual differences in older speakers).

The research on the acquisition of inflectional morphology also shows that children draw on different sources of information for their generalizations: They gather information about allomorphic variation (within one month after his first plural production, the German boy Leo had identified and overgeneralized all German plural affixes, cf. Behrens 2002). Like all other German children whose plural acquisition was studied, his overgeneralization errors were not coincidental, but fell in the realm of the errors that can be expected based on the phonological and prosodic properties of the stem (Ravid et al. 2008), and the resulting errors correspond to the prototypical plural schemas or Gestalt (Bittner & Köpcke 2001; Köpcke 1998). In sum, the German plural system is not determined by a single generalization, but it is a system with internal variability and a number of more or less reliable subregularities. Children make use of analogies on several levels when learning the system: They have to identify the functional equivalence of the different allomorphs (*affix-orientation*), they identify the phonotactic properties of the stem and form predictions about appropriate plural markers (*stem-orientation*) and they derive knowledge about the prosodic and phonotactic properties of the resulting inflected form (*product- or schema-orientation*). This allows them to identify the highly regular aspects of the system with very low error rates, and to make non-random choices in the less regular domains of the system (Behrens 2011). Given the complexity of the system, a continuing process of calibration can be observed since children also have to learn to disentangle the interaction of plural marking with case and gender marking (Behrens 2011; Szagun 2001, 2006; Szagun, Stumper, Sondag & Franik 2007).

10.5 The acquisition of argument structure: From concrete to abstract representations

Another domain in which there is rich research on the nature of generalization is argument structure, or the contingency between semantic and syntactic information as well as the influence of concrete strings of linguistic units and their frequency.

In usage-based linguistics, the key finding is that children do not operate with general 'rules' and abstract categories, but learn by making generalizations over the input they receive. In the terminology used in this framework, children proceed from concrete to abstract representations. "Concrete" here refers to the replication of strings of words or chunks without having analyzed their internal structure. Abstraction results from repeatedly registering commonalities between exemplars such that these commonalities are reinforced (Langacker 2000: 5). For example, forms like *faked, borrowed, hated, burped* and so forth have a dental suffix (-ed) to denote past tense that has three phonologically conditioned allomorphs. The repeated encounter of forms inflected with –*ed* will lead to the analysis and segmentation of the inflected forms and will allow speakers to then integrate new items into a morphological paradigm. Schematization is a special form of abstraction since we can compare items at different levels of specificity or granularity when we notice analogies at different levels of abstractness (Langacker 2000). In contrast to abstract rules, schemas always start out with concrete similarities in the expression, as they are based on concrete usage events (Langacker, 2008: 219-220). Tomasello (1992) analyzed the early verb use of an English-speaking child and demonstrated that early verb syntax was item-specific and did not generalize to other verbs of the same argument structure class. The argument structure of such "verb-islands" is thus better characterized by thematic roles such as *hitter/hittee* or *kisser/kissee* than by more abstract roles such as agent/patient and/or subject/object. In the initial phase of syntax acquisition, no transfer of knowledge between syntactically similar verbs seems to take place, and abstract categorical links between constructions seem to be absent (but see Naigles, Hoff & Vear 2009).

Subsequent research has employed a number of methods both in experimental investigations and in corpus analyses of naturalistic data to explore the extent to which children generalize over the form-function correspondences in the input. Although these studies rarely use the term "analogy", the findings can be framed in terms of analogical reasoning nonetheless, as Ibbotson (2013: 10) states:

> A key part of responding to this challenge will be to specify in greater detail the mechanisms of generalization, specifically a mechanistic account of the dimensions over which children and adults make (and do not make) analogies. As usage-based approaches have argued, relational structure, and mapping between representations is a fundamental psychological process that underpins forming these abstract connections.

Analogy thus plays a central role in the acquisition of language because children have to develop from mappings based on observable similarities. For example, activities in which an agent manipulates an object are typically encoded by transitive verbs (Slobin 1985). Languages differ as to which cues encode that relationship: morphology (case marking), semantics (agency) or syntax (word order). Research within the Competition Model has shown that the order in which children acquire the different facets of argument structure generalizations depends on the availability and reliability of these

cues in the input (Bates & MacWhinney 1987; Bates et al. 1984; MacWhinney 2004). In the following, I will present a selection of the rich acquisition literature to demonstrate how children develop from string-oriented, concrete units to more abstract generalizations based on the syntax or semantics of certain constructions, and how this accumulated knowledge prevents them from making possible generalizations when there is a well established alternative (pre-emption).

10.5.1 String-based processing

The hypothesis that early child language is item-based emphasize the role of concrete linguistic strings. Such strings can mark the beginning of utterances and determine their pragmatics, or they can take the form of slot-and-frame patterns with open slots, also in middle position. I call these processes "string-based" because the linguistic units that serve as the anchor for developing constructions may not have been fully analysed by the children. Utterance-initial strings are important in question formation and in the acquisition of auxiliaries. Here, children start out with very few utterance-initial patterns (*wh*-word+pronoun or pronoun+auxiliary) that encode certain semantic functions before acquiring the complete paradigm (Cameron-Faulkner, Lieven & Tomasello 2003; Lieven 2008; Rowland, Pine, Lieven & Theakston 2003). Similar processes can be observed when children acquire complex sentences. Again, they start out with a few strings (e.g. *I think, you know*) that are not used with their full semantics but serve as an evidentiality marker instead. Gradually, children acquire the full paradigm as well as the full semantics with independent propositions in the matrix and the complement clause (Brandt, Kidd, Lieven & Tomasello 2009; Diessel 2004).

But not only sentence onsets are relevant for detecting syntactic patterns and their functions. Children also detect stable frames with variable slots that can be filled by increasingly variable material. Such slot-and-frame patterns (Braine 1976) or low-scope formulae (Pine & Lieven 1993) can also act as anchors for future development. In morphology, such patterns are referred to as *frequent morphological frames* (Erkelens 2009; Mintz 2003). They can serve as the basis for developing word classes.

10.5.2 Syntax-based processing

A major research question concerns the productivity of children's emerging linguistic knowledge. In corpus analyses of naturalistic developmental data one typically studies the degree of overlap between syntactically related constructions: The more overlap, the more lexical-specificity, the less overlap, the more variability and productivity. This relationship has also been explored experimentally. In a training study with low-frequency verbs, Childers and Tomasello (2001) found that it is easier for children to acquire new structures if the frame of the construction is kept constant (by pronouns rather than variable full NPs). In a priming study with passive sentences, Savage, Lieven, Theakston & Tomasello (2003) showed that younger children were only able to produce new passives with the same verb (lexical priming), whereas older children were also able to produce passives with new lexical material (syntactic priming). A similar reliance on similarity in priming for 4-year-olds, but not older children, was found by Goldwater & Echols (2011).

Similar evidence for the growing abstractness of children's syntactic generalizations comes from studies in the so-called "weird word order paradigm". When children hear a new verb as a description of a transitive action, the 2-year-olds tended to copy the attested frame even if the word order is atypical (VSO: *dacking Elmo the car*, or SOV: *Elmo the car gopping*), whereas the 4-year-olds consistently corrected the utterances to SVO word order (Akhtar 1999). Studies like these show the development from exemplar-based processing to more abstract generalizations in which form-function correspondences have been learnt.

To trace form-function correspondences also helps to learn semantics. In their *syntactic bootstrapping hypothesis,* Gleitman (1990) and Fisher (1996) argued that children need to keep track of different uses of a verb in order to come to a fine-grained understanding of its meaning. Such form-function correlations can also be exploited in a different direction. *Coercion* describes the process by which a verb assumes the meaning of the construction, as in *sneeze the napkin off the table* (Goldberg 2006).

10.5.3 Semantics-based processing

The vast body of first language acquisition research focuses on the formal productivity of particular inflectional paradigms or argument structure constructions. It is less clear which mechanisms help the child to generalize across constructions (but see Abbot-Smith & Behrens 2006; Elman 2003). To this end, a functional analysis is required as well. In particular, the child needs to work out in what respect the constructions differ from one another, and whether and how the transfer of knowledge between constructions is constrained (cf. the research on argument structure overgeneralizations, e.g. Bowerman & Brown 2006). Put in terms of analogy, this means that children will have to work out what is the same or different between similar constructions in order to avoid overgeneralization errors. This question relates to a much debated topic in the usage-based language change literature that study how certain constructions emancipate themselves from their source construction through changes in the usage pattern (see, for example, Hilpert's visualization of verb to noun conversion in English, Hilpert 2011: 445 and 447). Here, speakers have to become aware of the range of uses of the new constructions as opposed to the form-meaning pairing of the old construction. Regarding language acquisition, I will focus on two research paradigms that explore the semantic basis of generalization: research on functional equivalents in so-called variation sets, and research on novel verb learning in the Artificial Language Learning paradigm.

In so-called *variation sets*, the function held is constant but the formal encoding varies (Küntay & Slobin 2002). Such sequences are used as reformulations or recasts when the child does not seem to understand the utterances in (2):

(2) Father to son, age 2;3
Who did we see when we went to the store?
Who did we see?
Who did we see in the store?
Who did we see today?
When we went out shopping, who did we see?

Typically such variation sets keep some elements stable and vary others, which can help the child to discover the formal and functional relationships between different constructions. In addition, the contextual embedding of such variation sets helps the child to identify the form-function pairings. Ibbotson (2013: 19) calls variation sets "powerful cross-sentential cues to generalization" and reports findings from Waterfall (2006) that about 20-80% of English child-directed speech consists of variation sets (the percentage depends on the criteria of the distance between items that are considered to be part of a "set"), and that children's use of verbs that occurred in variation sets was more appropriate. These findings stress the importance of syntactic variation for specifying verb meaning(s) (see the discussion of syntactic bootstrapping above).

While studies on variation sets exploit the effect of variation in naturalistic data, experiments in the Artificial Language Learning paradigm with children and adults investigate what constrains speakers' generalizations when they are confronted with novel verbs in a familiar construction, or with novel verbs in novel constructions. How readily do they transfer their existing knowledge to new items or constructions? In recent studies, Suttle & Goldberg (2011) and Robenalt & Goldberg (2015) provided further evidence for the influence of semantics on learner's generalizations. Suttle & Goldberg (2011) found that speakers are more confident about new uses of words when they fall within the semantic space typically encoded by that construction. Robenalt & Goldberg (2015) demonstrated that learners are less likely to accept a new use of a high-frequency verb if there is an alternative expression (pre-emption). This suggests that speakers tend to prefer familiar phrases, but accept creative uses more readily when there is no established alternative (see also Abbot-Smith & Behrens 2006 for related findings on the generalization of auxiliaries in present perfect, passive and future constructions).

10.6 Conclusions

Psycholinguistics deals with online processing in comprehension and production. Experiments such as the ones reviewed in sections 10.2 can inform us about the inferences that participants can draw given the evidence they get. Analogical reasoning is considered to be a very fundamental process that contributes to human categorization in general, and – more specifically – to the lines along which we extend categories. Thus, analogy has also become a prominent concept in explaining the processes by which grammatical categories or lexical items change over time (section 10.3). However, studies on the structure of language are typically offline as they can only compare synchronic varieties and their change. In order to study the mechanisms that lead to developmental change, language acquisition data could provide insights into the online processing of linguistic information by language learners, as well as the effect of this processing on the developing system.

Regarding language acquisition, the focus of usage-based research on language development lies on the social and general cognitive learning mechanisms children use to detect and abstract the grammatical patterns found in their input language (Behrens 2009; Ibbotson 2013; Tomasello 2003). Research has shown that children tend to start out with local, item-based generalizations but acquire more abstract relations readily when the form-function relationships are transparent. In doing so, they exploit analogy at the item-based, syntactic and semantic level.

First, there is reason to assume that analogical reasoning is a major driving force both in acquisition and change, because it allows speakers to integrate new items into existing categories, or extend the category based on similarities and perhaps even relational analogies. This leads to certain similarities between language change and language acquisition: Children are better with regular form-function mapping, and in historical development, we often observe regularization processes, for example in the change from forming past tense by vowel shift to forming it with a dental suffix (see above). In German plural formation, highly predictable classes do not pose problems for children, whereas error rates are high when the system allows several markers, as is the case for monosyllabic masculine and neuter nouns (e.g., the contrast between *Park-s* or *Pärk-e 'park*-s' *or Tunnel* or *Tunnel-s '*tunnels', where *Tunnel-s* is typical for Southern varieties of German, and *Pärk-e* is the Swiss German variety*)*. Thus is seems that the range of overgeneralization errors resembles the outcome of historical change as evidenced in current variation.

Second, change seems to be small and gradual, and often item-specific in the beginning. Bybee (2014, Chapter 4) discusses how children's generalizations stick closely to the established categories. This is confirmed by the data presented above: Although the same plural errors are found in several acquisition corpora, children in the end coalesce with the adult system. However, their errors provide evidence for possible lines of generalization by analogy. It seems that in order for a change to take effect in the system itself, the conventions of a speech community have to be changed. In language history, this, too, is an extended and gradual process. Rosemeyer (2016) analyses the change in the auxiliary selection in Spanish between 1270 and 1699, when an increase of *haber* 'have' at the expense of *ser* 'be' was observed. Mixed-model analyses that take the aspectual properties of verbs as main variables show that non-directional and non-telic verbs are first affected by the change, before it affects directional and telic verbs. In the end, only a few verbs with high token frequency withstand the change Rosemeyer argues that this change in auxiliary selection preferences is first driven by salience, because the new usages are very notable, until well attested frequency mechanisms set in (cf. Hilpert, this volume): Increasing type frequency for the new patterns drives the change further, whereas high token frequency leads to *remanence* or "the temporary persistence of a replaced construction in a usage context due to processes of social conventionalization" (Rosemeyer 2016: 183). Fischer (2007, Chapter 3) argues that analogical changes is a reanalysis of form-function associations that takes place within an analogical grid:

> I would argue that analogy is primary or at least stands on an equal footing with reanalysis since a reanalysis, both a semantic-pragmatic and a structural one, takes place within the contours of the communicative situation *and* the grammatical system in which a structure operates. The reanalysis will therefore also be confined and shaped by the formal structures that already exist. My hypothesis is that a reanalysis of a structure will not as a rule result in a totally new structure, but in one that is already in use elsewhere. (Fischer 2007: 123)

Despite these similarities in the processes that lead to change in the linguistic system of the individual or the language community, there are critical differences between acquisition and change (see Diessel 2011, 2012 for additional evidence). In grammaticalization processes, lexical items become grammatical functors, such as the verb *go* in English, which went through semantic bleaching such that its progressive

form became an auxiliary to denote intention (*going to*). But although children tend to acquire lexical items before function items, it is not the case that their ontogenetic development has to mirror historical development. I.e., they do not need to acquire the full lexical semantics before they can learn the bleached and grammatizised meaning. Instead, whether children learn the lexical verb *go* before the future marker depends on the distribution of these forms in the input. In German, *gehen* is still a lexical verb, and its use as an intention marker is relatively rare and still involves motion (i.e., it has a smaller functional range than its English or Dutch counterpart). Consequently, children acquire *gehen* as a lexical verb first (Behrens 2003). But a comparison with Dutch (Behrens 2003) and English data (Theakston et al. 2002) shows that children do not learn the auxiliary sense from the lexical verb. In these languages, *gaan* and *go* are predominantly used as auxiliaries, and the auxiliary use is early. *Go/gaan/gehen* are polysemous and polyfunctional verbs in these three closely related languages, and each language shows a different distribution of these functions. If language development mirrored historical change, we would expect similar developmental trajectories. Instead, we find language-specific and verb-island-like development: children acquire different form-function clusters or constructions in their respective target language, depending on the frequency and function as attested in the target language.

Furthermore, historical language change changes the system used by the linguistic community, whereas in the individual's ontogenetic language change through language acquisition the learner typically approximates that system. So how can we try to integrate this discrepancy between supposedly similar processes that account for different outcomes? In the following section, I will review two strands of research that may help to identify the crucial processing factors further.

10.6 Discussion and outlook

One line of research that tries to explain the mechanisms of change is social, since language change is a process that is mediated between the individual and his/her speech community. Here, the major difference between language learning and historical language change seems to be the *target* of development, because language change concerns the changing linguistic preferences of a language community, whereas first language acquisition looks at the change within an individual as s/he tries to approximate his/her language to the way it is used by his/her environment. Although many children make the same errors (e.g., go-ed for went), and may resist counterevidence or even corrections for a while, they ultimately give in to the conventional language use of the majority. The case is more complex with children growing up multilingually because they actually have a choice and can, for example, refuse to speak one of the languages they are exposed to (de Houwer 2007). Motivational aspects and questions of identity thus have a big influence in language use and learning outcome of second language learners and bilinguals. However, there is no evidence that children seem to drive language change (see Lieven, this volume).

A second line of research looks at the effect of time or experience on processing. So far, I have focussed on analogy. But the kinds of analogies we draw are not only determined by degrees of similarity, but by other processing factors such as frequency and recency, but also perceptual salience. Furthermore, there is developmental change in the individual mind, as well as in the system used by the speech community. How could this possible interaction between analogical reasoning, salience and frequency look like?

The contribution of analogy is twofold: It lets us categorize new experiences with existing ones, but also observe similarities to other categories, and form the relation of an element to several categories (e.g., in the case of plural development we do not see errors on the 100% predictable nouns on schwa, but a lot of variation on those groups of nouns that have similar phonotactics properties of the noun stem, but different plural markers. Here, the child has observed the analogy of a certain noun to several plural classes. Analogy also leads to innovation, if a speaker creates a new form (but note that innovation does not need to be based on analogy). As discussed in the cognitive science literature above (see Section 10.2), a spread of such an analogy based innovation will be particularly successful if the analogical link is promoted and made salient.

The contribution of salience is twofold, too: First, items can have lower or higher *perceptual* salience, the ease with which an item can be observed, for example because of its prosodic highlighting and its phonetic substance: Unreduced segments are easier to perceive than reduced ones (see Traugott, this volume, and Ellis this volume). But salience also relates to expectancy, or frequency-based inferences: Surprisal refers to the fact that an item may be salient because we do not expect it in this context. Whereas perceptual salience seems to pertain to the psychophysical prominence of a segment, surprisal seems to pertain to the semantic salience since it is context dependent (cf. Section 10.5 above and the discussion in Traugott, this volume; and Ellis, Section 1.3, this volume).

Frequency effects, finally, are multifold, too: The differential effect of type and token frequency (entrenchment versus learning and change from variation) has been much discussed (Bybee 2010), but becomes more complicated because this is a dynamic relationship over time. Time plays a role in the dispersion of the tokens over time (cf. the discussion of *dispersion* and *burstiness* in Hilpert, this volume, Section 3.5), but also in the accumulated experience of an individual over time (see Baayen, this volume), where growing experience leads to a continuous change in the type and token relationships that have been registered.

It follows that the interaction between analogical reasoning, salience and frequency are complex, but can be modelled with new theories and methods. In recent years, researchers from different fields proposed models that see both the individual and the collective linguistic system as dynamic or complex adaptive systems (Beckner et al. 2009; van Geert & Steenbeek 2005; de Bot, Lowe, Thorne & Verspoor 2013). They argue that all processing factors interact, and that the outcome of this interaction depends on the individual's current cognitive state. Hence, the initial state in the language learner is not knowing the language. Over time s/he accumulates more and more evidence based on the input they hear (typically a relatively stable synchronic state), and approximates that state. Thus, successful first language acquisition typically consolidates the state of the system. In language change, however, a relatively stable state disintegrates over time and consolidates on a new state because more and more speakers use the new form-function patterning.

By combining methods like analyses of complex developmental/historical databases and insights from language learning as well as language changes, we can specify the outcome of the interaction of different processing factors on a given state. This is the aim of current models that try to explain language evolution and change as well as first and second language acquisition (see also MacWhinney 202, Christiansen & Chater 2016).

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